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Improving School Children's Mathematical Word Problem Solving Skills through Computer-Based Multiple Representations

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Abstract

Instructional resources that employ multiple representations have become commonplace in mathematics classrooms. This study will present computer software, LaborScale which was designed to improve seventh grade students' word problem-solving skills through computer-based multiple representations including graphic, symbolic, and audio representations. The proposed presentation will illustrate the design, implementation and validation of an interactive learning environment (ILE), LaborScale. This ILE is based upon the principles of computer based interactive problem solving environments, which connects different types of knowledge representation forms, and aims primarily to assist students as they explore symbolic representations used in word-problem solving process.

Problem Solving

When solving problems, a learner combines previously learned elements of knowledge, rules, techniques, skills, and concepts to provide a solution to a novel situation. It is generally accepted that mathematics is both process and product: both an organized body of knowledge and a creative activity in which the learner participates. It might, in fact, be claimed that the real purpose of learning rules, techniques, and content is to enable the learner to do mathematics, indeed to solve problems (Orton, 1987). Thus problem solving can be considered to be the real essence of mathematics. Gagnè (1985) has expressed the view that problem solving is the highest form of learning. Having solved a problem, one has learned. One might only have learned to solve that problem, but it is more likely that one has learned to solve a variety of similar problems and perhaps even a variety of problems possessing some similar characteristics. Jonassen, Howland, Moore, and Marra (2003) also point out that solving problems are meaningful kind of learning activity in educational settings.

Problem solving activities introduce difficulties for management by teachers. For example: choosing and sequencing problem solving tasks, determining the degree and type of assistance to be given to students, maintaining motivation, and knowing how to consolidate understanding through reflection and follow-up discussions, demand continuous decision making on the part of teachers. Similarly, learners have complicated tasks to complete during problem solving, especially when solving word problems. Word problems are set in specific contexts from which students have to develop representations. Learners have to link representations to appropriate mathematical formulations, and to apply appropriate techniques in order to produce a solution. Learners have to monitor and evaluate this problem solving process, and consider the implications of the solution. In consequence, giving assistance and managing problem solving in ways which create effective learning and the development of cognitive skills is not an easy task.

Research shows that a major source of difficulty experienced by children in the problem solving process is transforming the written word into mathematical operations and the symbolization of these operations. Namely, children are required to disembed the information from the problem context, select the relevant values, and insert them into some formula. However, children are not very successful in transferring their abilities to solve problems to subsequent problems (Jonassen et al., 2003). Orton (1987) indicated that the most common difficulty of problem solving is failure to use known information. He also noted that in order to cope with this difficulty pupils should (1) write the problem in primitive form and sketch an accurate picture of the setup (where applicable), (2) transform the primitive statements to simpler language, and (3) translate verbal problems to more abstract mathematical statement(s) and figures, diagrams, charts and other similar representations.

Multiple Representations

Recent approaches to mathematics instruction in the classroom emphasize mathematics as flexible, insightful problem solving that requires understanding that mathematics involves pattern seeking, experimentation, hypothesis testing, and active seeking of solutions. But children's beliefs about the nature of mathematics contrast with this emphasis. For example, Baroody (1987) asserts that due to an overemphasis on 'the right answer', children commonly believe that all problems must have a correct answer, that there is only one correct way to solve a problem and that inexact answers or procedures (such as estimates) are undesirable. In order to recognize that multiple solutions and different representations of problems are possible, children need to have higher order problem solving skills. Polya (1962) advocated that solvers should choose multiple representations when they begin to solve a problem. Jiang and McClintock (2000) also suggested that encouraging multiple solutions to problem solving plays an important role in facilitating students' understanding of mathematical concepts and their grasp of methods of mathematical thinking. In this way, the National Council of Teachers of Mathematics (NCTM, 2000) states, "representations should be treated as essential elements in supporting students' understanding of mathematical concepts and relationships; in communicating mathematical approaches, arguments, and understandings to one's self and to others; in recognizing connections among related mathematical concepts; and in applying mathematics to realistic problem situations through modeling" (p. 67).

Representations are mainly divided into two categories. External representations are the knowledge and structure in the environment, as physical symbols, objects, or dimensions and as external rules, constraints, or relations embedded in physical configurations (Zhang, 1997, p. 180). Internal representations are retrieved from memory by cognitive processes. External and internal representations are particularly beneficial for learning when they are multiple. In most cases, learners have to process multiple representations, including graphics, symbols and audio. Classroom teaching has traditionally employed multiple external representations (MERs) in the pursuit of helping students learn. Teachers use MERs explicitly in order to make abstract situations more concrete.

Kaput (1992) proposed that multiple linked representations might allow learners to perceive complex ideas in a new way and to apply them more effectively. By providing a rich source of representations of a domain, one can supply learners with opportunities to build references across these representations. Such knowledge can be used to expose underlying structure in the domain represented. According to this view, mathematics knowledge can be characterized as the ability to construct and map across different representations.

Computer-Based Multiple Representations

Computer environments have been gaining great importance in education. Numerical computation tools can be used by problem solvers to emphasize planning and interpretation of arithmetic operations. The existence of computer graphics tools can be used to help students understand abstract mathematical concepts, to create entirely new graphic oriented representations of traditional mathematical topics, or to provide alternative visual methods in mathematical problem solving. As Kaput (1992) states for the case of mathematics education, this entails that routine computations can be off-loaded to a machine, that new representational mechanisms only available on computers (such as programs as representations) become available, and that one can reify abstract concepts by means of computer simulations, making them more readily accessible for reflection and dialogue.

Fey (1989) asserts that the use of numerical, graphic and symbol manipulation is a powerful technique for mathematics teaching and learning. He identified several ways in which computer-based representations of mathematical ideas are unique and especially promising as instructional and problem solving. First, computer representations of mathematical ideas and procedures can be made dynamic in ways that no text or chalkboard diagram can. Second, the computer makes it possible to offer individual students an environment for work with representations that are flexible, but at the same time, constrained to give corrective feedback to each individual user whenever appropriate. Third, the electronic representation plays a role in helping move students from concrete thinking about an idea or procedure to an ultimately more powerful abstract symbolic form. Fourth, the versatility of computer graphics has made it possible to give entirely new kinds of representations for mathematics-representation that can be created by each computer user to suit particular purposes. Finally, the machine accuracy of computer generated numerical, graphic, and symbolic representations make those computer representations available as powerful new tools for actually solving problems (p. 255).

Designing the Interactive Learning

The use of multimedia technology has offered an alternative way of delivering instruction. The old text-based approach to learning is being superseded by an approach, which includes multisensory representations (Jonassen et al., 2003). Interactive multimedia is one of the most promising technologies of the time and has the potential to revolutionize the way we work, learn, and communicate (Macromedia, 1992; Staub & Wertherbe, 1989). Interactive multimedia programs take the idea of learning and doing seriously. With interactive multimedia programs, the learning process is modified by the actions of the learners, thus changing the roles of both the learner and the teacher. Interactive multimedia learning is also a process, rather than a technology, that places new learning potential into the hands of users (Jonassen, 1999). The ideal interactive learning environment (ILE), then, is one where students are encouraged to undertake such activities and are provided with feedback as they do so.

Brooks (1993) stated that, with all the additional capabilities of the growing number of multimedia applications, the design of these applications has become a nightmare. He also pointed out the preponderance of ugly interfaces containing screens full of multiple fonts, insignificant boxes, irrelevant noises, and confusing webs of possible interactivity among the features of poorly designed multimedia packages. There are many requirements that must be checked while designing an interface such as screen design, learner control and navigation, use of feedback, student interactivity, and video and audio elements (Stemler, 1997). So, the design of the interface, which considers interactivity, is clearly important (Frye et al., 1988). Hence a properly designed interface should make the cognitive process transparent and externalized so as to support evaluation, reflection, and discussion and direct accessibility.

The following principles should be considered during the design of ILEs (Akpinar & Hartley, 1996).

- The ILE should provide interactive objects and operators, which are visual and can be directly manipulated by pupils.
- The ILE system should provide mechanisms for pupils to check the validity of their methods, and thus receive some feedback on the appropriateness of their actions in relation to task.
- As the instruction aims to support links between the concrete and symbolic representation of word problems, the ILE should be able to display these forms so that the equivalence between is apparent. The system should also be able to move its presentation modes to the symbolic as students gain in competence.
- The ILE should allow experimentation of concepts and procedures in ways that relate to the children's experiences. In brief the ILE should be able to support guided discovery as well as directed methods of instruction.
- The ILE should allow the learning to be conceptualized and procedural in its approach, and be capable of adjusting to the task needs of teachers.

Interactive Learning Environment: LaborScale

The overall aim of this research was to investigate the design of the LaborScale ILE that can assist problem solving performance and understanding specifically mathematical work and pool problems. Problem solving requires the integration and utilization of multiple knowledge representations e.g. graphical, symbolic, and audio. Depending upon these factors, the design of the computer based learning environment must take into consideration students' knowledge so that it can accommodate different levels of competence and be useful for varying modes of instruction in the classroom (Mayer 1985). The proposed design to realize these aims is LaborScale that provides a constructive environment based on direct manipulation, user-system interactions and available interface design.

The ILE should have all the features and components to develop children's word problem solving skills. Hence, it should be designed with an object-oriented and direct-manipulation approach. In order to reach this objective, the instructional software (LaborScale) was developed and implemented by the researchers using an authoring tool, Asymetrix Toolbook II 5.0 and other related multimedia programs (Macromedia Flash 5.0, 3D Studio Max and Photoshop 5.0) to support Toolbook Application with videos, animations, audios and pictures. The user-friendliness of Toolbook interface and its accompanied object-oriented scripting language, Openscript, used to specify the functionality were well suited to the development and implementation of the prototype. Toolbook software is a development environment that provides tools to draw objects that can be

made interactive using the Openscript programming language. Also the development can be carried out incrementally. Further, Toolbook is event-driven i.e. an application can respond to events such as mouse clicking whenever they occur. This is suitable for the ILE interface that is based on a direct-manipulation approach in addition to its ability to produce quality visual animation.

The user-interface of LaborScale has two-page design consisting of multiple viewers in which each viewer has a background and a foreground containing objects such as fields, buttons, graphics and text. The user interface has two units: a curriculum-manager unit and a student-working unit.

Curriculum Manager Unit

Curriculum Manager Unit (CMU) is one of the main windows of the LaborScale (Figure 1). This is the place where teachers set problems and customize environments for students. Each problem specification will need to provide context information, and the concepts based on the activity sets. Hence, the purpose of the problem specification is to provide contexts familiar to the students.

The CMU has been designed to manage the specification of activity sets that contains the problem content, specification of problems, and types of representation. In order to form a new activity set for any student, teachers can use two methods. One has two steps, which are pre-storing problems and their answers, and specification of the problems depending on the level of the students. The other is only specification of problems, which are saved to the system previously. In brief, teachers can manage the following tasks by using CMU:

- Forming problem sets including simple and advanced level problems of two types, work and pool, by saving problems to the systems,
- Setting audio environment of student-working unit,
- Preparing an activity set with respect to the students' level,
- Looking at the performances of the students who finish their activity sets,
- Viewing the activity set in the student-working unit.

Figure 1. A screen of curriculum manager unit

The screenshot shows the Curriculum Manager Unit (CMU) interface. The window title is "EMEKÖLÇER" and it contains menu items: "Öğrenci Çalışma Alanı", "Öğrenci Performans Kayıtları", "Yardım", and "Çıkış". The interface includes a "Soru" (Question) text area, a "Cevap" (Answer) text area, and "Kaydet" (Save) and "Düzenle" (Edit) buttons. There are radio buttons for "Giriş" (Selected), "İleri", "Sesli" (Selected), "Sessiz", and "Öğrenci Seçimine Bırak". Below these are "İsim" and "No" text areas, a list of numbers 1-9, "Ekle >>" and "<< Kaldır" buttons, and an "Etkinlik Seti Oluştur" (Create Activity Set) button.

Student Working Unit

The student working window (Figure 2), the learner mode of the LaborScale, is the second main window of the LaborScale. The Curriculum-Manager Unit passes the sequence of problems to the ILE controller that is to manage the interactions with students and to keep records of their progress. Hence a principal consideration in the design of this unit was the user-system interface in which these interactions take place. LaborScale is based on a high degree of graphical and symbolic object manipulation, and with the interface users are able to directly manipulate the LaborScale objects, for example by giving the values symbolically, dragging and dropping of picture of these values, and combining the representations of them to reach a solution. To outline, students can manage the following tasks in this unit:

- Displaying ratios they entered in the problems,
- Dragging and dropping the displayed objects and displaying a vertical scale as a result of this,
- Reaching right answers of the problems by analyzing a horizontal scale depending on the vertical scale,
- Setting audio environment,
- Transition to other problems.

Figure 2. A screen of student working unit

The screenshot shows the LaborScale student working unit interface. The window title is "EMEKÖLÇER". The main problem text asks: "Bir işi Ahmet tek başına 12 günde, Selim tek başına 24 günde bitirebiliyor. Buna göre, ikisi beraber bu işin tamamını kaç günde bitirebilir?". Below the problem, there are two input fields for ratios: "1. İşçi" with "1/12" and "2. İşçi" with "1/24". A yellow callout bubble says "Her bir işçinin bir günde yaptığı iş oranını kutulara giriniz." To the right is a vertical scale labeled "ÖLÇEK" with a scale from 0 to 24. Below the scale is a horizontal bar chart with 24 units. At the bottom, there is a text box: "İşçiler birlikte taralı birimlerin tamamını 1 günde yaparlarsa, Tüm birimleri kaç günde yapabilecekleri süre :". The input field for this duration contains the number "8". A red checkmark and the text "Tebrikler. Doğru Bildiniz." are displayed.

Evaluation studies

The validation of LaborScale was carried out during last week of May and first week of June 2001. The method of the research was pretest and posttest group design. The sample of the study was selected from seventh grade students of two different schools (Public school, school A and private school, school B) that have a computer laboratory. The subjects were selected by using clustering sample technique, namely, one class was selected from each school. The validation experiment was performed as a pretest of the work and pool problems. The pre-test was administered to 80 students (59 from public school and 21 from private school).

Their average age was 14 and 40 of them were girls and 40 of them were boys. For the application and post-test, convenient students were chosen from each class by considering their teacher's opinions and number of computers in the computer laboratories of both schools. Students were chosen according to their achievements for each mode of the pre-test, namely, numerical solutions, symbolic and graphic representations of solutions. The students' actions in LaborScale were recorded by the system and notes were taken by the researcher as well as the pre and posttest differences in performance.

The instructor organized software for 27 students to run in their laboratories. The reason for choosing only 27 students was that there were 28 computers in the computer laboratory of School A, but 17 of them were available

to run the software. There were 13 computers in the computer laboratory of School B, but 10 of them were available to run the software. Five problems randomly chosen from nine problems were assigned to these students for both work and pool problems respectively by regarding the pre-test scores of the students. Pool problems were given to them at the second week of the application to allow students to manage problems at ease and meaningfully. For low-achievers, three of the problems were simple and two of them were advanced. For intermediate students and high achievers, two of the problems were simple and three of them were advanced.

Before the application of the software in both schools, the researcher provided students with an orientation session at which the students received explanations and were experienced on how they will use the program by presenting worked examples for solving different type of problems. This session lasted about 20 minutes. Since the students in both schools had a regular computer course, they had no difficulty in controlling and manipulating the environment during the instruction.

After an orientation session, all groups received computer-assisted treatment for two hours without any break for two weeks respectively. During the instruction, students were left alone and they only interacted with computers. They solved their own problems about the program by themselves except system problems by using the help and information modes of the software. Therefore, the researcher behaved like an observer in the application. The time that the students completed their activity sets changed between 30 and 65 minutes for work problems, however, the instruction on pool problems lasted between 20 and 45 minutes.

At the end of the instruction the performance test (PT) was conducted to all subjects as a post-test. After all, the questionnaire about the software evaluation was applied to the teachers involved in the study to obtain their criticisms.

In order to analyze the differences between the pre and post tests mean scores of the whole group and School A obtained from each mode of PT, paired sampled t-test was used, and Wilcoxon test was used for school B since the numbers of subjects in the groups were too small.

The pre and posttests results showed significant improvements in students' performances for each mode that pointed to the benefits of LaborScale ILE (See Table 1, Table 2, and Table 3). When the schools were analyzed separately, there was a significant increase in all modes of the tests for each school. Looking at the posttest results of each mode, significant improvements were also observed (for more details see Adiguzel, 2001).

Table 1 *Differences between pre-post test scores of numerical solutions to PT*

| Groups | N | Pre-test Num. Sol. Mean | Pre-test Num. Sol. Std. Dev. | Post-test Num. Sol. Mean | Post-test Num. Sol. Std. Dev. | t | Sig. (2-tailed) |
|----------|----|-------------------------------|------------------------------------|--------------------------------|-------------------------------------|---------|--------------------|
| Total | 27 | 22.85 | 27.28 | 85.78 | 21.70 | 10.997* | .000 |
| School A | 17 | 18.47 | 25.36 | 88.35 | 24.43 | 9.036* | .000 |
| z | | | | | | | |
| School B | 10 | 30.30 | 30.16 | 81.40 | 16.29 | 2.805* | .005 |

* $p < .05$.

Conclusion

Studies formed a base for using computers featuring multiple linked representations to assist students

with the transition from concrete experiences to abstract mathematical ideas, with the practice of skills, and with the process of problem solving, like in the LaborScale ILE, namely, beginning with the concrete representations and reaching the symbolic representations by using visual components supported by audio developed seventh grade students' performance on work and pool problems.

Table 2 *Differences between pre-post test scores of symbolic mode of PT*

| Groups | N | Pre-test Symbolic Mean | Pre-test Symbolic Std. Dev. | Post-test Symbolic Mean | Post-test Symbolic Std. Dev. | t | Sig. (2-tailed) |
|----------|----|------------------------|-----------------------------|-------------------------|------------------------------|---------|-----------------|
| Total | 27 | 2.74 | 8.86 | 92.37 | 11.27 | 36.443* | .000 |
| School A | 17 | 2.47 | 9.68 | 96.59 | 5.49 | 37.343* | .000 |
| <i>z</i> | | | | | | | |
| School B | 10 | 3.20 | 7.73 | 85.20 | 14.92 | 2.807* | .005 |

* $p < .05$.

Table 3 *Differences between pre-post test scores of graphic mode of PT*

| Groups | N | Pre-test Graphic Mean | Pre-test Graphic Std. Dev. | Post-test Graphic Mean | Post-test Graphic Std. Dev. | t | Sig. (2-tailed) |
|----------|----|-----------------------|----------------------------|------------------------|-----------------------------|---------|-----------------|
| Total | 27 | 18.67 | 18.62 | 82.26 | 31.25 | 10.380* | .000 |
| School A | 17 | 21.65 | 14.71 | 95.00 | 10.90 | 16.858* | .000 |
| <i>z</i> | | | | | | | |
| School B | 10 | 13.60 | 23.92 | 60.60 | 42.21 | 2.499* | .012 |

* $p < .05$.

In the post-test, students had different graphical representations of solutions. The results showed that they were affected from the visual components of the LaborScale ILE, namely, some of them drew a box, meant whole work, for each worker and they indicated the results by the graph corresponding these related graphs. Some of them drew a vertical scale whose pointer's location showed the values of work done in a day for each worker and the result. The rest of the students drew a horizontal scale, similar to the number line, whose pointer's location also represented the values of work done in a day for each worker and the result. This proves that if the students are given more visual representations, they will use and connect them to the symbolic representation of these and they will grasp the meaning of the word problem solving by concretizing them.

The increase in the symbolic mode was more than the other modes. This proves that multiple linked representations relating the symbolic representation to graphic representation allow learners to perceive complex ideas in a new way and to apply them more effectively. However, the increase in the graphical mode was significant but less than the other modes. The reason for this may be that since text-based books were dominant in the curriculum children have not developed to present problems graphically. However, the graphical representations need to be well constructed and be capable of representing the information in a problem to enable the processing capabilities of the human visual system to be exploited, so that perceptual features and judgments can be developed and related to a more abstract symbolic understanding (Cox & Brna, 1995). Also, graphical representations are effective problem solving and learning tools because they reduce the space of applicable operations and they are more specific than the other representations. Relating with the theory, good performance on finding and presenting a graphic representation of a solution raised the performance on grasping symbolic representation of the solution in the study.

A similar result to the findings of this research was the outcome of ANIMATE software (Nathan, 1991). However, the potentials and facilities of ANIMATE differ from the LaborScale. Though Nathan's ANIMATE can not generalize the solution method into an algebraic formula, LaborScale can help students to build up algebraic formula that may be generalized and employed in a wide variety of problems. During the application, the time at which students finished each activity set was recorded by the researcher. According to the results, students spent longer time period on the first question of the activity set of the work problems than the other questions of the activity set since they were adapted to the system in the first question. After they gained an experience on the work problems, they acted carefully and swiftly on the pool problems

since the application of the pool problems was applied to them one week later.

Performance recording unit of the program stored two main functions of the students: three trials on the values that are work done in a day for each worker and the answer of the problem for each trial. According to the records obtained from this unit, all students had tried at least three times on the advanced level problems and problems requiring complex calculation to reach a right answer. The reason for this was the greatness of the least common multiple related with the value of denominator of the work done in one day and that because of the big unit differences in the scale students could not grasp net measurement. However, they usually solved these problems after they tried at least three times. The main thing in this part is requiring the students to grasp the values from the problem. As a result, students' problem solving skills significantly improved by the help of instructional software, LaborScale.

The rationale of the development of the LaborScale was to base students' problem solving on multiple representations. This should aid understanding, conform to problem solving as an investigatory and creative activity. While LaborScale was successful in fulfilling many of these claims in its design and conception, there are further requirements to complement or supplement its current facilities and strengths.

In conclusion, the LaborScale software and validation studies have given some support to the design principles of ILEs in which the aim is to produce user-system interfaces that release students' knowledge and stimulate active and investigatory methods of learning. The suggested further work could re-illuminate design principles for multi-representational interfaces. And, since the research was concluded successfully and significant results were obtained, hopefully it should be adapted for other domains of mathematics.

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Investigating the Relationships Among Instructional Strategies and Learning Styles in Online Environments

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Abstract

Researchers investigated differences in learner preferences for different types of instructional strategies and learning styles in online environments. Results suggested that matches between students' learning styles and instructional strategies did not affect their perception of their own learning outcomes, level of effort and involvement, and level of interactions in the course. Data also indicated that no single instructional strategy, among three instructional strategies tested, emerged as superior for high and low field dependent online students.

Introduction

The Internet has taken center stage today as a preferred medium for the delivery of distance education. Many universities offer online courses that respond to the diverse distance and time needs of today's learners. These universities provide course instructors with online tools to manage course participation and facilitate learning. Instructors can continuously monitor student progress, provide learners with time to reflect on content and feedback before participating, prompt active participation with content and peers, and offers instructional modules that are designed to appeal to a variety of learning styles and preferences (Hamilton-Pennell, 2002).

Learning style can be thought of as the combination of the learners' motivation, task engagement, and information-processing habits (Aragon, Johnson, & Shaik, 2002). Each learner can have different preferences as to how s/he receives, processes, and recalls information during instruction. Many researchers however, have not controlled for students' characteristics in their analyses of students' satisfaction of online instruction (Thurmond, Wambach, & Connors, 2002). Understanding the relationships among learning styles and instructional preferences holds great promise for enhancing educational practice (Claxton & Murrell, 1987).

The primary purpose of this exploratory pilot study was to investigate the relationships among learning styles, defined as high and low field dependence, and preferences for, and evaluation of, instructional strategies used in an online course. Field dependence describes the degree to which a learner's perception or comprehension of information is affected by the surrounding contextual field (Jonassen & Grabowski, 1993). Learning styles are useful because they provide information about individual differences from a cognitive and information-processing standpoint (Smith & Ragan, 1999). Field dependent individuals are more likely to succeed at learning tasks that engage them in:

- Group oriented and collaborative work situations
- Situations where individuals have to follow standardized pattern of performance
- Tests requiring individuals to recall information in the form or structure that it was presented (Jonassen & Grabowski, 1993).

High-field dependent individuals have more difficulty locating the information they are looking for than low field dependent individuals. Low field dependent individuals are more likely to excel at learning tasks involving identification of important aspects of information from a poorly organized body of information. High field dependent individuals tend to accept the information without reorganizing it from the way it was presented to them so low field dependent individuals are likely to reorganize information to fit their own perceptions. Muir (2001) recommends teaching methods that match instructional strategies to field dependence-independence style.

Instructional strategies represent a set of decision that result in plan, method, or series of activities aimed at obtaining a specific goal (Jonassen, Grabinger, & Harris, 1990). Instructional strategies are the activities used to engage learners in the learning process. Many types of instructional strategies are used to engage learner in different ways such as reading, collecting, thinking, etc. Expository strategies may include providing learners with lecture notes. Explanations are often kept simple and direct. Students usually use lecture notes to complete learning activities or respond to posed questions. Collaborative and group work instructional strategies require individuals, often at various levels, to work together to achieve a common goal. Individuals are prompted to analyze, synthesize, and evaluate their ideas collaboratively. Inquisitive (discovery learning)

instructional strategies require individuals to formulate investigative questions, obtain factual information, and build knowledge, which reflects their answer to the original question. Students develop several questions, which eventually lead them to answer the original question, use extensive resources to gather data, and answer the original question.

The characteristics of high field dependent individuals appear to match with expository (presentation), and collaborative (group work) types of strategies because these types of instructional strategies require learners to complete learning activities that are usually kept simple, and sometimes require learners to work together. The characteristics of low field dependent individuals suggest a match with inquisitive type of strategies because low field dependent individuals prefer generating their own hypothesis and testing their hypothesis. Table 1 illustrates the suggested match and mismatch of learning style and instructional strategy for this study.

Table 1. *Match and Mismatch of Learning Style and Instructional Strategy*

| | Expository | Collaborative | Discovery |
|----------------------|------------|---------------|-----------|
| High Field Dependent | Match | Match | Mismatch |
| Low Field Dependent | Mismatch | Mismatch | Match |

Abraham (1985) found that matching instructional styles to students' field-dependent or independent style improved students' performance in the course. In the study, researchers used two computer-assisted instruction lessons, one rule oriented, and the other deemphasizing rules, to test whether a teaching approach that did not emphasize rules would be of greater benefit to field-dependent students in an English as a second language class. The results of the study showed that field-independent students performed better with rule oriented approach whereas field-dependent students performed better with the approach deemphasizing rules. There has also been research that was contradictory to these results. Macneil (1980) found that learning did not increase when students categorized as field dependent and field independent receive instruction oriented to their style. In the study, researchers used discovery and expository approaches to test whether randomly assigned field dependent students learn more from the discovery approach and field independent students learn more from expository approach. Results of the study revealed that achievement of field dependent and field independent students did not vary as a function of style. The question remains can matching learning styles and instructional strategies in distance education better support student learning. This study was designed to address the following research questions:

1. Is there a difference in perceived learning outcomes for students whose learning style matches with the instructional strategy?
2. Is there a difference in students' effort and involvement for students whose learning style matches with the instructional strategy?
3. Is there a difference in students' perceived level of interaction for students whose learning style matches with the instructional strategy?
4. Is there a difference in perceived learning outcomes for low field dependent learners in match and mismatch instructional strategy situations?
5. Is there a difference in perceived learning outcomes for high field dependent learners in match and mismatch instructional strategy situations?

Method

Instructional Context

The pilot study was conducted at a private university located in the northeastern United States with graduate students enrolled in an online graduate course entitled *Design and Management of Distance Education*. This investigation focused on determining if students who were classified as low or high field dependent perceived different types of instructional strategies differently in an online instructional environment. Specifically, students would be queried about their perceptions of learning outcomes, their effort and involvement in the activities, and their level of interaction during the course.

The *Design and Management of Distance Education* course consisted of three modules. Each module was delivered online using a different instructional strategy including, expository (presentation), collaborative (group work), and inquisitive (discovery learning). All three units were experiential and generative in nature, requiring learners to interact in different ways with the content to facilitate learning. On average, each unit was completed over a four-week period.

Expository type of instructional strategy was utilized primarily to present module one content. Each student read the assigned chapters in the course text, specified web pages, and power point slides regarding the

growth and development of the field of distance education. Students were then required to participate asynchronous discussions responding to initial question posted by course professor and at least two other postings from their peers supporting their responses with references from readings. Finally students were required to write a reflection journal and complete content quizzes.

Module two was presented using collaborative group work. Four teams of 3 to 4 students were established. A case scenario was presented and each team was asked to design a prototype distance education course based on specified criteria. A private discussion forum and workspace was made available to each team to support their collaboration while completing the module. Throughout the module, each team was expected to submit status reports, and a final instructional design report. Quality of the deliverables and level of participation were used as evaluation criteria.

Inquisitive (discovery learning) types of strategies were used to present module three. Students were prompted to explore methods, media, and materials in distance education, to identify most important points of their implementation, and to prepare a mini presentation describing benefits and challenges of each. In addition to the course text, and additional web links, students were expected to utilize other resources to prepare the mini presentation. Then, students were expected to participate in a bulletin board discussion, write a reflection journal describing the at least five web sources helping them to better understand on hot topic in distance education related to methods, media, or materials. For example, if a student was curious about copyright s/he would explore the topic and report findings back to class. Ultimately, students were prompted to respond to inquiries into, and learn about distance education by investigating a variety of distance education areas of their own choice, and share their findings with the class.

Subjects

The subjects included twelve graduate students registered for this course. Sixty-six percent of the students were doctoral students and others were master degree students. Four students reported their technical skill as advanced. The other eight studied described their technical skills as intermediate. Sixty-six percent of the students had taken at least one online course before enrolling in this course. The results of the Psychological Differentiation Inventory showed that 25% of the students were high field dependent and others were low field dependent students.

Instruments

In order to conduct this research a valid and reliable measure of learning style had to be secured that could be implemented online. One such measure used for decades to study learning styles is the Group Embedded Figures Test (GEFT) (Witkin et al., 1971). The GEFT is used for measuring field dependence and independence. However, the use of this instrument is problematic for online environments because of the requirement to time participant responses and because participants have to draw responses in a given booklet. Given that distributed nature of students, the reliability of each participant completing the instrument per instruction is questionable. Therefore, the investigator searched for a version of the instrument that could be implemented online. The Psychological Differentiation Inventory (PDI), a questionnaire measure of field dependence was reconstructed as an online questionnaire for this study and used to measure high field dependence and low field dependence of participating learners. The PDI has good test-retest reliability (.69) and correlates ($r = 0.46 - 0.76$) with Embedded Figure Test which is frequently used as a single measure of field dependence (Evans, 1969).

In this research the evaluation system used to assess students' achievements in each module included three components. These components were (1) self-assessment of outcome, (2) individual effort and involvement, and (3) interaction and feedback between and among the instructor and students (Robles & Braathen, 2002). The modified version of Student Instructional Report II developed by John A. Centra in 1998 was used with permission to assess components 1 and 2. This instrument contains five items for assessing perceived unit outcome of students, and three items for assessing student effort and involvement. Returns indicated the student's perception of the effectiveness of each aspect of a unit to the same aspects in other units using a five-point scale. A rubric developed by Roblyer & Wiencke in 2003 was used to assess the level of interactivity in each module by having students evaluate elements of interactions including social goals, instructional goals, types and uses of technology, and impact of interactivity-changes in learner behaviors.

Procedure

The *Design and Management of Distance Education* course consisted of three modules. Each module had to be completed in order, and in a given time frame by all students. Data were collected after each unit was

completed. The online unit evaluation form at the end of each unit measured learner satisfaction and involvement with the instruction specifically through (1) perceived unit outcomes, (2) student perception of effort and involvement in the unit, and (3) student perception of interaction and feedback levels between and among the instructor and students during the unit (Roblyer & Wiencke, 2003; Centra, 1998). A java script was written for the online unit evaluation form to ensure that students answered all questions before submitting it. Using java script eliminated the risk of missing question response. Upon completing the online unit evaluation form, the data were automatically emailed to the researchers.

Students also had to complete the online questionnaire version of the Psychological Differentiation Inventory to measure their level of field dependence. A java script was also written for the online questionnaire version of the Psychological Differentiation Inventory to ensure that students answered all questions on the inventory. Researchers also received the results of the Psychological Differentiation Inventory through email.

Analysis

All data were ported into a statistical analysis package (Stata version 8.0) for later analysis. One way analysis of variance was used to test the hypotheses that there were differences in students perceived learning outcomes, students effort and involvement, and students' perceived level of interaction when students learning style matches with the instructional strategy, and to test whether one instructional strategy emerges with higher perceived learning outcomes for online students who are categorized as high field dependent and low field dependent. All statistical analysis reported in this research were conducted with a significant level of .05.

Results

Learning style

The results of the online questionnaire version the Psychological Differentiation Inventory revealed that nine students were low field dependent and three students were high field dependents. The mean score for students categorized as low field dependent was 19.55 (S.D. = 3.53) while the mean score for students categorized as high field dependent was 26.33 (S.D. = 0.57) (see Table 2).

Table 2. Means and Standard Deviations for Students Categorized as Low Field Dependent and High Field Dependent

| Categories | N | Mean | Standard Deviation | Min | Max |
|----------------------|---|-------|--------------------|-----|-----|
| Low Field Dependent | 9 | 19.55 | 3.53 | 14 | 23 |
| High Field Dependent | 3 | 26.33 | 0.57 | 26 | 27 |

Matching Learning Style with Instructional Strategy

The first hypothesis stated that there would be no significant difference in the perceived learning outcomes of students whose learning style matched the instructional strategy. The results of the one-way analysis of variance supported this null hypothesis, $F(2,18) = 0.11$, $p = 0.89$ (see Table 3). No significant difference was found in the perceived learning outcomes of students whose learning style matched the instructional strategy. Both low and high field dependent students perceived learning outcomes in the three instructional strategies the same. Table 4 shows the descriptive statistics for perceived learning outcomes of students whose learning style matched the instructional strategy.

Table 3. Results of One-way Analysis of Variance for Perceived Learning Outcomes of Students whose Learning Style Matched the Instructional Strategy Used to Present the Online Course Module

| Source | Sum of Squares | D.F. | Mean Squares | F ratio | F Prob. |
|----------------|----------------|------|--------------|---------|---------|
| Between groups | .18031733 | 2 | .090158665 | 0.11 | 0.8947 |
| Within groups | 14.4977771 | 18 | .805432064 | | |
| Total | 14.6780945 | 20 | .733904724 | | |

Table 4. The Descriptive Statistics for Perceived Learning Outcomes of Students whose Learning Style Matched the Instructional Strategy

| Matched Group | Instructional Strategy | Mean | N | S.D. | Min | Max |
|---------------|------------------------|------|---|------|-----|-----|
|---------------|------------------------|------|---|------|-----|-----|

| | | | | | | |
|----------------------|---------------|------|---|------|-----|-----|
| Low Field Dependent | Expository | 3.71 | 9 | 0.85 | 2 | 5 |
| Low Field Dependent | Collaborative | 3.55 | 9 | 0.88 | 2 | 5 |
| High Field Dependent | Discovery | 3.46 | 3 | 1.1 | 2.4 | 4.6 |

The second hypothesis stated that there would be no significant difference in the effort and involvement of students whose learning style matched the instructional strategy used to present the online course module. The results of the one way analysis of variance supported this null hypothesis, $F(2,18) = 1.02$, $p = 0.37$ (see Table 5). No significant difference was found in the effort and involvement of students whose learning style matched the instructional strategy used to present the online course module. When low and high field dependent students' learning styles matched three types of instructional strategies used in the study, low and high field dependent students reported they put equal effort and involvement to instructional activities. Table 6 shows the descriptive statistics for the effort and involvement of students whose learning style matched the instructional strategy.

Table 5. Results of One way Analysis of Variance for Effort and Involvement of Students whose Learning Style Matched the Instructional Strategy Used to Present the Online Course Module

| Source | Sum of Squares | D.F. | Mean Squares | F ratio | F Prob. |
|----------------|----------------|------|--------------|---------|---------|
| Between groups | 1.06779522 | 2 | .533897609 | 1.02 | 0.3795 |
| Within groups | 9.39358058 | 18 | .521865588 | | |
| Total | 10.4613758 | 20 | .52306879 | | |

Table 6. The Descriptive Statistics for the Effort and Involvement of Students whose Learning Style Matched the Instructional Strategy

| Matched Group | Instructional Strategy | Mean | N | S.D. | Min | Max |
|----------------------|------------------------|------|---|------|-----|-----|
| Low Field Dependent | Expository | 3.71 | 9 | 0.5 | 3 | 4.4 |
| Low Field Dependent | Collaborative | 3.81 | 9 | 0.64 | 3 | 5 |
| High Field Dependent | Discovery | 3.13 | 3 | 1.41 | 1.6 | 4.4 |

The third null hypothesis stated that there would be no significant difference in the perceived level of interaction of students whose learning style matched the instructional strategy. The results of the one way analysis of variance supported this hypothesis, $F(2,18) = 0.03$, $p = 0.97$ (see Table 7). No significant difference was found in the perceived level of interaction of students whose learning style matched the instructional strategy. Low and high field dependent students perceived their level of interactivity same for all three types of instructional strategies used in these modules. Table 8 shows the descriptive statistics for the level of interaction perceived by students whose learning style matched the instructional strategies.

Table 7. Results of One-way Analysis of Variance for Perceived Level of Interaction of Students whose Learning Style Matched the Instructional Strategy Used to Present the Online Course Module

| Source | Sum of Squares | D.F. | Mean Squares | F ratio | F Prob. |
|----------------|----------------|------|--------------|---------|---------|
| Between groups | .054603198 | 2 | .027301599 | 0.03 | 0.9703 |
| Within groups | 16.2755553 | 18 | .904197518 | | |
| Total | 16.3301585 | 20 | .816507926 | | |

Table 8. The Descriptive Statistics for the Level of Interaction Perceived by Students whose Learning Style Matched the Instructional Strategies

| Matched Group | Instructional Strategy | Mean | N | S.D. | Min | Max |
|----------------------|------------------------|------|---|------|------|-----|
| Low Field Dependent | Expository | 3.82 | 9 | 0.92 | 2.6 | 5 |
| Low Field Dependent | Collaborative | 3.77 | 9 | 0.95 | 2.66 | 5 |
| High Field Dependent | Discovery | 3.66 | 3 | 1.0 | 2.6 | 4.6 |

One Superior Instructional Strategy

The fourth null hypothesis stated that there would be no significant difference in the perceived learning outcomes for low-field-dependent learners in match and mismatch instructional strategy situations. The results of the one way analysis of variance supported this null hypothesis, $F(2,24) = 0.19$, $p = 0.82$ (see Table 9). No significant difference was found in the perceived learning outcomes of low-field-dependent students who

completed three online course modules. The characteristics of low field dependent students showed match with expository and collaborative type of instructional strategies, and mismatch with discovery type of instructional strategies. Statistical analysis showed no significant difference in the perceived learning outcomes of low field dependent students in match and mismatch instructional strategy situations. Table 10 shows the descriptive statistics for the perceived learning outcomes for low field dependent learners in match and mismatch instructional strategy situations.

Table 9. *Results of One-way Analysis of Variance for Perceived Learning Outcomes of Low-Field-Dependent Students in Match and Mismatch Instructional Strategy Situations*

| Source | Sum of Squares | D.F. | Mean Squares | F ratio | F Prob. |
|----------------|----------------|------|--------------|---------|---------|
| Between groups | .234073991 | 2 | .117036996 | 0.19 | 0.8286 |
| Within groups | 14.8266668 | 24 | .617777781 | | |
| Total | 15.0607407 | 26 | .579259259 | | |

Table 10. *The Descriptive Statistics for the Perceived Learning Outcomes for Low Field Dependent Learners in Match and Mismatch Instructional Strategy Situations*

| Low Field Dependent Learners Match and Mismatch Situations | Instructional Strategy | Mean | N | S.D. | Min | Max |
|--|------------------------|------|---|------|-----|-----|
| Match | Expository | 3.71 | 9 | 0.85 | 2 | 5 |
| Match | Collaborative | 3.55 | 9 | 0.88 | 2 | 5 |
| Mismatch | Discovery | 3.77 | 9 | 0.58 | 3 | 4.8 |

The last null hypothesis stated that there would be no significant difference in the perceived learning outcomes for high-field-dependent learners in match and mismatch instructional strategy situations. The results of the one way analysis of variance supported this null hypothesis, $F(2,6) = 0.13, p = 0.88$ (see Table 11). No significant difference was found in the perceived learning outcomes of high-field-dependent students who completed three online course modules each of which used different instructional strategy. Perceived learning outcomes of high field dependent students did not change when they were taught with different instructional strategies matching and mismatching their characteristics. Table 12 shows the descriptive statistics for the perceived learning outcomes for high field dependent learners in match and mismatch instructional strategy situations.

Table 11. *Results of One-way Analysis of Variance for Perceived Learning Outcomes of High-Field-Dependent Students in Match and Mismatch Instructional Strategy Situations*

| Source | Sum of Squares | D.F. | Mean Squares | F ratio | F Prob. |
|----------------|----------------|------|--------------|---------|---------|
| Between groups | .267654316 | 2 | .133827158 | 0.13 | 0.8824 |
| Within groups | 6.28740728 | 6 | 1.04790121 | | |
| Total | 6.5550616 | 8 | .8193827 | | |

Table 12. *The Descriptive Statistics for the Perceived Learning Outcomes for High Field Dependent Learners in Match and Mismatch Instructional Strategy Situations*

| High Field Dependent Learners Match and Mismatch Situations | Instructional Strategy | Mean | N | S.D. | Min | Max |
|---|------------------------|------|---|------|-----|-----|
| Mismatch | Expository | 3.66 | 3 | 0.94 | 2.6 | 4.4 |
| Mismatch | Collaborative | 3.88 | 3 | 1.01 | 3 | 5 |
| Match | Discovery | 3.46 | 3 | 1.1 | 2.4 | 4.6 |

Discussion and Conclusion

Delivering instruction on the Internet has become very popular in recent years. Often face-to-face courses are converted to online course activities and materials with little thought of learners' preferences for instruction. Understanding the effects that learning styles and learners' perceptions of engagement in online environments have potential to improve the planning, producing, and implementing of online educational experiences. Thus, learning styles can be utilized to enhance students' learning, retention, and retrieval (Federico, 2000). This study provides insight into the relationships among learning style and instructional strategies used in online environments.

The statistical analysis revealed no significant differences among three match situations for low and high field dependent students. When the characteristics of low and high field dependent students matched with instructional strategies, match groups did not show any statistically significant difference in their perceived learning outcomes, their perceived effort and involvement in units, and level of interactivity that they perceived during the unit. This result showed that when low and high field dependent students receive instruction utilizing instructional strategies matching their characteristics, they gain equal learning benefits from the instruction. Using expository and collaborative type of instructional strategies for high field dependent students, and using discovery type of instructional strategies for low field dependent students in online courses provided equal benefits for students in terms of their perceived learning outcomes, their perceived effort and involvement, and level of interactivity that they perceived in the class. However, considering the fact that mean scores of students for match situations were more than the average score, matching instructional strategies with low and high field dependent learners appears to show some positive effect on student learning. Online course instructors may utilize expository and collaborative types of instructional strategies for high field dependent students, and discovery types of instructional strategies for low field dependent students to make the instruction more appealing and effective. Ultimately online students may gain more learning benefits from the course in terms of their perceived learning outcome, their effort and involvement, and level of activity that they perceive in the online class.

The results also revealed that there is no single superior instructional strategy for high and low field dependent students among the three types of instructional strategy used in the study. The characteristics of low field dependent students matched expository and collaborative instructional strategies and mismatched discovery type of instructional strategies. When low field dependent student groups were statistically compared, no significant differences were detected for three constructs used in the study. Matching and mismatching instructional strategies for low field dependent students did not affect students' perceived learning outcome, their perceived effort and involvement in units, and level of interactivity that they perceived during the unit. Similar statistical analysis was conducted for high field dependent students whose characteristics matched discovery type of instructional strategies and mismatched expository and collaborative type of instructional strategies. However, statistically no significant results were found for high field dependent students as well. Results of this study showed that utilizing expository, collaborative, and discovery types of instructional strategies to design online courses provided almost equal learning benefits for low and high field dependent students.

Although, this pilot study provided valuable information on gathering learner style information from online learners, results of the study should be interpreted with caution. These findings may have been due to a number of factors. Finding no significant results could have been due to small number of subjects. Considering the fact that there were twelve-subjects involved to the study and only three subjects were categorized as high-field dependent individuals, more subjects are required to validate the results of this pilot study. There appears to be other factors that may have affected the results of the study. Existing course structure may not have provided pure experiences in different instructional strategies. Furthermore, the time allocated to complete units was not same so it may have influenced the experiences of students in three units. Finally the content of units were different so the content may have influenced the level of effort that each student put into completing units.

Future researchers should consider testing environments that do strictly follow instructional strategy guidelines to confirm these findings. Researchers should also consider testing other learning style instruments and instructional strategies in their future research. Although no significant differences were identified in this study, there is much to learn about how individuals interact and learn in online environments.

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Capturing Rehearsals to Facilitate Reflection

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Introduction

Many learning environments involve rituals for rehearsal and reflection. Musicians, for instance, spend countless hours practicing scales and adjusting their bodies to increase their skills. But they do more than simply practice: They also play for instructors and others who can provide valuable critiques of their performances. Architectural design studios encourage students to create designs and share them with experts and peers in organized “crit” sessions that point out good and bad aspects of their work. Athletic coaches often watch videos of games with their players to reflect on issues for improvement. In all cases, there is a cycle of skill rehearsal followed by periods of critical reflection to understand successes and failures, ultimately to improve future performance.

Much of reflection is about making tacit knowledge and routines explicit so they can be analyzed and promote self-awareness or “knowledge-in-action” (Lin et al., 1999; Schon, 1983). In the above examples, these reflections are partially facilitated through concrete artifacts that capture aspects of past performance. Musical sessions can be recorded to tape, architecture students create drawings and models, and athletes use video when reflecting on their skills. Otherwise transient actions and performances are captured and made explicit as concrete artifacts for reflective thinking and learning.

Our research considers the importance of making actions into artifacts for reflective thinking. In particular, we will describe ongoing efforts to develop computer-based visualizations for diabetes health management. Approximately 17 million American suffer from diabetes (NIDDK, 1998), and those numbers continue to increase. The disease cannot be cured, but it can be managed through insulin and oral medications and changes in diet and exercise habits. We are focused on the latter part of diabetes self-management, the regulation of daily routines to prevent abnormal blood sugar levels that could lead to future health complications.

Most diabetics carry and use glucose meters, small, handheld devices that measure and report current blood sugar levels. These technologies are critical to diabetic lifestyles, as they present physiological data to help people see *how* they are dealing with the disease. Our research tries to add additional information to glucose meters by helping diabetics explore questions about *why* their sugar levels are normal or abnormal during the day. Specifically, we developed a computer-based visualization for displaying glucose meter data that makes patterns of regularity (or irregularity) explicit to its users. The hallmark of these visualizations is the use of color to provide global overviews of high, low, and normal blood sugars over extended periods of time.

Beyond visualizing physiological data, we have diabetics take photographs of their daily activities, focusing on things that might impact their blood sugar levels. These images are integrated into the computer visualizations to contextualize the numerical data. Our hypothesis was that diabetics could begin to engage in reflective thinking around their health practices when provided with visualizations that point out potential correlations between blood sugar levels (captured by glucose meters) and behaviors (captured in photographs). We will report results from a recent study of the use of visualizations of behavioral and physiological data to enhance the aspects of reflection stated in findings

Definitions of Reflection

Reflection has been defined differently by different people. Before analyzing our study data we considered the following definitions.

In a chapter in *How We Think* (1997), entitled “What is Thought?”. Dewey defines and emphasizes the importance of reflective thought. Reflective thought is one of the four senses of thought: the process of accepting a belief after deliberately seeking and examining its grounds. Reflection involves the consequences of ideas rather than merely a sequence of ideas. Each created idea is a link in a chain of ideas. The important consequences of beliefs or behaviors might force one to consider the reasons for these and come to a “*reasoned conclusion*”. Reflective thought is the “*active, persistent, and careful consideration of any belief or supposed*

form of knowledge in the light of the grounds that support it, and the further conclusions to which it tends” (Dewey, p. 6). Reflective thinking has two elements or subprocesses: “a state of perplexity, hesitation, doubt” and an investigation to confirm or refute the further facts (Dewey, p. 9). In other words reflective thinking starts with facing a problem or questioning and then continues with efforts at solving the problem by reasoning. The process ends with a reasoned conclusion which would be the start of another reflective thinking process. Dewey concludes that reflective thinking “... means judgment suspended during further inquiry; and suspense is likely to be somewhat painful.” (1997, p. 13)

Schon’s definition of reflection comes with the following terms: knowing-in-action, reflection-in-action and reflection on action-in-action. Knowing-in-action refers to the kind of knowing that is revealed in our intelligent action while executing a spontaneous performance (Schon, 1987). This is a kind of action that cannot be verbalized. The knowing occurs in the action as a response to an unexpected outcome. The unexpected outcome can be result of anything that does not happen as a part of routine. Further knowing-in-action may help us to reflect on the unexpected outcomes of daily routine and take an in action. For example, automatically steering a bicycle to the left in order to maintain balance whenever the bicycle tilts to the left is an example of reflection-in action, The action which occurs in that present moment as a response to the unexpected results from and demonstrates knowing-in-action. During an action, we still can make a change to the situation and our thinking serves to reshape what we are doing while we are doing. In cases like this, we reflect-in-action, “thinking on our feet” (Schon, 1983, p. 54). For example one bikes to the left naturally when the bike tilts to the left at the moment of in-action. When we think back to see how our knowing-in-action helped us respond to the unexpected situation, then we are reflecting *on* action. Reflection on action can help reveal our own theories as well. When one finds himself experiencing puzzlement, or confusion in an uncertain or unique situation, “he reflects on the phenomena before him, and on the prior understandings which have been implicit in his behavior (Schon, 1983, p. 68). This experience results in generating “both a new understanding of the phenomena and a change in the situation” (Schon, 1983, p. 68).

Self-reflection and reflection are the terms defined as a part of self-regulated learning (SRL) by Zimmerman and Pintrich (Puustinen & Pulkkinen, 2001). Zimmerman (1998) defines self-regulated learning as a cyclical process which has three components: forethought, performance and self-reflection. Each of these components support each other in a sequence. Further more specifically self-reflection has four types of processes: self-evaluation, attributions, self-reactions and adaptivity. As one of the initial processes during self-evaluation, one compares self-monitored information with a goal. Self-evaluation leads one to attributions of reasoned conclusions. Attributions lead one to self-reaction and also to adaptation to the performance. Similarly, Pintrich’s SRL definition has reflection as one of the four phases, whereas the first three are forethought, monitoring, control and reflection (Puustinen & Pulkkinen, 2001). More “reflection includes cognitive judgments, affective reactions, making choices and task and context evaluation”.(Puustinen & Pulkkinen, p. 274)”

Study described

Specifically, our study involved six type I diabetics and one type II diabetic. This group took photographs of their everyday activities for a month and met with us weekly to discuss their health, using their visualized data as a conversational prop (Brinck & Gomez, 1992; Roschelle, 1992) for reflection.

They were given small digital cameras and asked to take pictures of diabetes-related behaviors. The diabetics were free to decide what they would take pictures of. We suggested that they might take pictures of their meals and exercise activities. In their daily activities they were testing and monitoring glucose results by using a digital glucose tester.

Before each weekly meeting, we uploaded the glucose data and the pictures to the computer. Then we displayed the data with software which was created for this purpose (see Figure 1 and 2). With this interface we could see the glucose results and diabetes-related activities, captured in pictures, accompanied by a record of the time and day. For the glucose results, color codes were used in order to facilitate an easy and quick grasp of glucose patterns. The colors represented ranges of blood sugar levels as follows:

- Dark blue: 0-39
- Lighter blue: 40-80
- Gray: 81-120
- Red: 121-140
- Dark Red: 141 and higher

The data for the entire period were displayed and then we posed questions to facilitate reflection. When

necessary, the pictures were magnified (see Figure 3).

What follows is a discussion, based on preliminary data analysis, of the experience of the participants and how it helped them reflect.

Findings

Schon claims that his examples of a baseball pitcher who reflects on “winning habits” and a jazz musician who reflects on the experience of making music, show that “reflection tends to focus interactively on the outcomes of action, the action itself, and the intuitive knowing implicit in action” (1983, p. 56). In our study, participants were invited to focus on the outcomes of activities related to being diabetic, activities by themselves and the intuitive knowing implicit in activity. Before taking photos of activities they had to focus on the outcomes of the activities related to diabetes. For example, how does this exercise affect my glucose? Most of them took pictures of their meals and exercise activities such as walking and weight-lifting. In the process of capturing activities the participant experiences the intuitive knowing implicit in the activity. The participant makes this implicit knowledge explicit in two ways. The participant makes the knowledge explicit by communicating via visual representations of captured activities, photos and also by talking about them later on during the interviews. The knowledge is received by two parties: the participant and the interviewer who in some cases could be a health care person or physician.

In our study we could see how reflection occurred differently for different participants. When we consider a consensus over given definitions of reflection above and the outcomes, we could see four phases in our study. These phases were cyclical, temporally overlapping only somewhat linear. They corresponded to key concepts emerging from the definitions.

1. confusion, perplexity, hesitation, doubt, unexpected outcome, judgment suspended
2. judgment suspended, investigation, monitoring, self-evaluation, context evaluation, reasoning, persistent and careful consideration, knowing-in action, reflection-in action
3. reflection-in-action, reflection on reflection-in-action, new-understandings, confirm/refute the facts/conclusions, affective reactions, making choices and tasks
4. making choices and tasks, changes

Following we will introduce our preliminary data results associated with these phases. Participants’ awareness about what to do was extremely variable. Most of the participants know what to do in general for their health care. P108, who was an athletic, had already come to an understanding through past experience of what affects her blood sugar and how to deal with it by correlating her eating and exercise. She had been exercising couple of times per a week since her childhood. She kept log books recording of what she ate and what she did for exercise. She thinks she does not have room to improve much. In other words, she does not have much confusion in her diabetes-related life. However she still is not sure about some blood sugar changes that specifically occur due to exercise. She still has not found the reasons of this. This is still a puzzle to her. When we asked what she learned about herself during the study, she answered:

“...I don’t think I learned anything new...because I am an athlete and I have been at least recently really looking at my diabetics what affects it and how to change it, kind of understanding myself more what the exercise does to my health aham I think I have already gone that process but if maybe the other people haven’t aham that they don’t really understand what affects it as much it might help them for a better understanding. Since I wrote down everything I eat what insulin I take, I can sort of already look back and see what affects more...I have a basic understanding but some things are still different like I said exercise will kick in at strange times, some times directly after sometimes later which I am still trying to figure out...for some reason one day my body would kick in earlier or later” (P108, interview4, conscious, 1:36)

On the other hand some of the participants still did not know what causes what. They were still in confusion or hesitation. And knowing the reasons for changes could be helpful for P106.

“...I hope to see what it is causing me to get high blood sugar...but if I see what is causing me that would definitely be direction...” (P106, interview1, conscious, 20:03)

Even though they know, what they do or they do not do to manage their diabetes has already become part of their daily routine. They may not be thinking about their diabetics-related experiences enough because they have become repetitive practices embedded in their daily routines. For example, Schon (1983, p. 61) mentions that when practice becomes more repetitive and routine, knowing becomes sufficiently implicit and natural that the practitioner may miss important opportunities of careful consideration of what he is doing. By asking participants to capture their diabetes-related behaviors, we invited them stand outside of their routine lives and think actively, persistently and carefully about what they are doing for their health care as they are

doing it (thinking on their feet). As a result of experiencing their lives out of their routine by wearing different lenses which comes with the study requirement, capturing behaviors, they could reveal their knowing-in-action and then reflect in-action.

For example P109 was not sure about the reasons for his high glucose measures and he was having suspended judgment:

“...I think with this really high one I had a big dinner that evening that could have been of the causes of that...aham I know for most of the high ones they come after meals...that could be something to do with eating a meal right before that that could be why they are high...” (P109, interview1, conscious, 24:58) and he was reflecting-in-action by facing the problem that needs to be fixed but not having the solution/response yet:

“...I think now looking at the blood sugars that there are a lot of higher ones which something needs to be fixed...” (P109, interview1, conscious, 27:02)

While monitoring the two-week data on our second interview, he continues reflection-in-action, advantageously, this time he realizes some patterns on his high glucose results in the mornings and questions the reason. He wants to know the reason. This is still reflection-in-action, investigation, since there is an inquiry but he does not respond to the problem yet.

“...I think I need to trying get my blood sugar under control especially in the mornings. I have to figure out what is causing that.” (P109, interview2, conscious, 56:37)

P107 started living a different life when she left home and became a college student. This new life brought her some perplexity and suspended judgment regarding her diabetes management. We can see her experience of four phases at the same time: doubt, context evaluation, making choices and changes.

“...(her doctor) said they should have nutrition facts up there stuff, they do have that for a lot stuff but I eat a lot at the salad bar and they don't have that stuff up so unless I go and bug somebody in. I tried to looking up on the Internet...now just trying judging...now I am trying...I better go low then high but it is hard to the fact that at home I think I could manage my diabetes better...here my schedule I mean everything is so different every day is different and I am walking everywhere so that's why it is much easier to control at home...” (P107, interview 1, as a student-nutrition, 16:29)

“...I have been a lot more conscious about how to cover my meals...they don't have carbs in the dining hall...so I am trying to guess and it is the reason why sometimes it is high or low...so I have been trying to eat more regular salad dressing not fat-free” (P107, interview1, conscious, 04:17)

Choosing the regular salad dressing shows her solution. She has a problem and responds to that problem while it is occurring. She is reflecting-in-action and also making choices and changes.

Monitoring the glucose data and captured activities supported the participants on their investigation. For example both P109 also P110 observe how their eating amounts affect their blood sugars by monitoring the patterns on the visualized and color-coded data. They noticed that their glucose level was high in the mornings as well. More, some of them stated some new understandings of their life:

“...It was interesting to see what kind of habits I have. Maybe I realized what I should do a little bit more...Like I really never thought about sleeping how it affects my sugar...” (P105, interview4, conscious, 36:27)

“...this is interesting because I don't usually view as stress affecting me much but you guys said anything affect my blood sugar level that I could feel it...like affecting me and I don't usually give that much” (P106, interview1, conscious, 10:14)

“...I just became more aware like at the gym...this is first time I kept a log book for a long time it kind of helps seeing the pattern...”(P107, interview3, conscious, 12:21)

Monitoring also helped for realizing some habits, self-evaluation and followed with confirming the fact:

“...I took a picture of glucose tablets...aham let me see...geez I don't why I ate glucose tablets. I just eat them sometimes when I feel low...well that's even normal to deal with ...we (then he sees the pictures and says) yeah I am actually starting to remember this day I ate a lot...I ate what ever I want...then I try to compensate with extra insulin which is not good idea I am trying to learn more on that, me myself...” (P106, interview3, conscious, 30:30)

After investigation confirmation emerged. Some participants noticed or confirmed that different kinds of exercising such as walking versus weight lifting affects blood sugar drops differently. For example P108 mentioned that weight lifting kind of activities affect later rather than just immediate after. She already had an awareness of that. On the other hand P109 was not sure of this and had an idea about that when questions prompted him to see a correlation:

“...maybe weight lifting is affecting the next day more than the same day...” (P109, interview4, conscious, 45:47)

“...I think we saw a connection between exercise and the next day blood sugar seems to be lower in the morning the day after exercise. I think it is one pattern that we saw. Seems that if I have a big dinner I don't know how to adjust (?)...”(P109, interview4, conscious, 51:05)

When asked to provide the reasons for the fluctuations by monitoring the data, one participant responded,

“...Aham there could be a lot of different reasons of that. For instance if I am taking the insulin or I am taking too much insulin or eating I have noticed depending on what eat has different effects. like if I eat pizza or something the effects of that don't really impact me until like two hours later.” (P111, interview 3, measures-fluctuations, 36:46)

In the fourth interview when the color-coded data viewed P111 realizes changes:

“...I see a significant improvement in the back last five days...”

and then he comes to some conclusions when he is asked to see the connection between his exercise and blood glucose data:

Interviewer 1: “...when you look all overall this data and do you see connection between your exercise and blood glucose data?”

P111: “definitely”

Interviewer 1: “how?”

“...aham I think (?) last week (?) shows and from when I work as well shows that my blood glucoses decreases dramatically so if it doesn't decrease dramatically immediately if it doesn't immediate effect like from running or something aham symptoms of it will definitely show up in the morning rather than at night and from I think from work since work is usually a longer period than a few hours you see the results of working of when I finish working my work I test my blood and you see the results...” (P111, interview 4, reflection-on, 22:48)

Ultimately, some participants reported some changes or considerations of changes in their life. After they responded to the problem and then reflected on that. Some participants increased their exercise with more walking or decreased eating non-recommended food. For example P111 stated that he stopped eating ice cream, or P110 tried to increase his exercise (walking) and decided not to eat late at night. P111 is talking on the experience of the study:

“...it was definitely a positive experience just because of the fact that I just had to be consciously aware of yeah I need to take picture of this and sometimes it is a horrible (deter?) but sometimes I think that ‘do I really need to eat this?’ because I am gonna take picture of it. I think it it definitely helped just making me conscious of what I eat...” (P111, interview4, DPS-taking pictures-stops more eating, 31:19)

Interviewer 1 follows: “Do you think it affected your choices of eating?”

“...yeah a few times it did...like for instance this whole past last two months like I have not eaten any ice-cream which is very weird considering that I love ice-cream and I am in the Penn State (referring the popular ice-cream place)...” (P111, interview4, DPS-taking pictures-stops more eating, 31:19)

“...I have improved the numbers (blood results)...it is definitely worked a lot...” (P106, interview4, conscious, 43:31)

Interviewer 1 asks: “This experience have helped your health?”

“...this just made me realize I am pretty out (?) of control now...so many little things make big differences...I am trying to get under control I guess...” (P107, interview4, conscious, 4:00)

Limitations and Conclusion

One of the limitations was the interviewers' lack of expertise on the content. The interviewers were not health experts, so that could have decreased their ability to see the correlations between the data and the disease. Further, some questions asked by the interviewers to facilitate seeing the impact and correlation could affect the statements given by the participants. More the tendency of pictures on the subjects of eating and exercise could have been the result of examples given by the researchers at the beginning of the study. In addition to these, we had some technology-related limitations. The camera was forgotten or inconvenient to carry for some participants. One participant mentioned that it would be better to have camera and the monitor together in one tool, since she already has to carry the monitor. Also a few comments were made about how difficult it is to communicate everything by taking pictures. One participant found writing log books easier while some others found taking pictures easier.

Further applications and research of this study might be in various areas for various purposes. In

general, this could be used for reflection processes as a path to improvement. Facilitating active, persistent and careful consideration of lived experiences by thinking about captured and monitored activities might help one to improve. We can see applications in health for complex disease diagnosis, adaptation and management. The study also has broader educational applications because it describes and evaluates a form of self-regulated learning.

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Graphics

Figure 1: Glucose results on color-coded chart

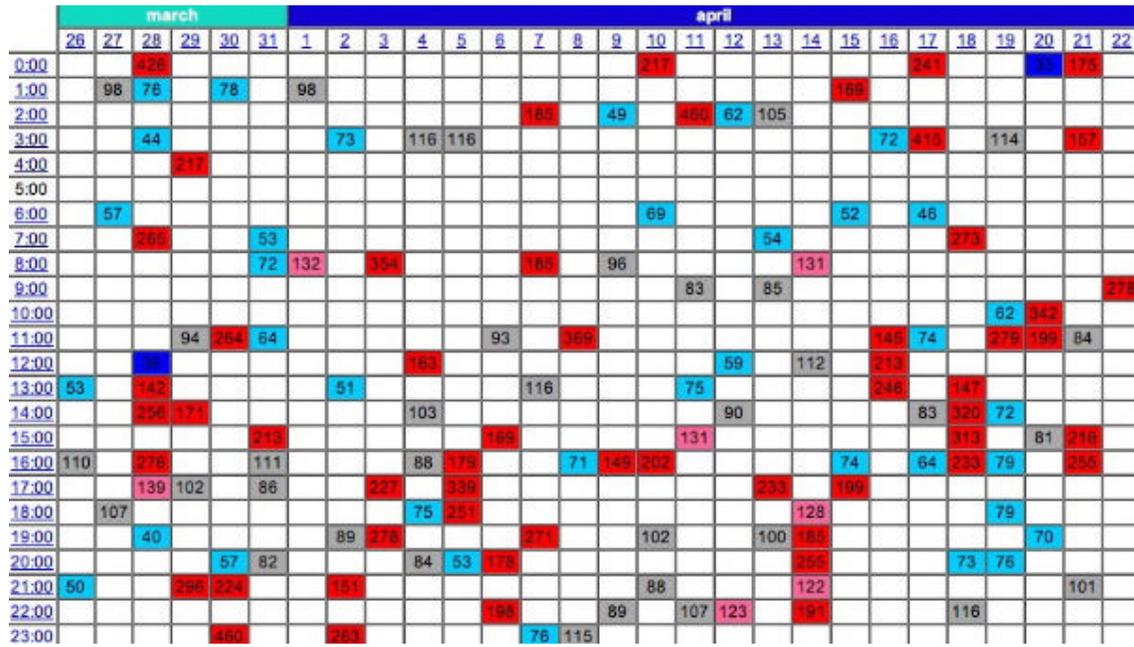
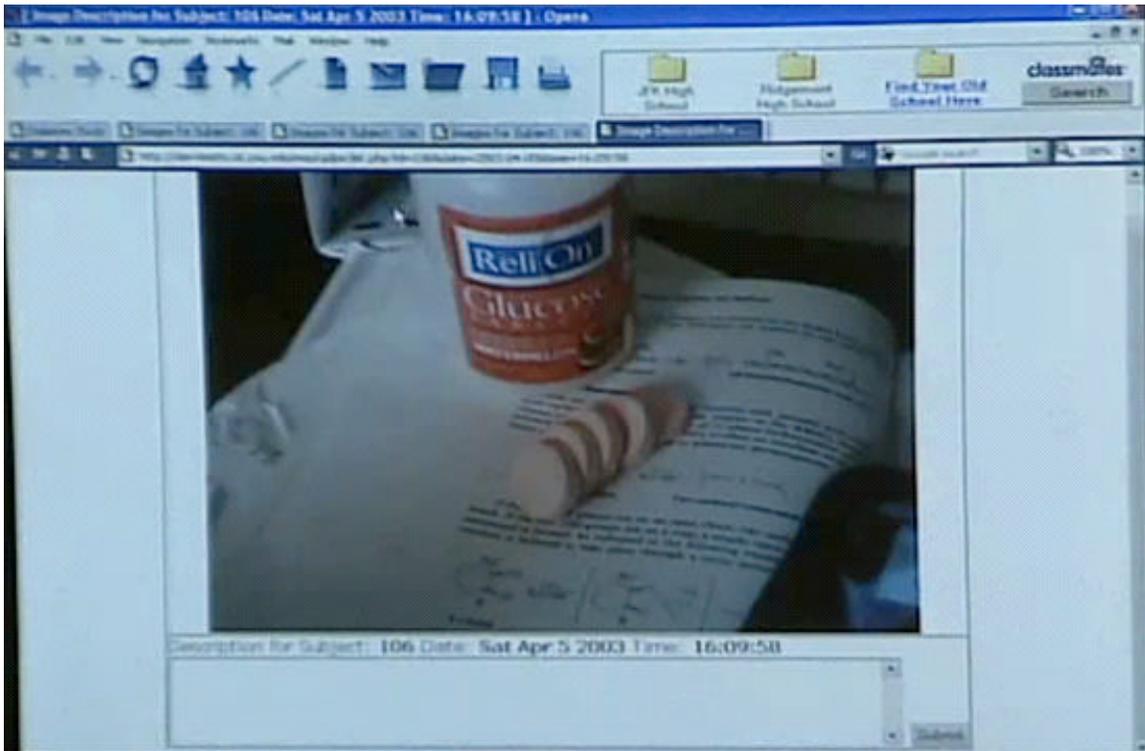


Figure 2: Glucose results and pictures taken



Figure 3: A magnified view of a picture



Communities of Practice as Organizational Knowledge Networks

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Abstract

As the amount of critical information in companies continues to burgeon and employees' knowledge is heralded as an organization's key competitive advantage, knowledge management has become a compelling workplace topic of discussion. Communities of practice have recently been recognized as effective means for organizations to manage their knowledge. In order to determine how virtual communities of practice serve as knowledge management vehicles, the authors of this paper conducted a study on virtual communities of practice within twelve large, international companies by interviewing virtual community of practice builders and leaders within these organizations. This paper reveals the study's findings. It outlines specific ways that organizations can benefit from sponsoring virtual communities of practice. It also identifies factors that community builders and leaders can influence to ensure a VCoP's success as a knowledge management vehicle.

Introduction

In our current age where information and knowledge are recognized as key ingredients for success and competitive advantage (Goldwassar, 2001), employees' knowledge, skills, and ideas are often considered to be companies' most valuable assets (Schwen, Kalman, Hara, & Kisling, 1998; Stewart, 1997). As the pressure to manage knowledge has become more and more pronounced, companies are undertaking major initiatives to protect and preserve it (Wenger, 1998). Accordingly, much literature has been dedicated to knowledge management (Blunt, 2001; Davenport & Prusak, 1998; Hamel & Prahalad, 1994; Kelly, 1998; Schwen et al., 1998; Sharp, 1997; Pfeffer & Sutton, 2000; Wenger & Snyder, 2000).

Proponents of knowledge management primarily recommend two ways of capturing and managing an organization's knowledge (Hansen, Nohria, & Tierney, 2001; Schwen et al., 1998). One recommended way to manage knowledge is to codify, index, and warehouse the information (Davenport & Prusak, 1997; Davenport & Prusak, 1998; Nonaka & Takeuchi, 1995; Schwen et al., 1998). This method is known as the codification means of managing knowledge (Hansen et al., 2001). Another recommended way to manage knowledge is to have the people who generate, refine, share, distribute, and use the knowledge actively manage it (Brown & Gray, 1995; Davenport & Prusak, 1998; Pfeffer & Sutton, 2000; Wenger, 2000). This method is known as the personalization means of managing knowledge (Hansen et al., 2001). A number of individuals who promote actively managing knowledge via people recommend using informal workplace learning networks, like communities of practice as knowledge management vehicles (Masterson, 2002; Pfeffer & Sutton, 2000).

This paper describes and discusses the findings of a study that reveals specific ways that virtual communities of practice can benefit individuals and organizations by helping them manage their knowledge more efficiently. To place the research in context, communities of practice are first introduced and discussed as knowledge management vehicles. An account of the research methodology follows, along with a general description of the study findings. The findings are then discussed in detail in terms of gains that individuals and organizations realize from participating in and sponsoring VCoPs. The paper concludes with suggestions of how this research contributes to the field.

Communities of Practice as Knowledge Management Vehicles

Communities of practice (CoPs) are comprised of members who communicate one with another to generate and share knowledge and expertise. They function as an interdependent network over an extended period of time, with the shared goal of furthering their 'practice' or doing their work better (Wenger, 1998). Many CoPs operate virtually because community members live and work around the globe, relying on various technological means to communicate with one another. These CoPs are often called virtual communities of practice (VCoPs).

Existing research on communities of practice indicates that they have been found to help employees acculturate themselves into an organization (Chao, 2001; Gregory, 1993) develop a work-associated identity (Hara, 2000; Yi, 1999), teach them skills to get their work done more efficiently (Brown & Gray, 1995; Sharp,

1997), motivate them to do their work (Barab & Duffy, 2000; Bradsher & Hagan, 1995), and improve their individual job performance (Allen, 2003). However, literature relating the individual and organizational impact of CoPs to knowledge management is limited.

Wenger and Snyder (2000) reported that CoPs have helped several organizations improve their overall performance, enhance their communication structure, and support their goals. However, beyond a few individual case studies and Wenger and Snyder's case study synthesis, little research focuses on the ways that CoPs facilitate knowledge management within organizations. In order to learn more about the ways that CoPs, and particularly VCoPs, help organizations and individual VCoP members manage their knowledge, a study was conducted on VCoPs within large corporations, government organizations, and educational institutions.

Research Methodology

The research team utilized interviews as the primary research data source because they are a key means of gathering qualitative case study data (Stake, 1995; Yin, 1994). They used a survey as a secondary research data source. The researchers collected the study data in two phases. They interviewed VCoP builders and leaders in phase one. During phase two, the researchers collected data from VCoP participants via a web-based survey. Prior to starting each phase, the researchers pilot tested and validated the data collection instruments with a small group of selected potential participants to ensure that the collected data would be reliable and valid.

The research participants involved in phase one consisted of twenty-five builders and leaders of virtual communities of practice from thirteen organizations. These organizations were primarily large, global companies who provide a wide range of products and services, such as financial services, microprocessor chips, technology services, training, health care services, consumer products, and insurance. The interviewees were carefully screened before they were interviewed to ensure that the virtual communities of practice they lead or built adhered to the theory and practices of community of practices. Once the VCoPs' legitimacy was established, formal interviews were conducted via 60-90 minute telephone conversations. These interviews were recorded and later transcribed.

The interviews addressed all aspects of VCoPs in order to gain a holistic understanding of their utilization. Some interview questions focused around discovering why VCoPs exist within organizations, what kind of "work" they do, and how they get started. Other questions attempted to ascertain how VCoPs impact the flow of data, information, and knowledge throughout their organizations. For example, interviewees were asked to identify and explain how the communities of practice served as forums to create and disseminate knowledge throughout their organizations.

During the second phase, the research team used the data gathered in phase one to create a web-based survey that was distributed via e-mail to participants of VCoPs in forty organizations. Approximately 150 virtual community of practice members responded to the web-based survey. The survey respondents worked for financial institutions, microprocessor chip manufacturers, technology services companies, training providers, health care providers, consumer product developers and distributors, insurance providers, and various other corporations. The survey questions focused around discovering why participants join and participate in VCoPs, what factors contribute to a VCoP's success or failure, what learning medium participants prefer for various types of learning and information exchange, and how learning in VCoPs compares to learning via more formal training methods. The web-based survey software automatically captured the participants' responses.

Findings

In general, the findings indicate that individuals and organizations can receive substantial knowledge management-related benefits from participating in and sponsoring VCoPs. The interviews with VCoP builders and leaders and survey responses uncovered a wide range of explicit and tacit knowledge about virtual communities of practice. The interviewees articulated how the VCoPs actually perform in applied contexts and explained the benefits they provide to their members and to the organizations that sponsor them. The survey data revealed ways that members believe VCoPs can significantly help individuals learn, manage their knowledge, and perform their jobs better.

Ways that VCoPs Benefit Individual Members

During the course of the study, the data provided both by VCoP builders and participants suggest that VCoPs benefit members by helping them do their jobs better, support their learning process, and extend or share their knowledge with one another. In their interview responses, builders of various virtual communities explained how VCoPs support their members' learning processes. For example, one VCoP builder stated:

[VCoPs] form because that's how people actually learn. That's how they share information, share resources... ask questions, get answers to those questions, and so forth. This is how people really do work and we in the training world, since that is where I'm coming from, we often look from an educational training perspective that most learning goes on in the classroom, but the reality is obviously that it doesn't. Most of it goes on in the workplace... most of the real critical learning goes on in the workplace.

In general, the study data suggest that VCoPs help employees learn by situating learning in the workplace, providing just-in-time and context-specific solutions to problems, and increasing employee interaction.

VCoPs Situate Learning in the Workplace

Recent research shows that employees often learn more in the workplace than they do in formal training environments because they fail to transfer and implement formal training into their jobs (Gilbert, 1978; Mager, 1992; Sorohan, 1993; Stolovitch & Keeps, 1999). VCoPs are valuable on-the-job learning environments because they are situated in employees' immediate work setting. One VCoP builder stated that "a community of practice is a better vessel even to do training [than formal training environments] because it's done within the situation of the work [they're] doing."

VCoPs Provide Just-in-time Solutions to Problems

VCoPs also provide a context where individual members gain access to people and resources that can help them solve their problems by viewing their problem from multiple perspectives and generating numerous problem-solving ideas. In other words, VCoPs provide a way for members to discover solutions to problems when they are most needed – just in time and in their own unique context. This significantly increases employees' performance capabilities.

As part of the web-based survey, VCoP members were asked to identify the benefits they personally gain from participating in virtual communities. In response to this question, 99% of participant responded that "job skills and knowledge" were the most important benefits. Approximately 84% of participants also indicated that VCoPs provide "excellent problem solving resources." The percentages of these responses clearly suggest that people join and participate in VCoPs to "gain knowledge and skills" and to "access resources" that will empower them to make better decisions.

VCoPs Increase Employee Interaction

VCoPs also benefit individual members because the group structure of VCoPs allows members to share information and engage in learning activities with peers. The increased peer interaction then leads to an increase in the members' knowledge retention and stronger relationships across the organization. This is particularly true when VCoPs involve people from across the organization, around the world, and different job descriptions and specializations. Because of these variations, the input and connections made by VCoP members unite employees and help them gain a sense of purpose and awareness that their individual efforts contribute to organization-wide strategies. In this way, community participation and interaction reduces both hierarchical and geographical boundaries and increases employee unification.

In a related survey question, VCoP participants selected their top three reasons for participating in virtual communities. Participants selected their reasons from a variety of responses related to relationship building, productivity, status, and motives. In response to this question, the participants indicated that developing "professional relationships with other community members" is their top reason for participating in VCoPs. This response specifically relates to knowledge management because developing professional relationships with other VCoP members is a key step in transferring knowledge among members. Also, when members exchange information and aid one another in solving problems, the overall productivity of the community increases. This increase in job-performance implies that employees are learning how to do their jobs better.

The benefits of situating learning in the workplace, providing just-in-time and context-specific solutions to problems, and increasing employee interaction were reinforced by a final question from the web-based survey, which asked VCoP members to identify whether VCoPs, web-based/computer-based training, instructor-led training, or mentor/apprentice learning environments best help them accomplish certain aspects of their jobs. In response to this survey question, VCoP members indicated that participating in VCoPs helps them do the following six specified job aspects better:

- Providing for an efficient idea exchange
- Generating a broad perspective on solving problems

- Providing greater access to experts
- Increasing members' knowledge
- Increasing members' motivation to learn
- Effectively helping others learn

Additionally, VCoPs ranked second in conjunction with “providing a more direct solution to a problem” and “impacting people’s attitude about their jobs.” These responses suggest that VCoP members view VCoPs as a learning environment that helps them manage their knowledge and better perform on the job.

Ways that VCoPs Benefit Organizations

Organizations also gain key knowledge management-related benefits from supporting virtual communities of practice. As previously indicated, knowledge management initiatives revolve around moving data, information, and knowledge effectively throughout an organization. The general goal is to decrease the communication barriers that exist in nearly every organization between individuals due to divisions, levels within the organization, and physical locations. In their interviews, all of the virtual community of practice builders and leaders stated that VCoPs improve their organization’s knowledge management initiatives via either direct or indirect means. They indicated that virtual communities of practice facilitate a greater flow of information across organizations by breaking down many of the existing barriers. They also indicated that VCoPs increase the networking and communication opportunities available to VCoP members across organizations by providing increased interaction between organizational units where communication was previously impossible, increasing exchanges between management and employees, extending discussions that occur in face-to-face meetings, and creating a written repository of best practices that VCoP members have ongoing access to. VCoPs also appear to increase the informal training that occurs within the organization, foster innovation, and instigate cost savings. Each of these benefits is elaborated upon below.

VCoPs Increase Interaction Among the Best Minds

Before VCoPs existed, employees that spanned geographic borders or time zones were limited in their ability to effectively share data, information, and knowledge with one another. Virtual communities of practice overcome time and physical boundary limitations. Thus, they grant community members access to the best and brightest human resources throughout an organization, no matter what business unit or country they reside in. One community builder explained this benefit when he stated, “a virtual community of practice expands the quality of the skill base that we’re able to draw from... it helps us get the best quality people ... by not being constrained by physical location.”

By granting open access to the knowledge and expertise of a collective whole, VCoPs increase their members’ power and ability to function effectively and efficiently. For example, VCoP members often help individuals solve problems that they couldn’t solve on their own in a relatively short period of time. By posing a problem to VCoP members around the globe, these individuals can get a variety of contextualized solutions to their exact problem or recommendations based on similar problems that other VCoP participants have experienced very quickly. One VCoP builder emphasized the problem-solving benefit of VCoPs in the following statement:

There is no time barrier, no geographic barrier, no culture barrier keeping you from solving your problem.... If you are in the middle of Kalimantan, or in the middle of the Borneo Islands, you have the company’s [virtual community members] and with that, you have the support of everywhere in the world helping you resolve your problem.

VCoPs Increase Communication between Employees and Management

Another way that VCoPs boost an organization’s data, information, and knowledge flow is increasing the communication between management and employees. VCoPs do this by providing a means for employees to safely voice opinions and concerns and introducing a channel through which management can solicit individual employee input and feedback. The exchange both directions helps to break down the hierarchies that separate management from front line employees. For example, many community builders indicated that individual VCoP members who hesitate to voice their opinion, share their ideas, and help create new processes on their own will engage in these activities within their virtual communities. The results of these exchanges can be shared directly with members of the company’s management if they are VCoP members. If not, the VCoP members are able to discuss the issue(s) raised among themselves, and then pass their collective, and usually improved opinions, ideas, and recommendations on to company management from the collective community membership instead of

a single individual. In that situation, VCoP members' feedback and recommendations often have more credence with management because it is collective, rather than feedback from a single individual.

In the same manner that VCoPs provide members with a safe vehicle to communicate with management, VCoPs provide managers with a non-invasive mechanism to inform employees of new developments, influence policy and solicit feedback. In her interview, one VCoP builder indicated that her management actively uses VCoPs to gather input from employees in remote locations, especially when they are building new programs that will impact those employees. She said that the VCoPs provide an easy way to get feedback on new programs or policies from people across their organization instead of only receiving input from employees in the corporate office as they did in the past. In addition to facilitating the creation of better policies and programs, VCoPs inadvertently increase employee buy-behavior because they have opportunities to voice their opinion about those policies and programs. Additionally, virtual communities of practice establish a forum for company management and employees to collectively establish standards across geographic and culture boundaries.

VCoPs Extend Communication Between Face-to-Face Meetings

VCoPs also increase the information flow between employees by extending communication that occurs in face-to-face meetings. Members of VCoPs who meet physically on a regular basis often use the virtual component of their communities to interact with one another between these meetings. As an example, one VCoP leader said that the virtual communication channel between members of his virtual community allows them to follow up on issues and stay abreast of concerns facing their organization, divisions, or product lines when they are not physically present. It also gives community members the chance to jointly work on unresolved issues and action items assigned during face-to-face meetings before the next meeting takes place. For example, one VCoP builder commented that the addition of a virtual component to a co-located community of practice greatly increased communication between community members because they were able to discuss items and follow up on tasks that they had previously forgotten between face-to-face meetings. This made both the face-to-face meetings and the period of time between those meetings more productive.

VCoPs Codify Best Practices and Solutions to Problems

Another positive VCoP outcome related to knowledge management is the manner in which the information is captured. Since most of the communication and information exchange originating in virtual communities of practice occurs electronically, the questions, solutions, and best practices exchanged can be captured, organized, and archived for reference at a later date, in addition to being shared among community members immediately. This practice positively impacts an organization's knowledge management initiative from both the codification and personalization knowledge management perspectives introduced at the beginning of this paper. Through VCoPs, information is shared between people in relation to a specific context; thus it is personalized. Additionally, because it is digitally captured, it is also codified so that others can benefit from the exchange in the future.

One example of such a beneficial exchange occurred in a VCoP hosted by a multi-national insurance provider. In this instance when individuals in a Canadian office said, "Boy we've got a problem with..." members of the VCoP were able to say, "Oh, the Midwest office has already figured it out and they've already got the solution implemented. Talk to them and look at the information in the community archives to see what they did." In that single instance, the VCoP provided both the personal contacts and the repository of information that saved the Canadian office countless hours of duplicate effort and a large amount of money.

VCoPs Facilitate Informal and Formal Training

Due to the nature of the communication that occurs in VCoPs, these communities regularly facilitate informal training. In many ways, the questions that VCoP participants pose to one another and their calls for problem solving assistance serve as informal training requests because one VCoP member is seeking information from peers or experts to perform his or her job better. If community interaction is viewed in this light, whenever VCoP members answer one another's questions or provide advice, they are filling those informal training requests with impromptu training experiences. As a result, virtual communities of practice act as informal training networks and they provide constant informal training and mentoring opportunities. VCoP leaders indicated that community members also impact and influence formal training opportunities by identifying where collective knowledge gaps exist and requesting formal training for VCoP members in order to fill those gaps.

VCoPs Foster Innovation

Virtual communities of practice also benefit their sponsoring organizations by fostering innovation. VCoP builders and leaders indicate that VCoPs tend to foster innovation and refine organizational processes because the members examine problems and processes from multiple perspectives in a non-threatening, non-hierarchical, non-constrained environment and often create new processes or streamline existing processes. One VCoP expert focused in on this organizational benefit in her interview when she said, “If you bring the right people together and help them share their tasks and knowledge and collaborate on problem solving, you have innovation... so a community of practice is a perfect structure to engender innovation.” Other VCoP builders echoed this expert’s assertion when they told us that their VCoP members generally get excited about having opportunities to innovate and take advantage of those opportunities.

VCoPs Help Organizations Reduce Costs

Virtual communities of practice can help companies reduce their bottom line in a variety of ways. VCoP builders and leaders indicated that by sponsoring virtual communities of practice they were able to reduce the need for travel, decrease their overall training budget, reduce duplicated efforts, and minimize the time it takes to communicate with VCoP members across the world. In particular, several community builders noted that by utilizing virtual communities of practice as a training and collaboration tool, they have been able to significantly decrease the overall training expenses for their organization. For example, one VCoP builder of a worldwide oil product company indicated that his organization saves \$35,000-\$40,000 every month because members of a specific community of practice discuss and work on issues that they used to discuss in a monthly face-to-face meeting through the VCoP. This builder said that even though VCoPs require specific software and other technology to communicate, the costs associated with that technology are substantially less than paying for all the community members to meet physically on a regular basis so he happily provides the needed software, hardware, and server space needed by the VCoP to operate effectively.

Several community builders also noted that sponsoring virtual communities can help organizations reduce costs incurred by duplicating efforts. One VCoP builder stated that VCoPs “help out the bottom line” as they start to reduce redundancies and eliminate duplicated efforts. Another VCoP leader quantified the costs savings achieved by a particular community in terms of his personal time savings. He commented that he is able to achieve the same gains by relaying a message to members of this community virtually in a couple of hours as he did when he traveled for two or three days to relay the same message with community members physically.

Conclusion

The research data indicate that virtual communities of practice benefit the knowledge management initiatives of the organizations that sponsor them. The interviewees’ comments evidence the fact that the interaction between VCoP members increases the amount of data, information, and knowledge that is exchanged throughout an organization and heightens employees’ awareness of what others are doing. The information exchange mutually benefits community members throughout organizations and the organizations themselves. The data also indicate that VCoPs increase opportunities for training and innovation, and help to reduce costs. These combined benefits lead to improved management of an organization’s knowledge because they facilitate knowledge generation, knowledge codification and coordination, and knowledge transfer throughout organizations (Davenport & Prusak, 2000).

This study’s findings contribute to the growing body of knowledge about virtual communities of practice by identifying specific ways that organizations benefit from sponsoring VCoPs and by revealing critical factors that organizations can influence to strengthen the likelihood that these communities will succeed. As a result, the data are valuable for organizations who desire to strengthen their ability to manage their collective employees’ knowledge and utilize virtual communities of practice in that endeavor. The VCoP builders and leaders who participated in the study collectively articulated that greater information and communication flow, increased opportunities for training and innovation, better utilization of global resources, and reduced costs are benefits that organizations can realize from supporting virtual communities of practice. These benefits directly lead to improved knowledge management on both the individual and organizational level because the virtual communities of practice serve as organizational networks where knowledge is created, disseminated, and transferred throughout organizations.

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The Digital Divide: Focused Research Results On Peer Mentoring, Scalability and Occupational Self Efficacy In a Home-Based Technology Integration Program

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Introduction

The existence of a "digital divide" in which portions of society do not have sufficient access to technology, nor to the information and skills that technology use imparts, was of concern for educators and policy makers even before home computers were easily connected to the Internet (NTIA 1995, 1998, 1999, 2000; Resmer, Mingle & Oblinger, 1995; Riley, 1996; Annie E. Casey Foundation, 1998). As new technologies (such as broadband Internet access), and new uses for technology (such as interactive websites for homework) are developed, new levels of the divide will appear, certainly to the extent that children in low income homes do not gain access to the same level of information at the same rate as other children (c.f. Hundt, 2003; Digital Divide Network, 2003). In an era in which funding may be difficult to obtain, the development of tested, scalable, affordable solutions should therefore be a mandate for educators.

Research in the digital divide field is still in the critical early stages; consequently, much of the research has focused on demographic information and on documentation of participant benefits (cf. Chow, Ellis, Walker & Wise, 2000). As it is now well established that participants do benefit, and that those who would not otherwise have access to technology do take advantage of such opportunities, more focused research is called for. In addition, much early digital divide research has been based on solutions developed in conjunction with community technology centers (Chow, Ellis, Walker & Wise, 2000); the notable exceptions (e.g. Apple Classroom of Tomorrow, 1995; Pinkett, 2000, 2002) were largely based on partnerships with specific institutions and on highly funded pilot programs, so that conclusions drawn may be limited in the extent to which they can be used to plan larger programs and fiscally reasonable solutions. Moreover, as Secretary of Education Rod Paige has pointed out (US Dept. of Ed., 2003a, 2003b, 2003c), access in schools and in other institutions such as libraries does not substitute for access to home computers with Internet connectivity. Projects designed to test home-based technology programs are thus seen to be a priority (Andrews, DiGangi, & Jannasch-Pennell, 1999, 2000; Stock, 2001).

This paper reports on a seven-year project that was specifically designed to generate scalable and affordable solutions to the digital divide in a participatory research setting, and on a briefer study based on the project; one year was allocated to data collection in the study, and a second year was devoted to completing the analysis. The paper offers an overview of results of the study, and of the means by which the results were obtained. While more detailed papers are planned, it is hoped that this overview will draw attention not only to the divide, but also to some solutions, and to the efficacy of a grassroots -oriented means of generating such solutions.

In the seven-year project, computers were placed in low income homes as well as in non-standard dwelling places (e.g. shelters and vehicles) via a participant-led grassroots technology program, Floaters.org. Outcomes regarding disposition and use of the computers were tracked largely via a peer mentoring process in which previous recipients introduced new members to the computers. Mentors in particular, and mentees as well, were invited to bring their experiences and suggestions to a participant research group and in so doing to serve as a bridge to trained researchers. The participant research group met weekly and functioned as a consensus-based decision-making body with regard to the evolution of the project. Participants thus shaped the program to their needs in an exemplary participatory action research project (c.f. Moser, 1977; Fals Borda, 1995; Sohng, 1996).

Five years into the project, a mixed-method study was begun that would focus on specific aspects of home-based technology integration. Methods were chosen, with participant input, to maximize the amount of information gained. Thus, discourse analysis was selected as the appropriate method to examine transcripts of taped peer mentoring sessions; grounded theory was used to identify changes to the program that emerged as

the program was scaled up in size; and a standard self-efficacy scale was used to examine participant self efficacy with regard to technology occupations. Finally, the program looked back at itself via the process of participatory action research, used in the project in order to generate and evaluate digital divide solutions from the bottom up, that is, with maximum input from the people most affected.

Purposes of the Project and Study, and Research Questions for the Study

Participant-chosen goals for the project, and therefore for the participatory aspect of the study as well, were to investigate how best technology could be integrated into the homes and lives of low income populations; and, consequently, how technology could be used to improve these lives. From the beginning, the project sought not only demographic information and information about participant benefits, but also information about how those benefits could be accomplished.

Goals of the study, as contrasted with those of the project, were chosen in participant-driven focus groups in which members learned research methods. These goals focused specifically on a set of particular research questions:

What took place with regard to teaching and learning in the peer mentoring sessions?

How did the structure of the program, designed over time by participants, change further as the program was scaled up in size?

Did participant self efficacy change during the study with regard to occupations, especially with regard to technology occupations?

About the Floaters.org Project

Working with university researchers, a community group designed and implemented the Floaters.org project, in which older computers were and are recycled into low-income homes and then monitored. The Floaters.org project itself is a participatory action research project, wherein all participants have an equal voice and goals are set by group members working together. The project was designed to integrate technology with those who are least likely to otherwise attain it: specifically, those living in poverty, those who have been homeless and later, people with disabilities who could not otherwise afford technology. The project simultaneously was designed to identify and put into practice the highest pedagogical and research practices. This does not imply that mistakes were not made, but rather that learning from mistakes was a built-in part of the process.

An examination of the nature of the project, undertaken as the two year study began, showed that participants took on three roles: peer mentors or mentees; shapers of the program; and co-researchers. Each role corresponds to one of the research questions stated above.

The monitored study was designed with input from participants, and participant approval was gained for all aspects of the study. As part of their work as co-researchers, participants learned about ethics standards, including the right to withdraw from the study without having to withdraw from the program. Each participant chose a screen name or alias, and data were recorded for these aliases. Where privacy dictated, the academic researcher occasionally chose to use an additional naming convention as well. Those participants who did leave the study have given their permission to continue using their data.

Discourse Analysis

Discourse analysis, a qualitative research method used to examine the peer mentoring sessions, consists of a number of approaches to analysis of verbal interactions. Discourse analysis was agreed upon as a method for the study by the participants, who saw this method as a means of investigating empowerment. This view is consistent with the literature: in *Language and Power*, Fairclough (1989) invited both researchers and lay people to investigate the uses of discourse strategies to take and consolidate power.

It is the branch of discourse analysis known as conversation analysis, or CA, that was primarily used in this study. In conversation analysis, audio or video recordings are transcribed, and the transcriptions then analyzed, with structural details taking precedence over content. That is, rather than interpreting data and assigning motives, conversation analysts seek information about the structure of the conversation. Intonations, pauses, interruptions and grammatical structures are among the features typically coded for.

Conversation analysis was pioneered by sociologist Harvey Sacks in the 1960's; his work, edited by Gail Jefferson and Emmanuel Schegloff, was not published until 1992, as the *Lectures on Conversation* (Sacks, 1992). However, long before this publication date, Sacks, Jefferson, and Schegloff had begun a collaboration

that resulted in a series of works that defined conversation analysis. These works included the *Semiotica* article "Opening up Closings" in which Schegloff and Sacks proposed the concept of the adjacency pair to explain conversational structures such as questions and answers (Schegloff & Sacks, 1973) as well as the *Language* article, "A Simplest Systematics for the Organization of Turn-Taking for Conversation" (Sacks, Schegloff and Jefferson, 1974). Working with Sacks' material, Gail Jefferson originated a set of notations for marking up text that was published with the 1974 article, and that has remained standard among conversation analysts.

In addition to Sacks' pioneering work, Sacks, Schlegloff and Jefferson built on the work of Harold Garfinkel, founder of the ethnomethodology school of sociology. Ethnomethodology focuses on the study of everyday actions, including language use, and takes for granted that ordinary people understand what they are doing; thus it is by nature well suited to a participatory action research project in which participants are co-researchers. Garfinkel presented the principles of his approach in *Studies in Ethnomethodology*, citing transcripts of conversations to show how people organize their shared realities using "common understandings" (Garfinkel, 1967, p. 38). In other words, ordinary people can and do understand their own actions. Like the conversation analysts, Garfinkel relied on observable data, using only as much context as was necessary to understand the data and expressing a belief that only those involved could understand the whole situation (Garfinkel, 1967).

Also related is the work of Erving Goffman. In *The Presentation of Self in Everyday Life*, Goffman showed how, whether consciously or not, conversationalists act out roles and create a "front"—"that part of the individual's performance which regularly functions in a general and fixed fashion to define the situation for those who observe the performance" (Goffman, 1959, p.22). Conversation analysis draws from the work of Goffman in that both reveal the ways in which relationships are constructed and roles created.

Transcription in itself has come to be viewed as a theoretical process, a viewpoint introduced by Elinor Ochs in "Transcription as Theory" (1979) and by Carole Edelsky, in "Who's Got the Floor?" (1981). Central here are the realizations that the raw data are not the same as the transcribed data; that, rather, the transcription is a representation of the data; and that the infinite multitude of decisions made during transcription are actually theoretical decisions reflecting the relative importance of particular discourse features. Two researchers working independently would not make the same theoretical decisions; and a single researcher, writing about the same text at different times, may make different coding decisions.

It cannot, therefore, be assumed that reliance on observable data over inference in conversation analysis implies that the data are wholly objective. The ongoing development of software applications that can be brought to bear on the transcription process (for example, software that measures pauses) does not change this, as researchers will continue to make the important decisions: for example, pauses in a technology mentoring session may have to do not with hesitation but with mentee concentration on a technology task. Where there is reason, a second researcher may separately transcribe audio or video recordings, and the two versions can be compared; or, a group of researchers working together may listen/view and transcribe as a group, as is recommended procedure in ethnographic inquiry and interaction analysis (Jordan & Henderson, 1995). However, neither process is necessarily indicated if it is accepted that transcription decisions are properly the domain of the researcher (c.f. Ochs, 1979; Edelsky, 1981; Lemke, 1998).

A second branch of discourse analysis useful in a participatory action research study is critical discourse analysis, or CDA, in which discourse is examined for underlying relationships of power. In the European countries, Foucault is thought of as the father of discourse analysis (e.g. Fricke, 1999; Diaz-Bone, 2003), in part for work published in his *Archeology of Knowledge* and in his *Discourse on Language*, published together in English in 1972. Elsewhere, Foucault might be thought of at least as the godfather of critical discourse analysis: Foucault began the *Archeology of Knowledge* by declaring that in order to understand any discourse it would be necessary first to get rid of all preconceived ideas in order to begin anew, and then to examine relations, including relations of power.

The Floaters.org study is closer in its approach to another critical discourse analyst, Norman Fairclough. Fairclough's use of close readings of text resembles that of conversation analysis, although his intention is to identify and uncover power relations. In *Language and Power* (1989), Fairclough not only identified discourse structures that give and take power, but invited others (including those with no prior academic background) to do so as well.

Participatory Action Research

The term "action research" has several meanings. In educational research, action research might be classified into two major branches, practitioner research and participatory action research or PAR. In both, research is carried on at least in part by people who have not been formally trained as researchers, but who have

the advantage of being directly within the research situation and so have access to an unusually high level of information. Practitioner research in education rests on the belief that teachers (“practitioners”) can participate in research, generally via self study, rather than being consumers of research only. In “participatory action research” on the other hand, the object is goal-oriented social justice, as guided by those affected. In PAR, a researcher or researchers may enter the situation with the intent of forming a participatory research group. The Floaters.org study utilizes the PAR approach: the initial impulse came from a researcher, who invited a counterpart in an affected community to join together in investigating technology integration by distributing donated computers.

Further confusion as to the nature of action research arises because participatory investigation or participatory action research has been used widely by such entities as the World Bank (Narayan, Patel, Schafft, Rademacher & Koch-Schulte, 2000). Such entities generally have an a priori interest in showing immediate financial gains for participants, whereas true participatory action research centers on the identification of participant values prior to the taking of action (Fals Borda, 1995; Sohng, 1996).

Participatory action research has been used in the United States in the establishment of support groups for sufferers from AIDS (Glasser & Bridgman, 1999) and in the investigation of the efficacy of prison education. (Fine, Boudin, Bowen, Clark, Hylton, Migdalia, Missy, Rivera, Robers, Smart, Torre & Upegui, 2001). In education, the work of Paolo Freire can also be seen as participatory action research, in that Freire mobilized participants to take control of their education (Freire, 1970, 1994, 1998).

In participatory action research, participants are co-researchers, with an equal voice in all decisions. The method itself therefore is also open to further refinement. Before the Floaters.org study began, five years’ of group work on the project had resulted in three principles against which all decisions were tested: equality of voice; consensus-based decision making; and revolving authority, in which those who are expert in a particular area may step forward and take charge, so long as those who are interested in the area may also participate.

In interactions outside of the group, “Nothing about us without us” is the credo of grassroots participatory action research, as documented on the Homeless People’s Network, the sister website and mailing list for the Floaters.org project (c.f. also Charlton, 2000). “Speak truth to power,” is a related imperative, implying that participants must at every step of the way open to stating their opinion rather than, for example, avoiding the situation (Carey et al, 1955; Kennedy Cuomo & Adams, 2004).

With these guiding principles in participatory action research, project members take an ethical stance that is every bit as difficult to implement as the most rigorous of quantitative methods; in both, at the end of the study, the researchers know that their findings are trustworthy to the extent that the method has been properly followed.

Self Efficacy

“Perceived self efficacy” refers to people’s optimistic beliefs about their ability to reach their goals (Bandura, 1977, 2001). Hackett and Betz have stated that one of the most useful concepts in modern psychology is Albert Bandura’s concept of self-efficacy expectations, for self efficacy has been shown to affect human development (Hackett & Betz, 1981; Betz & Hackett, 1981; Bandura, 1977; Bandura, 2001). Changes in self efficacy have four sources, according to Bandura: mastery experiences, vicarious experiences modeled by others, verbal persuasion, and people’s own physiological indicators or somatic and emotional states resulting from the attempt to achieve. Investigating these four sources, Bandura found, for example, that verbal dissuasion is easier to accomplish than verbal persuasion; that both positive and negative moods may affect self efficacy, as can pain; and that, in a learning environment, teacher self efficacy can negatively or positively impact student self efficacy (Bandura, 1994, 1995, 1997, 2001). Bandura’s work with self efficacy was a part of his pioneering work that made a place for cognition, rather than adhering to the older “black box” theories of psychology. In thus allowing for the thought processes of the individual, Bandura created a concept which is more appropriate to grassroots PAR investigation, which also places emphasis on the individual participant, than earlier theories.

Self efficacy is domain specific. Bandura states in his *Guide to the Construction of Self-Efficacy Scales* (2001) that is important to use a domain-specific measure rather than a general measure of efficacy, as general measures are too ambiguous to be meaningful. Self efficacy can transfer across domains, and powerful experiences, in particular, can effect changes across many domains (Bandura, 1994, 1995, 1997, 2001).

With regard to the study of self efficacy with low income populations, early research conducted by CTCNet (CTCNet, acc. 2003) identified a number of benefits to users, one of which was personal efficacy (Mark, Cornebise & Wahl, 1997). In subsequent CTCNet studies, this benefit was dropped as a concept of interest (Chow et. al., 2000), but a more domain-specific self-efficacy concept may be worth a closer

examination.

While career goals are not the only objective of technology integration, they are a concept of interest among the Floaters.org population, as determined by the participatory research group. "Work self efficacy" or "Occupational self efficacy" refers to the belief that one can succeed in a particular job. The concept of occupational self efficacy itself was introduced in pioneering work published in 1981 by Gail Hackett and Nancy Betz (Hackett & Betz, 1981; Betz & Hackett, 1981). In these works, Betz and Hackett applied the concept of self efficacy to career counseling and discovered gender differences among with regard to traditionally gendered occupations, in particular, men had much stronger self efficacy scores for traditionally male careers (Betz & Hackett, 1981; Hackett & Betz, 1981.)

Following Bandura's model, Hackett and Betz created the Occupational Self-Efficacy Scale (OSES) in the form of a Likert scale from one to ten for 20 occupations; respondents were asked to select their answers based first on how certain they were of being able to complete the education or training for each occupation, and then on how certain they were of being able to carry out the job duties (Betz & Hackett, 1998). A revised version of their 1981 *Manual for the Occupational Self-Efficacy Scale* was made available online in 1998 (Betz & Hackett, 1998). Typically the scale is revised by the researcher to offer relevant occupations for the population of interest (Hackett, personal communications, 2001, 2003); in this PAR study, the participants themselves chose the relevant occupations. The scale can be administered in terms of the training aspect, in terms of the job duties aspect, or with both aspects included.

Method

Participants

Participants in the group (n=184 at the time of the study) comprise a "snowball" sample (Babbie, 1998) in that new participants were recruited by project members, each of whom was asked to choose someone else to teach. For the study, 37 primary participants were lent recycled computers, standardized to the extent possible. Data were collected over the course of a year for each of the 37. Each primary participant represented a different family except where there were two or more computers in a family; in these cases, each primary user of a computer was also a primary participant in the study. All of the 37 volunteered for the project, and all were over the age of eighteen.

Each section of the study drew on a different subset of participants as appropriate:

Fourteen of the 37 took part in the taped peer mentoring sessions. The taped sessions used for the study were theoretically sampled, that is, they were chosen in order to provide as wide a range as possible in terms of age, level of experience in the program, gender, and level of education.

All participants were invited to optional weekly research meetings, where data were collected in the form of field notes and observations regarding changes in the structure of the Floaters.org project during the study.

Twenty-two members agreed to take part in the self efficacy portion of the study; of these, seventeen took part in both administrations of the self-efficacy scale, at approximately four-month intervals, while five took part only in the first administration. The 22 were self-selected from the 37 primary participants.

While research decisions (e.g. aspects studied and methods) were made by the participants after group study of research methods, and while participants took part in other aspects of the research as appropriate (e.g., participants selected the careers to appear on the Occupational Self Efficacy Scale), a trained researcher conducted the analysis, with constant member checks wherein participants were asked to comment on portions of the analysis.

Data Sources

Data sources included the following:

- Records of the computers and the work done with them
- Field notes, observations, and qualitative memos
- Eight videotaped mentoring sessions, theoretically sampled so as to provide the widest possible variety of mentors and mentees
- Field notes and observations from focus group sessions
- Scores from the two administrations of the Occupational Self Efficacy Scale
- Responses to followup questions asked of those who took part in the mentoring study

Procedure

Recycled Macintosh computers with a standard set of applications were distributed to thirty-seven primary participants, along with self-study materials and resources for feedback.

Eight peer mentoring sessions, theoretically sampled to provide the widest possible range in education, experience, age, and gender, were videotaped by the researcher.

The Occupational Self-Efficacy Scale was administered at approximately four-month intervals to a subset of twenty-two self-selected mentors and mentees in order to determine any changes in attitude towards computer-related jobs. Seventeen of the twenty-two were available to take the self-efficacy instrument a second time; five took it only once.

Weekly focus group sessions/research group sessions were held, and follow-up interviews were scheduled during the last three months.

occupations, they chose to use them all, adding eight more technology occupations and the occupation of President.

For this aspect of the study, four smaller questions were formulated:

1. Will there be a significant difference between means for technology-related occupations and non-technology related occupations within the first administration of the instrument?
2. Will there be a significant difference between means of technology-related occupations and non-technology related occupations within the second administration of the instrument?
3. Will there be a significant difference between means of non-technology occupations, between the two administrations of the instrument?
4. Will there be a significant difference between means of technology-related occupations, between the two administrations of the instrument?

Scores on the self-efficacy scales were analyzed for each of the four smaller research questions by running a paired samples t-test to test for difference of means. Follow-up questions were generated based on a pattern analysis of the results, and participants were contacted and interviewed.

Results

Peer Mentoring Sessions: A Discourse Analysis

Analysis of the peer mentoring sessions showed that peer mentors developed and used sophisticated teaching strategies and that these strategies were similar among experienced mentors, regardless of education levels. Coding yielded two sets of mentor discourse strategies that had to do with verbal contributions of the mentee to the session. Differences were found in the use of these strategies between experienced and beginning mentor discourse: expert mentors alternated the two types of strategies, thereby encouraging mentee contributions while advancing the instruction. On the other hand, features found in the discourse of experienced mentors were similar regardless of educational level: members with and without a high school diploma were equally expert in mentoring if they had an equal amount of mentoring experience.

One set of strategies encouraged mentee participation: these strategies included such features as questions, problem statements, and off-topic remarks. This problem statement by the mentor, for example, is followed by a mentee response:

→Mentor: 30. I've never seen the mouse
 31. connected to the cord before.
Mentee 32. (.) Then nobody can steal them.

The second set of strategies included such discourse features as interrupting, ignoring mentee contributions, and speeding up the rate of mentor speech. Here, the mentor interrupts, thereby retaining control of the instruction:

→ → Mentee: 23. Let me show [you ()
→ Mentor: 24. [And then you can, now if you want to do.
 25. ° Let me show you.°

Scalability/Changes to the Program

Participants modified the Floaters.org program further during the study, primarily increasing communication opportunities. The first modification, in which participants requested that the focus and research group meet weekly, and that it be immediately opened to mentors and mentees alike, provided a regular opportunity for participants to bring up their concerns and to suggest changes. Participants successfully maintained the basic premises of the program (equality of voice, consensus-based decision making, and revolving authority) throughout the mixed method study: no mean feat, for as the group learned, in a research situation methods can easily deviate from grassroots principles unless there is constant attention to the principles. A second major modification was that of the addition of a fourth principle to group interactions: speaking truth to power within the group (as well as outside of it) rather than walking away. This addition to the internal principles of participatory action research was needed since many participants (as documented in the self efficacy interviews) perceived of their power as limited in some senses, but strong in that they stated that they could always walk away from a situation in which they were not being treated fairly. Encouragement to speak out in the group over perceived slights was the solution to losing participants over such problems.

Occupational Self Efficacy

Results of the self-efficacy questionnaire were inconclusive, though a major history effect may have had some impact on these results. The study was interrupted by the events of September 11, 2001, and in follow-up interviews as well as in focus group observations, some participants indicated that these events had changed their opinions.

One significant difference was found, for the exploratory question, Will there be a significant difference between means for technology-related occupations and non-technology related occupations within the first administration of the instrument?

For the difference between means of technical and non-technical occupations in the first administration of the OSES, the p value was .047. As the sample size is small, a non-parametric test, the Wilcoxon Signed Ranks test was also run, and here the p value was .049, leading to the same conclusion. This difference disappeared in the second administration of the OSES, where scores for non-technology occupations rose, although not significantly. Standard deviations for technology-related occupations, particularly in the second administration, were higher than for non-technology-related occupations:

Table 1 *Standard Deviations*

| Non-technology 1 | Technology 1 | Non-technology 2 | Technology 2 |
|------------------|--------------|------------------|--------------|
| 1.6949 | 1.8254 | 1.6474 | 2.0261 |

These results are somewhat counter-intuitive as it might have been expected that technology self efficacy would increase after participants received their computers. In order to investigate this further, responses to the scale were first graphed and patterns of responses were analyzed, in order to generate follow-up questions. Open-ended follow-up qualitative interviews were then held.

Three types of typical patterns were found: one subset reached the ceiling in technology self-efficacy either in the second administration, or in both administrations: these scores either rose, or stayed the same.

Statements from this group in follow-up interviews indicated that these participants wished to make it clear that they could do anything if they had the opportunities for education and success that others have. These members felt that they were capable of completing the education for occupations requiring high levels of education, but felt others in society were unaware of their ability.

In another subset, scores fell, sometimes radically. Interviews with this group indicated that after September 11, some participants lost interest in their work with the computer, and some lost faith in their ability to prepare for computer-related jobs.

With a third group, response levels varied based on the specific type of computer career, either in both administrations or in the second. That is, a participant might score high on a career involving computer art, but low on a career involving programming. In follow-up interviews, these participants indicated that their greater understanding of technology careers had led them to give more precise answers, sometimes resulting in an overall lower score.

Looking at the Participatory Process

With regard to participant goals, localized best practices were found regarding technology integration. Financial goals remained problematic, but other goals defined by participants as pertaining to a better life were met to a degree. As one participant stated, "I will stay as long as it feeds my spirit."

Also documented in the focus group sessions and noted in the Changes to the Program section is the refinement of the participatory action research process over the course of the study.

Participatory studies may more commonly limit methods to ethnography: in this study, other methods were used as well, but introduced with care and always with participant understanding and consent. For example, the research group voiced concerns that quantitative methods would be disempowering, and a

discourse analysis has been proposed to determine if the self-efficacy scale is less empowering with this population than an open-ended questionnaire.

As a method, discourse analysis was not seen as disempowering, as the group was introduced to it via Fairclough's call for lay attention to discourse as a means of taking power (Fairclough, 1989.) The origins of conversation analysis being to some extent in ethnomethodology, a field in which ordinary people are seen as able to understand their own discourse, further makes this method approachable to discourse analysis. Finally, the place of self efficacy in psychology as introducing the importance of cognition makes this concept also appropriate.

Discussion and Future Research

Generalizability in the traditional meaning of the word is not the purpose of a study that takes a qualitative perspective; instead, theory is generated in the form of hypotheses based directly on data. In such a study, sufficient detail is ideally presented for readers to be able to make the decision as to whether or not the findings may also generalize to particular situations with which the researcher is familiar. Such detail adds to the credibility of the study. In this brief paper, detail is necessarily necessity limited: further papers are planned, and in the meantime it is hoped that the detailed presentation here of the participatory process as used in this study will encourage the reader to entertain the assumption that the rest of the study may likewise be credible.

It is also important for credibility that rapport and "buy-in" on the part of participants can be shown. This study sought such rapport and buy-in by following participatory action research principles. As all participants are co-researchers with an equal voice in decision making, rapport was a natural outcome.

Credibility is further enhanced by triangulation, or the use of multiple methods and/or data sources, especially when the findings of the methods and sources converge, as they do here. In terms of the purposes of the project and of the study, a project using specific means of technology integration (participatory research, peer mentoring, focus groups, home-based technology integration) was examined in differing ways (discourse analysis, field notes, and a self-efficacy scale) to yield converging results.

The results point to the usefulness and potential for success of peer mentoring, a process that is eminently affordable as a means of instruction. The discourse strategies can be studied further; one next step for this project will be to incorporate the strategies into mentor training.

Within the participatory process, it is interesting to note that grassroots participants, after five years of work with the process, were able to transform the project to meet the challenges of scalability and indeed to further refine the participatory process. Further study of the nature of power and empowerment for such a group appears to be in order.

As mentioned earlier, participants themselves have suggested a close look at the discourse of those who are taking the OSES, in order to determine if the OSES is empowering or disempowering as an educational experience

Another direction for study, and currently underway, is the further development of the OSES in the direction of a Technology Occupational Self-Efficacy Scale. Important here will be the identification of sets of related technology occupations that are of varying difficulty, so as to satisfy Bandura's requirement that items on the scale present varying levels of challenges (Bandura, 2001). To take an example from the current version of the scale, "video game tester" and "video game designer" require varying levels of training or education. Since technology-related occupations exist across various subdomains—programming, networking, and art, for example—it will be important to identify the various technology-related domains. A related avenue of future research will be the further development of an instructional intervention that describes the technology domains.

Appendix A

Transcription Conventions Used in the Floaters.org Study

Markup is based on the work of Gail Jefferson (1974, 1984).

| Markup | Definition/Samples |
|--------|--|
| [| Left bracket: beginning of overlap or interruption |
| S. | Yah I was in one of those technology classes [or |
| A. | [Computer class? |

-] Right bracket (optional): end of overlap or interruption
- = Equal signs: no break or pause.
- == Two equal signs indicate no break between the lines. One equal sign may be lined up above the other; or, one may appear at the end of one line and one at the beginning of the next.
- A. one day=
S. =yah (.
T.
- Dash: speech is cut off.
- A. All in the box. It all stays in the box-
no ! Get out! Can anybody hear me?
- yah Underscoring denotes a louder voice or other stress, as in a slight rising inflection.
- U. Yea::h, Pe:te!
- dit** Bolded text denotes an even louder voice or other form of exaggeration:
- P. **dit dit dit dit**
- F. That said it closed down (.) **i:m** properly=
- :: Colons indicate prolongation of the prior sound. The longer the colon row, the longer the prolongation.
- N. She lo::ves using the computer.
- < Angle brackets (carets, greater than signs) surrounding text and pointing inward: speech is said more quickly relative to other utterances.
- S. >very cool very cool<
- <> Angle brackets (carets, greater than signs) surrounding text and pointing outward: speech is said more slowly relative to other utterances.
- <and you ca::n't kill it>
- () Empty parentheses or with the word "inaudible" indicate something not heard by the transcriber.
- (yah?) Parenthesized words are guesses on the part of the transcriber.
- ° ° Degree signs indicate something said very quietly.

- F. °Let me show you.°
- { } Curly brackets indicate context.
{Context: mentor is looking at computer.}
- (()) Doubled parentheses contain descriptions of sounds other than speech.

Pauses are measured approximately.

New lines and micropauses (.) are about .1 second.

A number within parentheses, such as (2.5), is also approximate.

Some pauses were the result of engagement with the computer. Where this engagement was audible, it was transcribed with an explanation in double parentheses, as for example ((clicking)).

Silences longer than a few seconds were coded by approximate length or by an explanation within double parentheses: ((extended silence)).

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Effects of Varied Animation Strategies in Facilitating Animated Instruction

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Background

The use of animation and audio as a virtual panacea for everything from advertising to educational videos and instruction has created the presumption that any materials that use them 'must be better!' Now doubt that the addition of animation can improve message delivery on a number of scales, but the use of animation regardless of message and with little concern for systematic placement may be causing more harm than good. Combined with the increasing prevalence of computing technology and increasing ease of development on standard workstations the integration of animation in web-based instruction is a more realistic possibility. This study explores the effect of animation on higher order educational objective achievement in a web-based, self-paced programmed instructional unit on the human heart and its functions for undergraduate students with majors outside of the life sciences.

Introduction

In instruction the use of pictorial media has long been considered to be an important instructional variable supported by a number of theoretical considerations. Kulik and Kulik (1985) reported that computer-based instruction enhances learning and fosters positive attitudes toward instruction with college students. Unfortunately most of the studies that have been carried out examining animation in computer-based and web-based instruction have been cursed with confounding and poor designs. (Rieber, 1991; Dwyer 1978; Park & Hopkins 1993) There are various reasons for the conflicting results and inconclusive results. Dwyer (1978) pointed out that one of the major problems with media research was that it didn't describe the types of learning tasks or objectives that it expected the participants to achieve. Sadly upon review of available literature dealing with animation in computer-based and web-based instruction this still appears to be the case. In the subsequent literature review this author makes a case that not much has changed in the past 25 plus years in media research since Dwyer's observation. Further the questions of effectiveness in practice and convergence of theory remain largely inconclusive.

Definition

With a lack of definition of terms being one of the major criticisms of the research reviewed in the subsequent pages the researchers will explicate their operating definitions for animation. Animation is a sequence of images played in rapid succession such that to the human eye the result is apparent motion (Park & Gittelman, 1992) and is generally used in instructional materials for one of three purposes: attention-gaining / attention-direction, presentation, and practice (Rieber, 1990).

Literature Review

Paivio's dual coding theory (DCT) asserts that images and verbal processes together determine learning and memory performance (Clark & Paivio, 1991). According to Paivio's (1971, 1986) and later Clark and Paivio's (1991) explanation, using the information processing model and the spread of activation in the brain, the links between verbal and non-verbal symbolic storage can trigger each other, "...this spreading activation results in complex patterns of arousal among the representations in the network." (Clark & Paivio, 1991, p. 154) Further, Clark and Paivio propose that both types of mental representations have dedicated

channels for the processing and encoding of information. Tulving (1976) suggests that information can be processed on several levels in parallel processes and a logical extension of this using information processing as a guide is that the parallel processing can aid in the transfer of information into long-term storage. The concept of parallel processing is not new to cognitive psychology, and will be generally accepted by the researchers. What is of interest to the researchers stems from the apparent inconsistencies in the literature regarding the use of animated sequences to facilitate learning or achievement.

Animation Studies and Findings

Park and Hopkins (1993) suggest that educational research on visual displays evolved from two distinct camps: the behaviorist with work by Guthrie, Skinner, and Thorndike on eliciting desired responses after some stimulus, and the cognitive with work by Paivio and his Dual Coding Theory (DCT). Tulving and his concept of 3 major types of memory: episodic, semantic, and procedural would also fall under the cognitive branch in this division as well. (Gredler, 2001, p. 171)

In Reiber's 1990 review of 12 studies spanning 25 years, he found inconsistent results in the effects of animation on achievement and learning by extension. Similarly, Park and Hopkins (1993) reviewed 25 empirical studies, 17 of which dealing directly with computer based instruction and also reported mixed results. Dwyer and Dwyer in a 2003 presentation reviewed 5 animation based studies using similar content and identical assessment tools on a total of 781 subjects, and found only three cases out of the 72 examined where animation showed significant benefits over static visuals. Owens and Dwyer (2003) in an unpublished study actually found animation to be less effective than static visuals at higher levels of learning.

In a study published in 1988 by Reiber and Hannafin looking at the effects of animated or textual orienting activities on learning in computer based instruction with fourth, fifth, and sixth graders, they report that neither text-based or animated activities were powerful influences on learning. This studies content was based on Newton's laws of motion, and the authors report that a 24 item posttest was administered with a KR-20 reliability of .83 overall. While not explained they also report that validity was established through expert review by independent science teachers.

In a study published one year later in 1989, Reiber ran another factorial study 3x2x2 looking at more factors comparing graphic type (animation, static graphic, not graphic) and text type (text, no-text) and practice type (relevant, irrelevant). Additionally within subject he examined factual verses application objectives and near verses far transfer. The overall reliability of the improved dependent measures was .91. In this study "The lack of main effects among the embedded elaboration conditions was surprising." (Reiber, 1989, p. 439) Two years later Reiber (1991) ran a simple version of the study looking only at graphic type (static graphics verses animated graphics) and practice type (simulation verses simulation with questions) found significant effects in favor of animation for near transfer on incidental and intentional questions.

In a 1998 animation study conducted by Park using a computer based instructional unit on electronic circuit repair he reports that static graphics with motion cues can be used instead of full graphical animation as they both were equally effective on the performance and transfer tests that were administered. Will this finding may well be true, Park did not identify the level of educational objectives measured or report any reliability or efforts to support validity on his dependent measures. If the dependent measures were measuring factual or conceptually based knowledge than the finding may offer some direction an support but with out it being reported the readers are left to their own devices and field suffers once again.

"Although much research has been done on the effectiveness of static visuals (Dwyer, 1978), little research has conducted on animation's instructional effects. Empirical data that are available are inconsistent." (Reiber, 1990, p. 78) In the almost 15 years since Reiber wrote this statement, little has changed. More studies have been run, but a general consensus has yet to be reached. This lack of consistency stems from several different sources in both internal and external validity issues. There are the more obvious issues of poor study design, varying and insufficient sample sizes, issues with content relevance, lack of systematic process for placement of treatments, use of assessments with out evidence of -or even reported assessment reliability and content validity. Even with all of these issues surrounding the existing literature, one of the most egregious errors revolves around the lack of definition of the types or methods of animation used and the levels of instructional objectives that were being addressed in the studies. The failure of previous researchers to provide reasoning for placement of the interventions casts yet more doubt on use and application of reported results. With out a systematic process for placement of the animation the net effect may well be supporting an instructional objective that is already sufficiently addressed in the instruction thereby wasting the time and attentional resources of the participants as they would have responded with the correct answer before the added stimulus was introduced.

Literature Review Summary

The numerous studies addressing animation and its effects are asking good questions, but are for the most part lacking in execution in some major areas of concern. Gagne (1985) in his book entitled The Conditions of Learning, proposed that there are different types of learning and that each type of learning requires a different approach. The problem remains that while all the previously mentioned studies are asking good questions they are not providing sufficiently based answers. The need for the systematic placement of independent variables, which previous studies lack, and the use of sound instruments with reported reliability, which previous studies also lack, is paramount in accurate interpretation of results.

How This Study is Different

Where this study set itself apart from the previous studies in the literature is through the systematic placement of the animation in a programmed instructional unit. Further, in this study the researchers have gone to great pains in the pilot studies to refine the programmed instruction so that the participants have the necessary factual and conceptual knowledge to build upon for higher order learning to take place. “An awareness of the fact that there are different kinds of educational objectives each requiring specific prerequisites is crucial to educators who aspire to employ the visual media effectively” (Dwyer, 1978, p. 43). Additionally this study used instruments with previously reported reliability and demonstrated discriminatory power for its dependent measures. It is hypothesized that the use of the animation can reduce the overall cognitive load on the participant there by allowing them to queue to the import information in the instruction and process it more effectively.

Statement of Purpose

Specifically, this study sought to examine the effectiveness with which different types of stimuli, varied animation strategies, can be used to complement a web-based programmed instruction unit to improve learner achievement on four different types of educational objectives.

Design and Methodology

Eight-Eight undergraduate students enrolled in lower-division management, educational psychology, and information sciences technology classes were randomly assigned to one of three treatments in a randomized 1 X 3 post-test only experimental design. The type of animation strategy used was considered to be the independent variable with three levels (control with base animation employed, simple level with base animation and simple reveal, and complex level with base animation and progressive reveal). Dependent variables were the scores achieved on the criterion measures by the participants. Participation in the study was voluntary and at the recruitment sessions the students were able to select their preference of times to report to a list of labs were researchers would be waiting.

Systematic Placement and Development

Two pilot studies and the current study were run from September 2003 through September 2004 to systematically apply the effective use of the animated stimulus in the final iteration reported here. A brief explanation of the two pilot studies and treatments development will be covered in the following section.

Pilot Study #1: (n = 12) This first pilot and genesis for the larger study was done in response to criticism in the literature that one of the reasons for conflicting results was that it was unreasonable to expect any achievement differences at higher levels of educational objectives if the lower levels still were not addressed in sufficient detail as to achieve an acceptable score (average of 90%). The first pilot study was conducted to facilitate the development of the future instructional treatments and test the programmed instructional units effectiveness. This pilot study took the instructional booklet developed by Dwyer and Lamberski in 1977 and ported the treatment over to a web-based instructional unit and added five quizzes to make it into a programmed instructional unit. There was no use of animation and only a recreation of

Figure 1. Sample Pilot Screen Shot



the static visuals used in the original paper based instruction (figure 1). The purpose was to identify items with a high of difficulty (.60 or below on the drawing and identification tests) to determine areas where the static visual instruction might be complemented by a refined programmed instructional unit to further improve student achievement.

Pilot Study #2: (n = 138) This second pilot built off of the lessons learning in first pilot on the programmed instructional unit. Adaptations and corrections were made in the programmed instruction in hopes of pushing achievement even higher. Additionally there were questions to the effectiveness of our programmed instructional unit. If you are building a structure you need a good foundation, the factual and conceptual information is that base for higher order objectives was specifically stressed in the programmed instruction. Simple (base) animations were developed using flash and fireworks for the graphical development. In this study three levels were established: First there was the instructional script from Dwyer and Lamberski (1977), with static visuals only totaling 20 content pages. The second treatment (figure 2) was the programmed instructional version with the same script broken down into no more than 2 parts or concepts per webpage for a total of 28 content pages with embedded quizzes after every 5 or six parts of the heart were covered in the first 17 frames. The

Figure 2. Pilot #2 – Simple Screen Shot

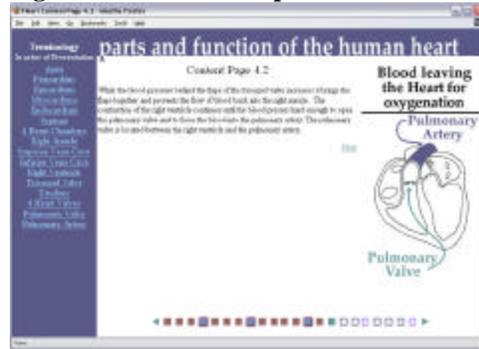
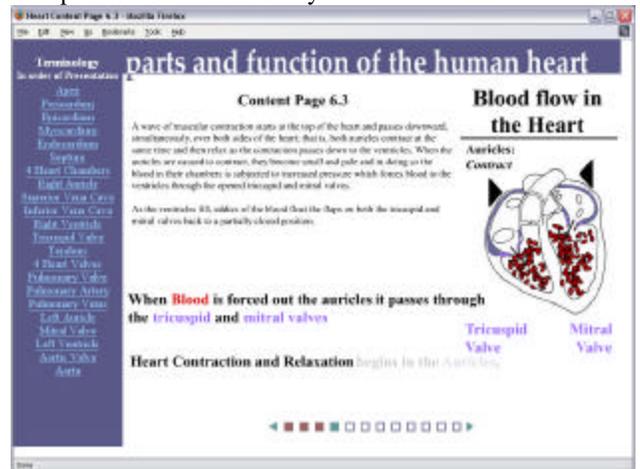
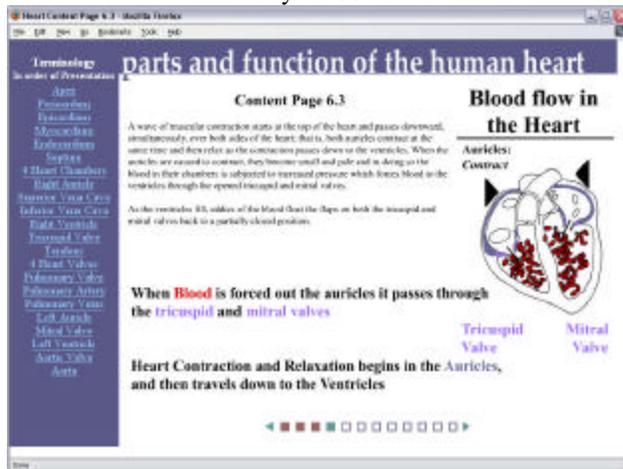


Figure 3. Pilot#2 – Complex Screen Shot



third treatment (figure 3) has the same breakdown and structure as the programmed instructional unit, but added basic animation to help facilitate and reduce the information processing load on the part of the subjects.

After the study was run and the groups of students (control n= 47, programmed instruction n = 47, programmed instruction + animation n = 44) data analyzed five items from the drawing test, nine items from the terminology test, and ten items from the comprehension test and zero items on the identification test were identified with a difficulty of .60 or less and the animation developed for the current study



Current Study: In this iteration of the study there are three levels of animations explored. The complex treatment from pilot study number 2 with the placed animation only at the right of center text area served as the base animation or control group. The second treatment (figure 4) used the same base animation as the control but added another effect of a simple reveal and fade that cycled two times than stayed on the screen until the subject moved on. The third treatment (figure 5) used the same base animation as the control but added another effect of a progressive reveal and fade that cycled two times than stayed on the screen until the subject moved on. The belief is that the forced information processing through the use of progressive display of

information will not only be more effective in directing attention but also establish links in memory that the simple and control treatments may not.

In the complex or progressive reveal treatment the subject was presented three units (a word, or a symbol, or a group of words) of information in succession. The simple reveal treatment had the same information but it was displayed and faded in all at once. Additionally, in the progressive reveal treatment the part of the heart or first part of the statement faded in, then in the on screen animation the corresponding part blinked three times, then the next two sections of the phrase or idea faded in after a short delay. For each thought or idea the process was repeated once for a forced display of the information happening twice on any given screen. At the conclusion of this animated sequence the subject could choose to view the entire animation again or move on to the next webpage. It should be noted that the complex animations, by the very nature of the progressive reveal, required more time to display and averaged around 22 seconds run time for the base animation and the progressive reveal. In the simple treatments where the idea was revealed all at once after the base animation the average run time was around 15 seconds. In the control group where only the base animation was displayed the average was around 11 seconds.

The subjects were given a moderate level of user control, they could replay or view previous animations at any time during the instruction, but were required to view the animation on a screen before being allowed to progress through the lesson. Additionally the environment allowed that subjects to pull up static images of all the parts of human heart after they had been covered in the instructional unit. There was a degree of linearity in programmed instructional part of the materials as there were required to correctly answer 4 out of 6 questions on the quizzes or they were automatically sent back the beginning of that section, generally 3 pages prior. If an acceptable score was achieved on the practice quizzes they were able to progress forward normally.

Dependent Measures

In the pilot studies and in this iteration of the study four criterion measures developed by Dwyer (1965) each consisting of 20-items was employed to assess the participant's achievement. It should be noted that with the exception of the drawing test, which was administered in a paper pencil format, all other assessments and quizzes were administered in an online format to minimize any mixed medium effects between the lesson and the assessment. Reported reliability coefficients (KR-20) and brief explanation adapted from Dwyer (1978, pp. 45-47) of each tool are outlined below:

Drawing Test. (K-R 20: .91) A 20 object queued recall test designed to evaluate student ability to construct and/or reproduce items in their appropriate context. The drawing test provided the students with a numbered list of terms corresponding to the parts of the heart discussed in the instructional presentation. The students were required to draw a representative diagram of the heart and place the numbers of the listed parts in their respective positions. For this test, the emphasis was on the correct positioning of the verbal symbols with respect to one another and in respect to their concrete referents. Conceptual level educational objectives were addressed with this assessment.

Identification Test. (K-R 20: .86) A 20 question - 5 option multiple choice test designed to evaluate student ability to identify parts or positions of an object in the heart. This multiple-choice test required students to identify the numbered parts on a supplied detailed drawing of a heart. Each part of the heart, which had been discussed in the presentation, was numbered on the drawing. The objective of this test was to measure the ability of the student to use visual cues to discriminate one structure of the heart from another and to associate specific parts of the heart with their proper names. Factual level educational objectives were addressed with this assessment.

Terminology Test. (K-R 20: .87) A 20 question - 5 option multiple choice test designed to measure knowledge of specific facts, terms, and definitions. This multiple-choice test consisted of items designed to measure knowledge of specific facts, terms, and definitions. The objectives measured by this type of test are appropriate to all content areas that have an understanding of the basic elements as a prerequisite to the learning of concepts, rules, and principles. Specifically, conceptual level educational objectives were addressed with this assessment as a spring board for high level objectives.

Comprehension Test. (K-R 20: .84) A 20 question - 4 option multiple choice test designed to measure a type of understanding in which the individual can use the information being received to explain some other phenomenon. This multiple-choice test consisted of items where given the location of certain parts of the heart at a particular moment of the heart beat cycle, the student was asked to determine the position of other specified parts in the heart at the same time. This test required that the students have a thorough understanding of the heart, its parts, its internal functioning, and the simultaneous processes occurring

during the systolic and diastolic phases of the heart beat. The comprehension test was designed to measure a type of understanding in which the individual can use the information being received to explain some other phenomenon and addressed the rule / procedural knowledge educational objectives.

Total Criterion Score. (K-R 20: .95). All items contained in the previously noted individual tests were combined into a composite test score to measure overall learning and understanding.

Validity of Dependent Measures

Upon examination of the content pages, instructional script and materials *face validity* is believed to be evident by the researchers. Given that the tests were textually identical in the web based version used in this study *content* and *construct validity* for dependent measures is assumed as part of the original instruments umbrella. An explanation of the process used in establishing validity is covered in detail greater in Dwyer 1978 and in his 1965 thesis. In short the instructional materials and dependent measures were put through content expert and educational expert review with objectives and descriptions were developed and employed during test development phase by Dwyer originally in 1965 as part of his doctoral thesis.

Results

For statistical analysis the alpha level was set a priori at the 0.05 level, and an ANOVA was conducted on each dependent measure. Where significant differences are obtained, Scheffe or Dunnett C, according to Levene's test of homogeneity of variance, follow –up procedures were implemented. From the outset of the study it was the intention of the researchers to analyze the data from each criterion measure individually and collectively and in an effort to comprehensively examine the effects the animation. In the table 1 below the descriptive statistics for all items are displayed.

| Table 1. Means and Standard Deviations for Each Treatment on Each Dependent Measure | | | |
|---|--|--------------------------------------|---|
| Dependent Measure Mean # Correct Standard Deviation. | Base Animation Control Group (n=29) | Base Animation with Reveal (n=31) | Base Animation with Progressive Reveal (n=28) |
| Drawing | | | |
| Mean | 15.97 | 16.00 | 18.07 |
| S.D. | 3.26 | 3.61 | 2.26 |
| Identification | | | |
| Mean | 17.62 | 18.35 | 18.45 |
| S.D. | 2.47 | 1.70 | 1.99 |
| Terminology | | | |
| Mean | 11.93 | 13.65 | 15.10 |
| S.D. | 5.03 | 3.96 | 3.30 |
| Comprehension | | | |
| Mean | 11.00 | 12.55 | 12.79 |
| S.D. | 3.64 | 3.67 | 3.51 |
| Total Criterion Score | | | |
| Mean | 56.52 | 45.55 | 64.75 |
| S.D. | 11.90 | 7.76 | 8.75 |

Tables 2 and 3 show the results of the One-Way Anova and the appropriate follow up tests used. Significant effects were found on the Drawing ($F=4.29$ df (2,85), $p=.02$) and Terminology ($F=4.25$ df (2,86), $p=.02$) and Total Criterion ($F=29.767$ df (2,85), $p=.001$). In the case of the drawing test, after using Scheffe post hoc test it was determined that the progressive reveal group did significantly better than both the simple reveal and control groups. For the Terminology test, after using Dunnett C follow up test because it failed the Levene test of homogeneity it was determined that the progressive reveal group statistically performed significantly better than the control group with base animation only. When looking at the Total Criterion measure the assumption of Levene's test of homogeneity test was not supported and Dunnett C was implemented on the results. The results were statistically significant in all comparisons and best illustrated by Figure 6.

Figure 6. Total Criterion Means Plot

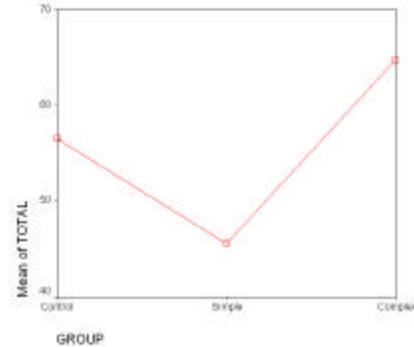


Table 2. Results of Analysis of Variance Across All Items

| | | Sums of Squares | df | Mean Square | F | sig |
|-----------------------|----------------|-----------------|----|-------------|-------|-------------|
| Drawing | Between groups | 83.26 | 2 | 41.63 | 4.29 | .016 |
| | Within Groups | 824.82 | 85 | 9.70 | | |
| | Total | 908.08 | 87 | | | |
| Identification | Between groups | 12.00 | 2 | 6.00 | 1.40 | .253 |
| | Within Groups | 369.10 | 86 | 4.29 | | |
| | Total | 381.10 | 88 | | | |
| Terminology | Between groups | 146.26 | 2 | 73.13 | 4.25 | .017 |
| | Within Groups | 1481.65 | 86 | 17.23 | | |
| | Total | 1627.91 | 88 | | | |
| Comprehension | Between groups | 55.20 | 2 | 27.60 | 2.189 | .118 |
| | Within Groups | 1084.44 | 86 | 12.61 | | |
| | Total | 1139.64 | 88 | | | |
| TOTAL | Between groups | 5491.29 | 2 | 2745.64 | 29.77 | .000 |
| | Within Groups | 7840.17 | 85 | 92.234 | | |
| | Total | 13331.46 | 87 | | | |

Table 3. Analysis of Variance Follow Up Tests With Significance All Items

| Test | Follow Up Used | Group 1 | Group 2 | Mean Difference |
|--------------------|-------------------|---------|---------|-----------------|
| Drawing | Scheffe .13 | Complex | Control | 2.11 |
| | | | Simple | 2.07 |
| Terminology | Dunnett C .001 | Complex | Control | 3.17 |
| TOTAL | Dunnett C .010 | Complex | Simple | 8.23 |
| | | | Control | 19.20 |
| | | Control | Simple | 10.97 |

Also of interest was the analysis run on just the items addressed in the treatments. For the Drawing test there were five items that had an item difficulty less than .60 after an item analysis. Similarly the Terminology and Comprehension tests had nine and ten items respectively that were specifically targeted. Table 4 displays the descriptive statistics for the items addressed. Table 5 shows the results of the analysis of variance and table six displays the appropriate follow-up tests and their significant results. It should be noted

that there were no items on the identification test with a difficulty level less than .60 and therefore were not addressed. Also the terminology test was found significant with comparing all 20 items on the test but when looking at the 9 items addressed specifically it just misses the .05 alpha level coming in with $p = .075$.

Table 4. *Means and Standard Deviations for Individual Items Addressed on Each Dependent Measure*

| Dependent Measure (# of items address) | Base Animation Control Group (n=29) | Base Animation with Reveal (n=31) | Base Animation with Progressive Reveal (n=28) |
|--|-------------------------------------|-----------------------------------|---|
| Mean # Correct | | | |
| Standard Deviation. | | | |
| Drawing (5 Items) | | | |
| Mean | 3.28 | 3.81 | 4.50 |
| S.D. | 1.60 | 1.28 | 0.73 |
| Identification (0 Items) | N/A | N/A | N/A |
| Terminology (9 Items) | | | |
| Mean | 4.14 | 4.77 | 5.52 |
| S.D. | 2.49 | 2.29 | 2.01 |
| Comprehension (10 Items) | | | |
| Mean | 5.14 | 5.06 | 5.21 |
| S.D. | 1.66 | 5.21 | 1.78 |
| Total Score | | | |
| Mean | 12.55 | 13.65 | 15.32 |
| S.D. | 4.56 | 3.63 | 3.61 |

Table 5. *Results of Analysis of Variance Addressed Items Only*

| | | Sums of Squares | Df | Mean Square | F | Sig |
|-----------------------------------|----------------|-----------------|----|-------------|------|-------------|
| Drawing | Between groups | 21.45 | 2 | 10.72 | 6.62 | .002 |
| | Within Groups | 137.63 | 85 | 1.62 | | |
| | Total | 159.08 | 87 | | | |
| Identification Terminology | None Targeted | | | | | |
| | Between groups | 27.64 | 2 | 13.82 | 2.68 | .075 |
| | Within Groups | 444.11 | 86 | 5.16 | | |
| | Total | 471.75 | 88 | | | |
| Comprehension | Between groups | 0.31 | 2 | 0.15 | 0.05 | .951 |
| | Within Groups | 258.38 | 86 | 3.00 | | |
| | Total | | 88 | | | |
| TOTAL | Between groups | 110.72 | 2 | 55.36 | 3.53 | .034 |
| | Within Groups | 1332.38 | 85 | 15.68 | | |
| | Total | 1443.09 | 87 | | | |

Table 6. *Analysis of Variance Follow Up Tests With Significance Addressed Items Only*

| Test | Follow Up Used | Group 1 | Group 2 | Mean Difference |
|----------------|----------------|---------|---------|-----------------|
| Drawing | Dunnett C | Complex | Control | 1.22 |
| | .004 | | | |
| TOTAL | Scheffe | Complex | Control | 2.77 |
| | .246 | | | |

Discussion

From the initial pilot study run in the fall of 2003 there has been marked improvement in the raw mean scores with each successive iteration beyond simple static visuals, first using programmed instruction, and then adding in basic animation, and finally with the additional animation strategy of simple reveal vs. progressive reveal. Results of this study have shown some statistically significant findings for some educational variable

levels and on the whole but not for all educational levels.

The results of this study indicate that the use of animation when properly designed and positioned is an important instructional variable for complementing web-based instruction. However, it should not be seen as a panacea that can cure all the ills of instruction and education. Results have also shown that the use of animation is not equally effective for facilitating achievement across all of the different levels of educational objectives. Even when subjects have the prerequisite knowledge required to build upon for success at the higher levels achievement is not guaranteed. In the case of this study the researcher went to great pains to ensure that lower level objectives were addressed in sufficient detail and we believe that we succeeded with the control group averaging almost 80 and 90 percent on the drawing and identification tests respectively.

One interesting note was the large drop in the overall and addressed items mean scores exhibited by the simple reveal group. Possible explanations of this apparent anomaly vary and were a frequent topic of discussion by the researchers. One suggestion is that of a statistical anomaly. We randomly assigned all subjects to treatments but there is still a chance that it was a random error. We are fairly certain that we have avoided common pitfalls in our research design but a replication study is currently planned for the spring of 2005 and this competing explanation can be explored in more detail then. Another possible explanation discussed by the group was lack of motivation by the individuals randomly assigned to this treatment, but once again we used random assignment this should have distributed this equally across groups. Further, upon inspection of the data and answers keyed into the assessments there did not appear to be any obvious patterns or clues indicating an obvious lack of effort by students. Participants were also allowed to exit the study at anytime if they so chose. No one exercised this option but all subjects were made aware of it at the onset when they read and signed their informed consent forms.

One possibility that seemed to resonate with researchers dealt with the level of cognitive processing load, part of the underlying theoretical basis for the study, was exceeded. Even though the subjects in the simple reveal and progressive viewed the same content and all textual and graphical information was identical, the presentation of information in the simple reveal increased the cognitive processing load beyond their individual thresholds. It is suggested that the subjects could no longer focus and direct attention and that onslaught of information that was taken in for processing was quickly disposed of. While experiencing this process of overload the subjects actually missed the other bits of information presented in all treatments that the control and complex groups were able to attune to. In future studies qualitative data and questions asking the students to rate the data presentation may be included but make the assumption that the subject is aware of the overload, which may or may not be the case.

Another interesting point that needs to be explored further is that when all items in the comprehension dependent measure the analysis of variance returned an F-ratio of 2.19, $p=.12$ but when compared to items addressed the F-ratio is .05 and $p=.951$. When viewed in tandem it appears that most if not all of the variance increase was on the ten out of twenty items that weren't specifically targeted or addressed by treatments. Further analysis is required to address this question.

What remains to be seen is the transfer and replication of these findings in future studies. Transfer of the findings of this study can be logically extended other domain areas where information is organized in a hierarchical manner. However, widespread generalization of findings is a dangerous proposition; never-the-less, implications for practitioners can be generated so long as they are 'taken with a grain of salt' and not assumed to be fact but merely a possible lens from which to view a problem. The use of animation increased overall achievement on the parts of the learners due in large part to effects on the factual and conceptual levels. Given the cost of development for use of animation this should be considered within a contextual frame work of what is it worth to you? If similar findings can be achieved with well designed and systematically placed static visuals the benefits outweigh the costs. There were clear areas where progressive reveal animation strategies were better in facilitating achievement. This relates to the clarity of the relationship between the way the animation was designed and information presented. When choosing to utilize animation, specific attention needs to be devoted to the cognitive load on the individual. If items require too great a processing time than they can do more detriment than not using them at all in an instructional module.

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Design and Architecture of Collaborative Online Communities: A Quantitative Analysis

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Abstract

This paper considers four aspects of online communities. Design, mechanisms, architecture, and the constructed knowledge. We hypothesize that different designs of communities drive different mechanisms, which give rise to different architectures, which in turn result in different levels of collaborative knowledge construction. To test this chain of hypotheses, we analyzed the recorded responsiveness data of two online communities of learners having different designs: a formal, structured team, and an informal, non-structured, Q&A forum. The designs are evaluated according to the Social Interdependence Theory of Cooperative Learning. Knowledge construction is assessed through Content Analysis. The architectures are revealed by Statistical Analysis of p Markov Models for the communities. The mechanisms are then identified by matching the predictions of Network Emergence Theories with the observed architectures. The hypotheses are strongly supported. Our analysis shows that the minimal-effort hunt-for-social-capital mechanism controls a major behavior of both communities: negative tendency to respond. Differences in the goals, interdependence and the promotive interaction features of the designs of the two communities lead to the development of different mechanisms: cognition balance and peer pressure in the team, but not in the forum. Exchange mechanism in the forum, but not in the team. In addition, the pre-assigned role of the tutor in the forum gave rise to its responsibility mechanism in that community, but not in team community. These differences in the mechanisms led to the formation of different sets of virtual neighborhoods, which show up macroscopically as differences in the cohesion and the distribution of response power. These differences are associated with the differences in the buildup of knowledge in the two communities. The methods can be extended to other relations in online communities and longitudinal analysis, and for real-time monitoring of online communications.*

Introduction

Building communities is recognized as an essential strategy for online learning. An online community consists of actors who develop certain relations among themselves. For example, some actors only read what others write; some respond to queries posted by others and some influence others to do something (for example to access a web page), etc. This simple observation led us to adopt a network abstraction to describe online communities. A network is a set of actors – members of communities, groups, web-pages, countries, genes, etc., with certain possible relations between pairs of actors. The relations may – or may not – be hierarchical, symmetrical, binary, or other. Network abstraction is thus very flexible.

Social Network Analysis (Wasserman and Faust 1999) is a useful tool for studying relations in a network. It is a collection of graph analysis methods developed by researchers to analyze networks which consist of precise mathematical definitions of certain network structures and the methods to calculate them. Examples of network structures are *cohesiveness* and *transitivity*: cohesiveness measures the tendency to form groups of strongly interconnected actors; transitivity measures the tendency to form transitive triad relations (if i relates to j and j relates to k, then i necessarily also relates to k). SNA has been utilized to analyze networks in various areas, whose actors include politicians (Faust, Willet et al. 2002), the military (Dekker 2002), adolescents (Ellen, Dolcini et al. 2001), multi-national corporations (Athanassiou 1999), families (Widmer and La Farga 1999), and terrorist networks (van Meter 2002). SNA methods were introduced to online communities research in (Garton, Haythornthwaite et al. 1997). Since then several scholars have demonstrated the applicability of SNA to specific collaborative learning situations (Haythornthwaite 1998; Wortham 1999; Lipponen, Rahikainen et al. 2001; Cho, Stefanone et al. 2002; de Laat 2002; Martinez, Dimitriadis et al. 2002; Reffay and Chanier 2002; Aviv 2003).

Macro-level SNA identifies network macro-structures such as *cohesiveness*. Micro level SNA reveals significant underlying microstructures, or *neighborhoods*, such as transitive triads (Pattison and Robbins 2000;

Pattison and Robbins 2002). The identified neighborhoods are the basis for revealing theories that explain their emergence (Contractor, Wasserman et al. 1999). For example, the theory of cognitive balance explains the emergence of transitive triads, which underlies the macroscopic phenomenon of cohesiveness. The precise definition of a neighborhood will be given in section 2.

We examine online communities of learners according to the constructivist perspective (Jonassen, Davidson et al. 1995). Rafaeli (Rafaeli 1988) emphasized that constructive communication is determined by its responsiveness. Accordingly, we analyze the network structures of the responsiveness relation between actors in the online communities. Previous work (Aviv, Erlich et al. 2003) demonstrated that certain macrostructures (cohesion, centrality and role groups) are correlated with the design of the communities and with the quality of the constructed shared knowledge. In this study, we extract the micro-level neighborhoods of the same communities. Our goal is to reveal the underlying theoretical mechanisms that control the dynamics of the communities and to correlate them with the design parameters and with the quality of the knowledge constructed by the communities.

Architecture of a Community

An online community is modeled as a network of actors. Every ordered pair of actors has a potential *response tie relation*. The response tie between actor i and actor j is *realized* if i responded to at least one message sent by j to the community; otherwise the response tie is not realized. In addition, a (non-directed) *viewing relation* is realized between a pair of actors if they read the same messages. In a broadcast community, a realized response tie relation is also a realized viewing tie. The reverse is not necessarily true.

A *virtual neighborhood (VN)* is a sub-set of actors, endowed with a set of prescribed possible response ties between them, all of which are pair-wise statistically dependent. We identified the significant VNs of a community by fitting a p^* stochastic Markov model (Wasserman and Pattison 1996; Robins and Pattison 2002) to the response tie data. In this model, every pair of response ties in a VN has a common actor, which is why they are interdependent. Same topology VNs are aggregated into a class of VNs. In the model every possible class is associated with a *strength parameter* that measures the tendency of the network to realize VNs of that class. The basic ideas and the formulas of the p^* Markov model are elaborated in (Wasserman and Pattison 1996; Robins and Pattison 2002). The model equations are presented in the Appendix. Examples of Markov VNs are presented graphically in Figure 1.

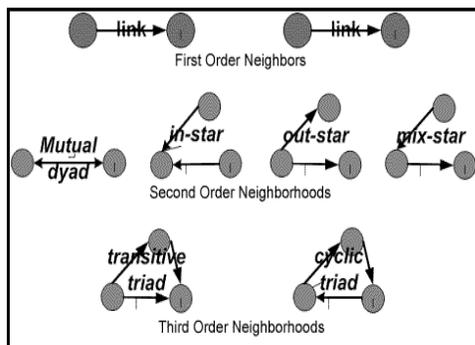


Figure 1. Virtual neighborhoods

In this research we consider the set of Markov classes of VNs listed in Table 1.

| VN Class | Participating Actors & Prescribed Response Ties |
|--------------------------|--|
| <i>link</i> | All pairs: $(i? j)$ or $(j? i)$ |
| <i>resp_i</i> | All pairs: $(i? j)$ fixed i |
| <i>trigg_i</i> | All pairs: $(j? i)$ fixed i |
| <i>mutuality</i> | All pairs: $(i? j)$ and $(j? i)$ |
| <i>out-stars</i> | All triplets: $(i? j)$ and $(i? k)$ |
| <i>in-stars</i> | All triplets: $(i? j)$ and $(k? j)$ |
| <i>mixed-stars</i> | All triplets: $(i? j)$ and $(j? k)$ |
| <i>transitivity</i> | All triplets: $(i? j)$ and $(j? k)$ and $(i? k)$ |

Table 1. *Classes of VNs*

Tendencies to form VNs of a certain class are the result of the underlying mechanisms. Several candidate mechanisms, postulated by certain network emergence theories are briefly described below. See (Monge and Contractor 2003) for an extensive survey.

The theory of social capital (Burt 1992; Burt 2002) postulates efficient connectivity in the hunt for a social capital mechanism. In an online *broadcast* community, efficiency means forming zero response ties because a response tie is a redundant viewing tie, so actors prefer to remain passive. This mechanism predicts a tendency for not creating VNs of any class. Thus, other mechanisms are responsible for creating responsiveness.

Exchange and resource dependency theories (Homans 1958; Willer 1999) postulate an information exchange mechanism, in which actors prefer to forge ties with potentially “resource-promising” peers. This mechanism creates tendency for VNs of class *mutuality*.

The theory of generalized exchange (Bearman 1997) postulates an information exchange mechanism via mediators. This theory then predicts tendencies for n-link cycles, in particular VNs from the *cyclicality* class.

Theories of collective action (Marwell and Oliver 1993) postulate a social pressure mechanism that induces actors to contribute to the goal of the community if threshold values of “pressing” peers, existing ties, and central actors are met (Granovetter 1983; Valente 1996). In that case, actors will respond to several others, forging *out-stars* VNs.

Contagion theories (Burt 1987; Contractor and Eisenberg 1990) postulate that the exposure of actors leads to a contagion mechanism that uses social influence and imitation to create groups of equivalent actors with similar behaviors (Carley and Kaufer 1993). Contagion predicts a tendency for VNs of the various *star* shaped classes.

| Theories | Predicted Tendencies | Hypotheses |
|-----------------------------|--|---|
| Social capital | Few single tie links | H1: $link < 0$ |
| Collective action | If thresholds met then respond to several others | H2: if thresholds met then $out-stars > 0$ |
| Exchange | Tendency to reciprocate | H3: $mutuality > 0$ |
| Generalized exchange | Tendency to respond cyclically | H4: $cyclicality > 0$ |
| Contagion | Respond to same as others | H5: $out-stars > 0$; $in-stars > 0$; $mixed-stars > 0$ |
| Cognitive consistency | Respond via several paths | H6: $transitivity > 0$ |
| Uncertainty reduction | Attract many responses | H7: $in-stars > 0$ |
| Exogenous factors: Students | No tendencies to respond/trigger | H8: $\{resp_i = 0 \mid i ? \text{students}\}$ H9: $\{trigg_i = 0 \mid i ? \text{students}\}$ |
| Exogenous factors: Tutors | Personal tendencies to respond/trigger | H10: $\{resp_i > 0 \mid i = \text{tutor}\}$ H11: $\{trigg_i > 0 \mid i = \text{tutor}\}$ |

Table 2: *Research Hypotheses*

Theories of cognitive balance (Cartwright and Harary 1956; Festinger 1957; Harary, Norman et al. 1965) postulate a cognition balance mechanism with a drive to overcome dissonance and achieve cognition consistency among actors. This drive is implemented by *transitivity* VNs.

The uncertainty reduction theory (Berger 1987) postulates drives in actors to forge links with many others to reduce the gap of the unknown between themselves and their environment; this theory predicts a tendency to create *in-stars* (responses to triggering actors) VNs.

Finally, responsibilities of actors influence their residual personal tendencies toward response ties. In this study, students did not have pre-assigned responsibilities, predicting that the students’ VNs $resp_i$ and $trigg_i$ will be insignificant. The tutors’ residual tendencies will be significant, due to their roles.

The theories, and predicted tendencies stated as Research Hypotheses, are presented in Table 2.

The Analysis

We analyzed recorded transcripts of two online communities – two communities of students at the Open University of Israel. These communities were established for 17 weeks during the Fall 2000 semester (19 participants) and the Spring 2002 semester (18 participants) as part of an academic course in Business Ethics. Each community included one tutor. The designs of the activities of the two communities were different. The

Fall 2000 community was designed as a goal-directed collaborative team, whereas the Spring 2002 community was a Q&A forum. Hence we have labeled the communities “team” and “forum,” respectively. The data is available at <http://telem.openu.ac.il/courses> (password protected).

The *team* community engaged in a formal debate. Participants registered and committed to active participation, with associated rewards in place. Students took the role of an "advisory committee" that had to advise a company on how to handle the business/ethical problem of cellular phone emissions. The debate was scheduled as a 5-step process of moral decision-making, with predefined goals (Geva 2000). A unique feature of the team community was that the goals of the debate were to reach consensus up to the point of writing a joint proposal to an external agency. The *forum* community was open to all students in the course. Participants were asked to raise questions on issues relating to the course. We followed the social interdependence theory of cooperative learning (Johnson and Johnson 1999) to characterize the communities according to four groups of parameters: interdependence, promotive interaction, pre-assigned roles, and reflection. The two communities differ in most of the design parameters. Table 3 summarizes the differences between the designs of the two communities.

| Parameter | Team | Forum |
|--|------|-------|
| Registration & commitment | Yes | No |
| Interdependence: deliverables | Yes | No |
| Interdependence: tasks & schedule | Yes | No |
| Interdependence: resources | Yes | No |
| Reward mechanism | Yes | No |
| Interdependence: reward | No | No |
| Promotive interaction: support & help | Yes | No |
| Promotive interaction: feedback | Yes | No |
| Promotive interaction: advocating achievements | No | No |
| Promotive interaction: monitoring | Yes | No |
| Pre-assigned roles: tutor | No | Yes |
| Pre-assigned roles: students | No | No |
| Reflection procedures | No | No |
| Individual accountability | Yes | No |
| Social skills | Yes | Yes |

Table 3: *Design of Communities*

Previous analysis (Aviv, Erlich et al. 2003) analyzed the constructed knowledge and the macro-structures of the communities. The analysis revealed that the team community exhibited high levels of constructing knowledge, developed a mesh of interlinked cliques, and that many participants took on bridging and triggering roles while the tutor remained on the side. The forum community did not construct knowledge, cohesion was dull, and only the tutor had a special role. In the team community, many students participate in many cliques, but the tutor belongs to only one clique. In the forum community, only one student and the tutor belong to the two cliques that developed. In addition, participants in the team community shared the role of responders among them, whereas in the forum community only the tutor was a central responder.

The p^* model of the team community has 43 classes of virtual neighborhoods, each with its explanatory and parameter: 18 $resp_i$, 18 $trigg_i$, *link*, *mutuality*, *transitivity*, *cyclicity*, and the three *stars*. Similarly, the model of the forum community includes 45 classes of virtual neighborhoods: 19 $resp_i$, 19 $trigg_i$, *link*, *mutuality*, *transitivity*, *cyclicity*, and the three *stars*. The explanatories count the number of virtual neighborhoods that were completely realized in the networks. The strength parameters represent the tendency to create (or not) neighborhoods from the classes.

The analysis of the p^* model consists of two steps: In the first step we calculate the explanatories. This was performed using the PREPSTAR program (Anderson, Wasserman et al. 1999). The second step involves solving the binary logistic regression (equation A5). The solution provides an approximate estimate for the strength parameters. This step was performed with SPSS. Details are provided in the Appendix. We configured the SPSS binary logistic procedure to work in forward steps, adding one class of virtual neighborhoods (i.e., its explanatory) at a time, according to its significance, where significance was assessed by the decrements in the PLLD (Pseudo Log-Likelihood Deviance). The analysis stops when no more significant explanatory variables

can be identified.

The analysis revealed three significant classes of virtual neighborhoods for the team community, and four significant classes of virtual neighborhoods for the forum community. The PLLD estimates of the strength parameters are presented in Table 4.

| Class | θ_K | SE | Wald | p | $\exp(\theta_K)$ |
|--------------------------|------------|------|-------|------|------------------|
| Team | | | | | |
| <i>link</i> | - | .32 | 97.5 | .000 | .043 |
| | 3.1 | | | | |
| | 3 | | | | |
| <i>out-star</i> | .18 | .06 | 9.6 | .002 | 1.199 |
| <i>transitivity</i> | .31 | .06 | 23.9 | .000 | 1.366 |
| Forum | | | | | |
| <i>link</i> | - | .8 | 10.29 | .001 | .076 |
| | 2.6 | | | | |
| <i>resp₁₈</i> | 6.1 | .12 | 26.78 | .000 | 456.28 |
| <i>mutuality</i> | 6.2 | 1.38 | 20.61 | .002 | 519.92 |
| <i>ty</i> | | | | | |
| <i>in-stars</i> | - | .91 | 12.39 | .000 | .041 |
| | 3.2 | | | | |

Table 4: Revealed VNs

In Table 4, θ_K is the MPLE (maximal pseudo-likelihood estimator) for the strength parameter of class K of VNs; SE is an estimate of its associated standard error, $\exp(\theta_K)$ measures the increase (or decrease, if θ_K negative) in the conditional odds of creating a response tie between any pair of participants if that response tie completes a new VN of class K.

We tested the hypotheses that $\theta_K = 0$ by the Wald parameter $(\theta_K/SE)^2$ which is assumed to have chi square distribution. Table 3 shows that all these null hypotheses were rejected with extremely small p values. The statistical distributions of the MPLEs and the Wald parameters are unknown (Robins and Pattison 2002), so inferences are not precise in the pure statistical sense.

Results

Few classes of VNs are significant: 3 in the Team, 4 in the Forum. In particular, the personal classes of VNs of students, *resp_i* and *trigg_i*, are *not* significant. This corroborates hypotheses H8 and H9. The relative importance of the classes of VNs is depicted by their contributions to the goodness of fit of the Markov models. These are presented in Figure 2.

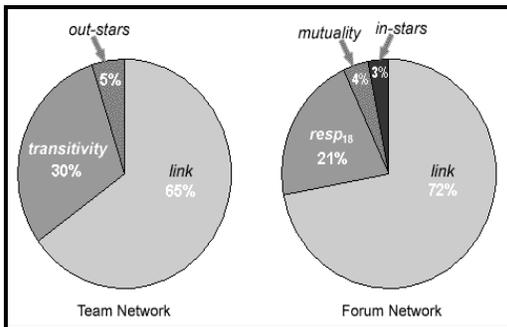


Figure 2. Relative importance of VNs

Figure 2 shows that the global class *link* of the single response tie virtual neighborhoods is the most significant in both communities: 65% and 72% of the goodness of fit are explained by the tendencies associated with this class. Table 5 shows that in both communities the strength parameter θ of the *link* class is negative. This means that the major observed phenomenon in both communities is a significant tendency for not creating

single response tie neighborhoods – the phenomenon of lurking. As elaborated above, this can be explained by basic self interest – minimizing the effort required to forge a response tie vs. the possible social capital reward, given that every response tie is a redundant viewing tie. This observation is in accordance with hypothesis H1. Note that the fact that response ties are redundant viewing ties is a feature of every broadcast community, irrespective of the design of the community.

By itself, the negative tendency to create virtual neighborhoods of class *link* will give rise to a community of non-responsive isolates. The actual responsiveness is formed by the other neighborhoods. These neighborhoods are quite different in the two communities. The significant virtual neighborhoods in the team community are from the global classes *transitivity* and *out-stars*. The significant virtual neighborhoods in the forum community are from the personal class *resp*₁₈, and from the global classes *mutuality* and *in-stars*. In the subsections below, we will consider each of these virtual neighborhoods.

The goodness of fit of the Markov model for the team community increases by 30% when the *transitivity* class of virtual neighborhoods is included. In this community there is a positive tendency to create transitive virtual neighborhoods. This means that in the team community, the likelihood of setting up a response tie from any actor *i* to any other actor *j* is enhanced (by 1.37) if that tie completes a transitive triangle virtual neighborhood. This is relative to the likelihood of setting up any other neighborhood. No such preference exists in the forum community. Hypothesis H6 – the tendency for creating virtual neighborhoods of the *transitivity* class is positive – is therefore accepted for the team community but rejected for the forum community.

The tendency to create transitive structures can be explained by cognitive balance theory. It seems that the design of the team community leads to the cognition balance mechanism, by which dissonance between actors and between their perceptions of objects is resolved by balanced paths of communication. This can be attributed to the interdependence built into the design of the community and to the particular goal which forced the participants to reach consensus during the online debate (in order to submit joint proposals). The forum community, on the other hand, was a series of typical Q&A sessions. Here each of the students participating was interested at a certain point in time in a specific issue usually related to an assignment. The scope of the issue was, in many cases, limited; it interested few students. Other issues, or even related concepts not directly connected to the query, were less important to the student who asked the question, let alone to other students. The lifetime of each issue was short (usually until the assignment due date). There was no drive to settle conceptual inconsistencies regarding past issues, or dissonance in perceptions regarding others. Thus, no cognition balance mechanism was needed and none was established.

Introducing the personal class *resp*₁₈ to the model of the forum community increases its goodness of fit by 21%. This class includes all the virtual neighborhoods of single response ties initiated by N18 – the tutor. This means that the residual tendency of N18 to respond – above and beyond the common tendency accounted for by *link* – is significant. Specifically, in the forum community the odds of setting up a response tie (*i* → *j*) increases (by 1,280) if actor *i* is N18, the main responder in this community. In contrast, the personal class of the tutor's responses in the team community, *resp*₁, is statistically insignificant. *resp*₁ neighborhoods are therefore not significant in the explanation of the behavior of the team community. This simply means that the tutor of the team community, P1, showed no tendency to respond. Hypothesis H10 – the tutor's residual responsiveness is significant – is accepted for the forum community but rejected for the team community.

This difference is attributed to the difference in the role-assignment design of the two communities, which leads to different responsibility mechanisms. The tutor of the forum community was assigned the job of responder. The tutor of the team community was – deliberately – not assigned that role. This results in a difference in their responsibility mechanisms which leads to the difference in their tendency to create the personal class of virtual neighborhoods. A similar observation, mentioned above, is that none of the students in either community showed a significant personal residual tendency to respond, which supports hypothesis H8. This again is attributed to the fact that students in both communities were not controlled by responsibility mechanisms because they were not assigned any particular role. Similarly, in both communities every actor could trigger others by posting a question. No student was pre-assigned the role of trigger. This is reflected in the insignificance of the *trigg*_{*i*} class of neighborhoods (consisting of a single response tie towards actor *i*), in agreement with hypothesis H9.

We see that the tutors in both communities had no significant tendency to trigger others, contrary to assumption H11. Checking the designs of the two communities, we see that the tutors' behavior was not controlled by responsibility mechanisms, but by other factors. In the forum community, the tutor served only as a helper or responder; no initiation of discussion was designed; accordingly, no triggering role was assigned to the tutor. In the team community, discussion was initiated by the tutor, but the design of the collaborative work dictated that the tutor should step aside. The tutor was therefore not responsible for triggering others.

Incorporating the *out-stars* class increases the goodness of fit of the Markov model for the team community by 5% but has no significance for the forum community. This means that in the team community the likelihood of forging a response tie from any actor *i* to an actor *j* is enhanced (by 1.2) if the tie completes an *out-star*. No such tendency is observed in the forum community.

The tendency to create *out-stars*, that is, to forge more than one response tie can be explained by the contagion theory (hypothesis H5) and the theory of collective action (hypothesis H2). The theory of contagion predicts tendencies toward both *in-stars* and *mixed-stars*, but these predictions were not supported by the data of either community. Thus, hypothesis H5 was rejected for both communities. In general, contagion by exposure, as found in friendship relations, is a time consuming process, which presumably could not be developed during the short lifetime of the communities (one semester).

The hypothesis concerning the theory of collective action, H2, was accepted for the team community but rejected for the forum community. This theory assumes the development of peer pressure, provided that the community parameters of density and centrality are above threshold values. This condition is fulfilled for the team community, but not for the forum community, as can be seen in Figures 2 and 3. In general, developing peer pressure is not trivial, as it has to overcome the basic tendency for lurking. In the team community, appropriate initial conditions – commitments, interdependence, and in particular promotive interactions – were set up, and peer pressure was maintained by the tight schedule of common sub-goals imposed on the community. None of these features were designed into the forum community, hence the density and the number of central actors did not reach the thresholds required for peer pressure to work. In the absence of peer pressure, no drive for collective action arouse, which is the reason for the non-significance of the *out-stars* class of virtual neighborhoods in the forum community. The differences between the two communities in the tendencies for *out-stars* is explained quite well by the theory of collective action.

The *mutuality* class of virtual neighborhoods accounts for 4% of the goodness of fit of the Markov model for the forum community. It has no significance for the team community. This means that in the forum community the likelihood of setting up a response tie from any actor *i* to any actor *j* is enhanced (by 5,000) if that tie closes a mutual tie. (As stated elsewhere in this paper, the actual number is not precise). This is relative to the likelihood of setting up a tie which is not part of a mutual tie. No such tendency for *mutuality* neighborhoods exists in the team community. Thus, hypothesis H3 is accepted for the forum community but rejected for the team community.

Hypothesis H3 predicts a tendency for *mutuality* virtual neighborhoods on the basis of the exchange mechanism postulated by the theories of exchange and resource dependency. Actors select their partners for response according to their particular resource-promising state. In the forum community the actors prefer to forge response ties (if at all) with partner(s) who usually respond to them – which in this community is the tutor. The tutor is an a priori resource-promising actor as result of her pre-assigned role. This kind of exchange calculus is not developed in the team community because actors in that community cannot identify a priori resource-promising actors. Instead, actors in the team community chose another response policy, governed by the cognition balance mechanism, of responding via transitive triads, as we saw above.

The *in-stars* class of neighborhoods accounts for 3% of the goodness of fit of the Markov model to the forum community but has no significance in the team community. From Table 5 we see that in the forum community *in-stars* is negative. In the forum community, the likelihood of setting up a response tie from *i* to *j* decreases if this tie complements an *in-star* neighborhood, that is, if some other actor already has a response tie with *j*. Contagion theory and the theory of uncertainty reduction both predict a positive tendency for *in-stars* virtual neighborhoods. This prediction is not fulfilled. Hypotheses H5 and H7 are rejected for both communities. As mentioned above, the fact that a contagion process did not develop can probably be attributed to the short lifetime of the communities (one semester). In addition, it seems that there was no need in either community to reduce uncertainties by attracting responses from several sources: in the forum community, the tutor was assigned this role; in the team community, the rules of the game were clearly explained in the document detailing the design of the forum.

We have yet to understand the negative tendency toward *in-stars* virtual neighborhoods in the forum community. This negative tendency means that participants deliberately avoid responding again to the same actor. This phenomenon is explained by the theory of social capital: responding again to an actor is a waste of energy; it decreases the structural autonomy of the responder.

Neither community shows a tendency for *mixed-stars* or *cyclicity* classes of virtual neighborhoods. *mixed-stars* is predicted by the contagion theory, hypothesis H5; the tendency for *cyclicity* is predicted by the theory of generalized exchange, hypothesis H4. Both hypotheses were rejected for both communities. As mentioned above, it is plausible that the contagion mechanism could not develop during the short lifetime of the

communities. The theory of generalized exchange relies on knowledge transfer through intermediaries, who seem to be unnecessary in online broadcast communities.

Our findings are summarized in Table 5.

| Predicted Hypotheses and Tendencies | Results |
|---|--|
| H1: $link < 0$ Few single tie links | Supported for both communities; feature of every broadcast community independent of design |
| H2: If large density, centralization, and size, then out-stars > 0 Respond to several others | Supported in team, but not in forum; difference in meeting threshold conditions due to built-in/lack of promotive interactions |
| H3: $mutuality > 0$ Tendency to reciprocate to resource promising partners | Supported in forum but not in team; difference in existence/non-existence of a priori resource-promising actors due to pre-assigned roles |
| H4: $cyclicality > 0$ Tendency to respond cyclically to resource-promising partner | Not supported in either community, probably because there was no need for information exchange via mediators |
| H5: $out-stars > 0$; $in-stars > 0$; $mixed-stars > 0$; $transitivity > 0$ Respond to same as other equivalent actors | Not supported in either community, probably because contagion process could not develop in the short lifetime of the communities |
| H6: $transitivity > 0$ Respond via several paths | Supported in team, but not in forum; difference due to difference in consensus reaching requirements and interdependence |
| H7: $in-stars > 0$ Attract responses from several others | Not supported in either community; uncertainties were clarified by the design (in team) and by the tutor (in forum) |
| H8: { $respi = 0 \mid i = ?$ students } H9: { $triggi = 0 \mid i = ?$ students } H10: { $respi > 0 \mid i =$ tutor } H11: { $triggi > 0 \mid i =$ tutor } Residual personal tendencies to respond or trigger only to actors with pre-assigned roles | H8, H9: Supported for both communities; no pre-assigned role of responders to students H10: Supported in forum, but not in team; differences due to differences in pre-assigned roles of the tutor H11: not supported for either community; no pre-assigned role of triggers to students |

Table 5: Summary of Results

Discussion

Our analysis shows that the minimal-effort hunt-for-social-capital mechanism, predicted by the theory of social capital & transaction costs controls a large part of the behavior of both communities: a negative tendency to respond. This is a feature of every broadcast community, independent of design.

Differences in the goals, interdependence, and the promotive interaction features of the designs of the two communities lead to the development of different mechanisms: cognition balance, predicted by the balance theory, and peer pressure, predicted by the collective action theory developed in the team community, but not in the forum community. An exchange mechanism developed in the forum community, but not in the team community. In addition, the unique pre-assigned role of the tutor in the forum community gave rise to the responsibility mechanism in that community, but not in the team community. The differences in the mechanisms led to the formation of different sets of virtual neighborhoods, which show up macroscopically as differences in cohesion and in distribution of response power. These differences are associated with the differences in the construction of knowledge in the two communities (Aviv et al., 2003).

It should be noted that the important contagion mechanism did not develop in either community. This mechanism, if developed, would have led to social influence and imitation in attitudes, knowledge, and behavior, which would have developed all kinds of *star* virtual neighborhoods. The required design parameters – promotive interaction – were in place in the team community, but it seems that the lifetime of the community was too short for the development of this mechanism.

There are obvious limitations to the conclusions drawn here. First, we have considered only two

communities. In order to capture the commonality, as well as the differences in design, neighborhoods, and mechanisms of online communities, one needs to consider a larger set of communities of different sizes, topics, and, in particular, with different designs. Furthermore, one should consider a set of relations embedded in these communities. One possibly relevant relation between actors is common interest, which can be captured by common keywords in the transcripts and/or common sets of visited web-pages.

Another limitation lies in restricting ourselves to Markov neighborhoods. Pattison and Robbins (Pattison and Robbins 2002) emphasized the possible importance of non-Markovian neighborhoods and brought initial evidence for the empirical value of models that incorporate such neighborhoods. Thus, the dependence structures can, and perhaps should, be treated as a hierarchy of increasingly complex dependence structures.

It seems that SNA can be a useful research tool for revealing community architectures and mechanisms of online communities. There are numerous directions for future research. One direction is “community-covariates interaction.” Several studies, such as (Lipponen, Rahikainen et al. 2001), revealed that certain participants take on the roles of influencers (who trigger responses) or of celebrities (who attract responses). Others are isolated – no-one responds to them or is triggered by them. The question is whether this behavior depends on individual attributes or whether this is universal and found across communities. Another direction is “community dynamics,” an inquiry into the time development of community structures. When do cliques develop? Are they stable? What network structures determine this behavior? Yet another direction is “large group information overload.” It is well known that the dynamics of large groups leads to boundary effects that occur when the group and/or the thread size increases (Jones, Ravid et al. 2002). How are these manifested in online communities?

One practical implication of the methodology used here is the possibility of online monitoring and evaluation of online communities, by embedding SNA tools into community support environments. But a word of caution is necessary: There are various definitions of network structures. Experience shows that applying different definitions may lead to different, even contradictory, results. Further research is needed to determine the stability of network structures under such redefinitions.

Appendix: Key Ideas of the p^* Markov Model and the Estimation Procedure

In this research we construct parameterized p^* Markov models for the two networks, assuming isomorphism invariance, thereafter extracting the parameters via the MPLLE (maximum pseudo-likelihood estimation) procedure (Strauss and Ikeda 1990). Details of the precise formulation of the models, assumptions and the analysis are presented in a series of papers (Wasserman and Pattison 1996; Anderson, Wasserman et al. 1999; Pattison and Robbins 2002). In this section we present the key ideas required for understanding the results and their interpretation.

Any ordered pair of actors in a network has a potential response tie relation. We say that the response tie relation between actor i and actor j is in the realized state if i responded to at least one message sent by j to the network. Otherwise a response tie is in the un-realized state. The state of the network of g actors is then defined by the $g \times g$ response matrix \mathbf{r} : $r_{ij} = 1$ if a response tie between i and j is realized, otherwise $r_{ij} = 0$. The states of the response ties are assumed to be the result of stochastic mechanisms operating between pairs of actors. Furthermore, we assume that the probability that the response matrix will actually develop into a state \mathbf{r} , $\Pr(\mathbf{r})$, is an exponential function of a linear combination of p state dependent explanatory variables or explanatories, $\{z_1(\mathbf{r}), z_2(\mathbf{r}), \dots, z_p(\mathbf{r})\}$. Each explanatory $z_i(\mathbf{r})$ has an associated unknown strength parameter θ_i . Estimates of the strength parameters are obtained by fitting the observed states of the response-ties in the forum to the predictions of the probability function $P(\mathbf{r})$.

$$\Pr(\mathbf{r}) = \exp\{\theta_1 z_1(\mathbf{r}) + \theta_2 z_2(\mathbf{r}) + \dots + \theta_p z_p(\mathbf{r})\} / K(\theta_1, \theta_2, \dots, \theta_p) \quad (A1)$$

The Hamersley-Clifford theorem (Besag, 1974, 1975) states that each explanatory $z_N(\mathbf{r})$ and its associated strength parameter θ_N are associated with one *virtual neighborhood* \mathbf{N} . A virtual neighborhood is a sub-set of actors and prescribed possible response ties between them, all of which are pair-wise statistically dependent. Actors in a neighborhood may be physically far apart (which is why we call it virtual), but due to certain mechanisms, their possible response ties are all statistically interdependent. Note that the interdependency of the prescribed possible response ties is an inherent property of the virtual neighborhood which in principle is unrelated to the actual realization states of the response ties. A virtual neighborhood may be completely or partially realized, or not realized at all. According to this definition, two possible response ties between pairs of actors in different virtual neighborhoods are statistically independent. The Hamersley-Clifford

theorem states that each virtual neighborhood is associated with one explanatory and its strength parameter. The explanatory measures whether the virtual neighborhood is completely realized, in which case it is 1. Otherwise it is zero. The strength parameter quantifies the probabilistic tendency to realize the virtual neighborhood completely.

A subset of a virtual neighborhood is also a virtual neighborhood. Any single pair of actors with a single prescribed possible response tie between them is by definition a virtual neighborhood. Different virtual neighborhoods might have the same set of actors but different prescribed response ties. Holland and Leinhardt (Holland and Leinhardt 1981) considered models in which virtual neighborhoods included only dyads of actors with mutual ties. This implies that dyads are independent, which is an oversimplification. Markov models incorporate a larger variety of various sizes of virtual neighborhoods. In a Markov neighborhood, every two prescribed response ties have one actor in common (which is why they are dependent). Examples of Markov virtual neighborhoods are graphically presented in Figure 1. Markov dependency was introduced by Frank and Strauss (Frank and Strauss 1986). It is a natural assumption in an online community: Forging response ties is an effort, so an actor's response ties are conceivably interdependent.

The isomorphism invariance (or homogeneity) approximation aggregates same-topology virtual neighborhoods into isomorphism classes, each having one common strength parameter and one explanatory. The explanatory is then a simple counter: It counts the number of virtual neighborhoods of the particular class that are realized in the network. For example, the explanatory associated with the class of transitive triads counts the number of such triads that are realized in the network. The strength parameter quantifies the probabilistic tendency of the network for realizing virtual neighborhoods of the class. In this research we consider the set of Markov isomorphism classes listed in Table A1. The three left-hand columns in the table define the membership of actors in each class and the prescribed possible response ties, the name of the associated strength parameter (which also serves as the name of the class itself), and the formula for deriving the explanatory variables (counters) from the response matrix \mathbf{r} .

Table A1: *Classes of Virtual Neighborhoods and Explanatories used in Study*

| Isomorphism Class of Virtual Neighborhoods: Participating Actors & Prescribed Response ties | Strength Parameter θ | Explanatory $z_N(\mathbf{r})$ (counter) | Effects: If $\theta > 0$ is significant ? enhanced tendency to create |
|--|-----------------------------|---|--|
| All pairs $\{i, j\} (i \neq j) \text{ or } (j \neq i)$ | <i>link</i> | $L(\mathbf{r}) = \sum_i \sum_j r_{ij}$ | links (either direction) |
| All pairs $\{i, j\} (i \neq j)$ fixed i | <i>resp_i</i> | $R_i(\mathbf{r}) = \sum_j r_{ij}$ | responses |
| All pairs $\{j, i\} (j \neq i)$ fixed i | <i>trigg_i</i> | $T_i(\mathbf{r}) = \sum_j r_{ji}$ | triggers |
| All pairs $\{i, j\} (i \neq j) \text{ AND } (j \neq i)$ | <i>mutuality</i> | $M(\mathbf{r}) = \sum_i \sum_j r_{ij} r_{ji}$ | mutual responses |
| All triplets $\{i, j, k\} (i \neq j) \text{ AND } (i \neq k)$ | <i>out-stars</i> | $OS_2(\mathbf{r}) = \sum_i \sum_j \sum_k r_{ij} r_{ik}$ | star-responses |
| All triplets $\{i, j, k\} (i \neq j) \text{ AND } (k \neq j)$ | <i>in-stars</i> | $IS_2(\mathbf{r}) = \sum_i \sum_j \sum_k r_{ji} r_{kj}$ | star-triggers |
| All triplets $\{i, j, k\} (i \neq j) \text{ AND } (j \neq k)$ | <i>mixed-stars</i> | $MS_2(\mathbf{r}) = \sum_i \sum_j \sum_k r_{ij} r_{jk}$ | mixed trigger-responses |
| All triplets $\{i, j, k\} (i \neq j) \text{ AND } (j \neq k) \text{ AND } (i \neq k)$ | <i>transitivity</i> | $TRT(\mathbf{r}) = \sum_i \sum_j \sum_k r_{ij} r_{jk} r_{ik}$ | transitive triads |
| All triplets $\{i, j, k\} (i \neq j) \text{ AND } (j \neq k) \text{ AND } (k \neq i)$ | <i>cyclicity</i> | $CYT(\mathbf{r}) = \sum_i \sum_j \sum_k r_{ij} r_{jk} r_{ki}$ | cyclic triads |

The probability function then takes the following form:

$$\Pr(\mathbf{r}) = \exp\{\underline{\theta}' \bullet \mathbf{z}(\mathbf{r})\} / k(\underline{\theta}) \quad (\text{A2})$$

Where the vector of explanatories consists of the counters listed in Table A1:

$$\mathbf{z}(\mathbf{r}) = \{L(\mathbf{r}), R_i(\mathbf{r}), T_i(\mathbf{r}), M(\mathbf{r}), OS_2(\mathbf{r}), IS_2(\mathbf{r}), MS_2(\mathbf{r}), TRT(\mathbf{r}), CYT(\mathbf{r})\} \quad (\text{A3})$$

and the strength parameters measure the tendencies for realizing the virtual neighborhoods of the corresponding Markov classes:

$$\underline{\theta} = \{link, resp_i, trigg_i, mutuality, out-stars, in-stars, mixed-stars, transitivity, cyclicity\} \quad (A4)$$

The $L(\mathbf{r})$ explanatory counts the number of neighborhoods of class *link* that were actually realized in the network whose response matrix is \mathbf{r} . Its strength parameter *link* measures the common tendency to form single response ties; that is, to respond or to trigger. If *link* is negative, it measures the tendency not to form response ties.

The $R_i(\mathbf{r})$ explanatory counts the number of neighborhoods of the *resp_i* class that were realized in the network, and its strength parameter. *resp_i* measures the residual tendency (or non-tendency) of actor *i* to respond, above and beyond the common tendency measured by *link*. Similarly, $T_i(\mathbf{r})$ counts the number of neighborhoods of class *trigg_i* that were actually realized, and the *trigg_i* strength parameter measures the residual capability of actor *i* to attract responses to his/her previous messages; that is, to trigger others to respond, above and beyond the common capability measured by *link*. The $M(\mathbf{r})$ explanatory counts the number of realized mutual dyads. The strength parameter *mutuality* measures the global tendency (or non-tendency) of a network to form such dyads. The $OS_2(\mathbf{r})$, $IS_2(\mathbf{r})$, and $MS_2(\mathbf{r})$ variables count the number of realized *star* virtual neighborhoods of the three global classes (see Fig. 3). The corresponding strength parameters measure the tendency (or non-tendency) to forge response ties with (and/or from) two partners. The *transitivity* and *cyclicity* global classes include all triad virtual neighborhoods that are transitive or cyclic, respectively. The associated explanatories, $TRT(\mathbf{r})$ and $CYT(\mathbf{r})$ count the number of virtual neighborhoods from these classes that were actually realized, and the corresponding strength parameters – *transitivity* and *cyclicity* – measure the tendency to realize virtual neighborhoods of these classes.

It should be emphasized that the explanatories count only completely realized neighborhoods: a virtual neighborhood must have all its prescribed response ties realized in order to be counted.

Wasserman and Pattison (Wasserman and Pattison 1996) reformulated the exponential form of $\Pr(\mathbf{r})$ into a logit form, which provides both an insight into the precise meaning of "tendency" and a useful procedure for estimating the strength parameters. The logit form of the Markov model is presented in equation A5:

$$w_{ij} = \log [\Pr(r_{ij} = 1 | r_{ij}^c) / \Pr(r_{ij} = 0 | r_{ij}^c)] = \sum_N \theta_N d_N(r_{ij}^c, ij) \quad (A5)$$

The left hand side is the logit – the log of the conditional odds of a pair of actors (*i*, *j*) to realize a response tie (*i* ? *j*). Here the odds (the ratio between the probability for realizing and not realizing a response tie) is conditioned on all other response tie states, denoted by r_{ij}^c , held fixed. The logit w_{ij} is a linear combination of the changes in the values of the explanatories when the response tie (*i* ? *j*) jumps from a not realized to a realized state, when all other response ties, r_{ij}^c are held fixed:

$$d_N(r_{ij}^c, ij) = z_N(r_{ij}^c, r_{ij} = 1) - z_N(r_{ij}^c, r_{ij} = 0) \quad (A6)$$

The change statistic $d_N(r_{ij}^c, ij)$ counts the increase in the number of virtual neighborhoods of class *N* when the response tie (*i* ? *j*) flips from "non-realized" to "realized." It is 1 if (*i* ? *j*) completes a whole virtual neighborhood; otherwise it is zero.

The logit form (A5) provides a simple interpretation of the strength parameters. Suppose that an explanatory $z_N(\mathbf{r})$ with strength parameter θ is significant. If this happens then the conditional odds for the realization of the response tie (*i* ? *j*) from any actor *i* to any actor *j* will be enhanced by e^θ if this envisaged response tie will make a new virtual neighborhood of class *N* realized completely. This will happen if the network already has an almost complete realization of the neighborhood: only (*i* ? *j*) is missing. Otherwise the conditional odds do not change. Note that if the strength parameter θ is negative, the conditional odds will be decreased. This means that the network has the opposite tendency. For example, if the *transitivity* explanatory is significant, then the conditional odds for forming a response tie (*i* ? *j*) is multiplied by $e^{\text{transitivity}}$ if the response tie (*i* ? *j*) completes a transitive triad (*i* responds to *j*, AND *j* responds to *k* AND *i* also responds to *k*). This will be larger or smaller than 1 depending on the *transitivity* sign.

The logit form (A5) is the basis for one method of estimating the strength-parameters. This method – the MPLE procedure – treats A5 as a binary logistic regression equation: the response tie variable is the dependent variable. There are $g(g-1)$ cases: each ordered pair of actors (*i*, *j*) is one case. The values of r_{ij} (1 or 0) for all cases are the observed response ties. The independent variables in the regression equation are the "change statistics" $d_N(r_{ij}^c, ij)$ associated with the explanatories. The coefficients of the change statistics in the

regression equation, θ_N , are the unknown strength parameters of the corresponding explanatories.

To solve A5 and estimate the strength parameters, one constructs the pseudo log likelihood function:

$$PL(\underline{\theta}) = \sum_{ij} \log [\Pr(r_{ij} = 1 | r_{ij}^c) / \Pr(r_{ij} = 0 | r_{ij}^c)] = \sum_{ij} \theta_N d_N(r_{ij}^c, ij) \quad (A7)$$

$PL(\underline{\theta})$ is the log of the product of all the conditional probabilities. It is considered a function of the unknown strength parameters $\underline{\theta} = \theta_1, \theta_2, \dots, \theta_p$ with the response tie states \mathbf{r} fixed at the observed values. The estimators of the strength parameters are then the values of $\theta_1, \theta_2, \dots, \theta_p$ that maximize $PL(\underline{\theta})$. These are the Maximum Pseudo Likelihood Estimators (MPLEs). The problem with this method is that the statistical distributions of these estimators are not known. One cannot assume that they have the same statistical (chi squared) distributions as their MLE (maximum likelihood estimator) counterparts. Significance intervals based on this assumption can at best be considered defensible approximations, not precise statistical statements. This study attempts to identify the relative strength of the most important explanatories, with no claim to provide precise numerical values for the actual values of their strength parameters.

In this research the actual values of the change-statistics $d_N(r_{ij}^c, ij)$ were calculated from the observed response \mathbf{r} matrix using PREPSTAR (Anderson et al., 1999). The MPLEs for the strength parameters were then obtained by solving equation (A7) using the binary logistic procedure of SPSS. See (Crouch and Wasserman 1998; Contractor, Wasserman et al. 1999) for examples and details.

Note that once we have estimates for the strength parameters, we can estimate the value of the pseudo log likelihood function, $PL(\underline{\theta})$, itself. This value, to be precise $-2 * PL(\underline{\theta})$, can serve as an estimate for the goodness of fit of the model. The best fit is when the product of the conditional probabilities is 1, so that $-2 * PL(\underline{\theta})$ is zero. In practice, this is a positive number called Pseudo Log Likelihood Deviance (PLLD) signifying that the model is not perfect. What we are interested in, however, are the decrements in the PLLD caused by introducing more explanatories into the model. A decrement, denoted by δ , measures the contribution of the virtual neighborhood N to the goodness of fit of the model. If one can conjecture that PLLD and δ have chi square distributions (as do their counterparts in MLE procedure), then one has precise numerical estimates for the relative importance of their contributions to the goodness of fit. As stated above, this assumption is approximate at best. Therefore the decrements δ serve as a guide to the relative importance of the virtual neighborhoods, but do not provide the range of the true values.

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Teacher Educators' Beliefs and Technology Uses in Relation to Preservice Teachers' Beliefs and Technology Attitudes

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Abstract

This study explored teacher educators' pedagogical beliefs and technology uses in relation to preservice teachers' pedagogical beliefs and attitudes toward technology. Correlation and regression analysis were conducted to answer the research questions. The results revealed some relationships between the teacher educators' beliefs and their uses of technology. In addition, it was found that the teacher educators' learner-centered beliefs could influence the preservice teachers' learner-centered beliefs. The frequency that the teacher educators had the preservice teachers use technology in both constructivist and traditional way could influence the preservice teachers' attitudes toward technology.

Introduction

The rapid development of information technology has made computers and computer-related technology an integral part of teaching and learning. According to Glenn (1997), computers have advanced from simple machines with limited functions and capabilities to powerful machines with sophisticated applications and high-speed networking capabilities. Since the mid-1970s, schools districts have raced to keep up with the rapid growth and change of technologies. Under such conditions, it is necessary for teachers to learn new pedagogical and technological skills to better facilitate students' learning in classrooms (Glenn, 1997).

To better prepare teachers to integrate technology in their K-12 classrooms, teacher educators should take the responsibility to prepare future teachers by infusing technology in their education courses (Vannatta & O'Bannon, 2002; Willis & Tucker, 2001). Faculty members should be prepared to model, support, and require technology use by students (Cuban, 1995). Ertmer (1999) described two barriers to technology integration: first-order barriers and second-order barriers. First-order barriers are extrinsic to teachers and include lack of access to hardware and software, time, and necessary support. Second-order barriers are intrinsic to teachers, including teachers' belief systems about teaching and learning and practices in teaching. Since the second-order barriers are more ingrained and personal, they may cause more difficulties to overcome. Furthermore, second-order barriers can affect meaningful technology integration. Therefore, as a second-order barrier, teachers' pedagogical beliefs may play an important role in the ways in which technology gets used in classrooms.

Richardson (1996) defined beliefs as "psychologically held understandings, premises, or propositions about the world that are felt to be true" (p. 103). Some previous studies (Becker, 1999; Bigatel, 2002; Niederhauser & Stoddart, 2001) have suggested that inservice teachers' beliefs about teaching and learning had impact on their uses of technology in the classroom. Compared to the teachers who had traditional beliefs about teaching and learning, the teachers who had constructivist beliefs were strong computer users, they used computers frequently and powerfully in their teaching. Instead of emphasizing the impact that teachers' beliefs on their uses of technology, some researchers (Hadley & Sheingold, 1993, Woodrow, et al., 1996) found that technology can influence teachers' beliefs and attitudes. Many of these teachers incorporated technology into their teaching practices, which deeply affected their teaching and the students' learning. Regardless the report on the relationship between *inservice* teachers' pedagogical beliefs and their uses of technology, little is known about the relationship between *teacher educators'* pedagogical beliefs and their technology uses. The examination of such relationship in this study is an exploratory effort to fill the gap in literature and contribute to our growing knowledge about faculty development in technology use in teacher preparation programs. Such exploration is also important in the efforts to prepare preservice teachers to effectively use technology in their future teaching.

Teacher educators shoulder the responsibility for educating technology-using preservice teachers. Since teachers' beliefs exert a powerful influence on teachers' instructional decisions and classroom practices (Pajares, 1992), it is reasonable to expect that teacher educators who have different pedagogical beliefs will deliver instruction in different ways, which in turn, may have differential influences over preservice teachers' beliefs about teaching and learning. Therefore, the exploration of teacher educators' pedagogical beliefs in relationship to preservice teachers' pedagogical beliefs is necessary educational inquiry in teacher education

programs. It will help us learn about the influence that teacher educators may have on preservice teachers' beliefs and add to our knowledge about how to broaden preservice teachers' pedagogical beliefs to encompass beliefs about meaningful uses of technology. The introduction of computers and related technologies into schools makes it necessary for teachers to take advantage of technology in instruction. Preservice teachers need to be well prepared in using technology in teacher education programs. Beliefs about teaching and learning play an important role in transforming classrooms with the use of technology (Ertmer, 1999). Understanding how preservice teachers' pedagogical beliefs relate to teacher educators' pedagogical beliefs may help to predict their technology uses in future teaching.

In addition to examining preservice teachers' beliefs about teaching and learning, it is also important to consider preservice teachers' attitudes toward technology use in education. According to Aiken (1980), attitudes "may be conceptualized as learned predispositions to respond positively or negatively to certain objects, situation, concepts, or persons" (p. 2).

Attitudes had influence on teachers' uses of technology in classrooms (Boone & Gabel, 1994; Levine & Donitsa-Schmidt, 1998; Piper, 2003). Being familiar with technology does not necessarily mean preservice teachers perceive that technology has a use in the classroom, and therefore, they may not be willing to teach with technology in the classroom (Ropp, 1999). Attitudes toward technology did not only influence the student's initial adoption of computer technology, but also their future uses (Selwyn, 1997). Teachers' positive attitudes toward technology will make them likely to use it in the future (Yildirim, 2000). Thus, it is important to understand the factors related to preservice teachers' attitudes toward technology.

Some researchers (Abbott & Faris, 2000; Kumar & Kumar, 2003) have suggested that preservice teachers' attitudes toward technology could be improved by integrating technology into teacher education course work. However, few studies have been conducted to *directly* connect teacher educators' uses of technology and preservice teachers' attitudes toward technology. "Teachers teach as they have been taught, and it is unlikely that computer skills will be transferred to students and encouraged by teachers unless the teachers have positive attitudes toward computer use" (Yildirim, 2000, p. 481). Thus, it is necessary to explore how teacher educators, as models of teaching and technology use in classrooms, influence preservice teachers' attitudes toward technology. Aiken (1980) used modeling theory to analyze the development and the change of attitudes.

Many attitudes are not the result of direct reinforcement but are learned by observing the activities of people who are perceived as significant. As a person grows to maturity, numerous individuals – parents, peers, and television stars, among others – serve as models of attitudes and behavior. In the process of modeling the behavior of people who are important to her or him, a person makes provisional attempts to act and believe as the model is perceived to act and believe (p. 16).

Therefore, it is a worthwhile effort to examine the relationship between teacher educators' technology uses in instruction and preservice teachers' attitudes toward technology. This effort is important in identifying the factors that have influence on preservice teachers' attitudes toward technology and facilitating preservice teachers' positive attitudes toward using technology in their future teaching.

Therefore, the purpose of this study was to examine how teacher educators' underlying beliefs about teaching and learning, or pedagogical beliefs, were related to their uses of technology in instruction. Also, this study intended to explore the relationship between teacher educators' pedagogical beliefs and preservice teachers' pedagogical beliefs, as well as the relationship between teacher educators' uses of technology and preservice teachers' attitudes toward technology uses in classrooms.

Specifically, this study will answer the following questions:

1. What is the relationship between teacher educators' pedagogical beliefs and their technology uses?
2. What is the relationship between teacher educators' pedagogical beliefs and preservice teachers' pedagogical beliefs?
3. What is the relationship between teacher educators' technology uses and preservice teachers' attitudes toward technology?

Methods

Overview of Design

This study employed a correlational research design. To answer the first question on the relationship between teacher educators' beliefs and their technology uses, bivariate correlational study method was used. To answer the second question on the relationship between teacher educators' beliefs and preservice teachers' beliefs, prediction study method was employed by using multiple regression technique. To answer the third research question on the relationship between teacher educators' uses of technology and preservice teachers'

attitudes toward technology, the same study method used to answer the second question was applied.

Participants and Site

This study was conducted with the instructors and the students in School of Education at a large mid-western university in a spring semester. Convenience sampling method was used. The preservice teacher participants were 100 students who enrolled in two *beginning* teacher education courses, course A and course B. Students in these two courses formed a cohort, which meant all those who attended one section of course A also took the corresponding section of course B. Of these 100 students, 59 of them were also taking an introductory educational technology course, course C. A total of 24 teacher educators took part in this study, 18 of them were graduate instructors and 6 of them were faculty members. Of the 24 instructors, 7 instructors were teaching course A, 9 were teaching course B, and 1 was teaching course C.

Variables and Instruments

In general, a total of four variables were examined to answer the research questions, including 1) teacher educators' pedagogical beliefs, 2) preservice teachers' pedagogical beliefs, 3) teacher educators' uses of technology in instruction, and 4) preservice teachers' attitudes toward technology use in instruction.

Teacher educators' beliefs and preservice teachers' beliefs were measured by Teacher Beliefs Survey (McCombs & Whisler, 1997). This original survey contained 35 four-point rating scale items (from 1-strongly disagree to 4-strongly agree). The factor analysis yielded three factors and 29 items (6 items from the original survey were dropped). The three factors were consistent with the factors defined by the authors: 1) learner-centered beliefs about learners, learning, and teaching (LB), such as the item "Students have more respect for teachers they see and can relate to as real people, not just as teachers", 2) non-learner-centered beliefs about learners (NLB-L), such as the item "There are some students whose personal lives are so dysfunctional that they simply do not have the capability to learn", and 3) non-learner-centered beliefs about learning and teaching (NLB-TL), such as the item "I can't allow myself to make mistakes with my students". The reliability coefficient alpha for the three factors were 0.71, 0.70 and 0.71 respectively.

Preservice teachers' technology attitudes (TA) were measured by computer technology attitude survey that was developed by Francis -Pelton and Pelton (1996). There were originally 42 five-point Likert scale items (from 1-strongly disagree to 5-strongly agree), such as "Students who use computer will have difficulty learning basic skills". The factor analysis identified five factors. A total of 38 items were retained. The reliability alpha of the 38 items was 0.94. The alpha for the five factors was 0.93, 0.87, 0.87, 0.72 and 0.76 respectively. Teacher educators' technology uses in instruction were measured in two parts. One part was the frequency of using a variety of computer tools and application (software), such as "Word Processing" and "Database". The other part was about *how* the instructors had students use computer technology. This part contained 12 items that fell into two subscales. One subscale included 8 items that reflected using technology in constructivist way. They were adapted from the objectives for computer use by teachers who had constructivist teaching philosophy (Becker, 1998) and from constructivist instructional goals (Niederhauser and Stoddart, 2001). The items were such as "expressing themselves in writing" and "learning to work collaboratively". The other subscale contained 4 items that reflected using technology in traditional way of learning. They were adapted from the objectives for computer use by those who had traditional transmission teaching philosophy (Becker, 2000). The items were such as "mastering skills just taught" and "learning to work independently". Specifically, the part of *how* computer technology used measured the *frequency* that the instructors have students use computer technology either in constructivist way (CW) or in traditional way (TW). All the items were in the form of rating scale (from 1 - None to 4 - High).

Data Collection

At the beginning of the spring semester, preservice teachers' pre-survey was administered to student participants to pretest their pedagogical beliefs and attitudes toward technology. At the end of the semester, a post-survey that was similar to the pre-survey was administered. At the end of the semester, a survey was administered to instructor participants to examine their pedagogical beliefs and technology uses in instruction. All the surveys were put online. The participants were informed of the web address of the surveys.

Data Analysis

In examining the relationship between teacher educators' beliefs and their technology uses, the Pearson product-moment correlation coefficient r was measured between each of the three beliefs scores (LB, LB-L,

LB-TL) and the score for each subscale of computer technology uses (software, CW, TW). Positive r value shows positive relationship between two variables, while negative r value shows negative relationship between two variables. P value was reported. The significance level was set at .05.

When examining the relationship between teacher educators' beliefs and preservice teachers' beliefs, data collected from 100 student participants and the instructors ($N = 17$) in course A, B and C was analyzed. Sequential multiple regression analysis was conducted to examine each beliefs score separately. To control the influence of student participants' pre-existed beliefs prior to coming to teacher education program, their beliefs score in the pre-survey was used as covariate in the regression analysis. The students' post-survey beliefs score was regressed as functions of instructors' beliefs score with the students' pre-survey beliefs scores as covariate. Since not all the student participants took course C, dummy variable was used to indicate course C instructor, with "1" indicating having this instructor and "0" indicating not having this instructor. Specifically, there will be three models:

| | |
|---|---|
| Learner-centered beliefs (LB) model | $y = b_0 + b_1X_1 + b_2X_2 + b_2X_3 + b_2X_4$ |
| Non-learner-centered beliefs about learners (NLB-L) model | $y = b_0 + b_1X_1 + b_2X_2 + b_2X_3 + b_2X_4$ |
| Non-learner-centered beliefs about teaching and learning (NLB-TL) model | $y = b_0 + b_1X_1 + b_2X_2 + b_2X_3 + b_2X_4$ |

In each model, X_1 represents students' beliefs score in pre-survey, X_2 represents course A instructors' beliefs score, X_3 represents course B instructors' beliefs score, X_4 represents the indicator of course C instructor's beliefs, and y represents students' beliefs score in post-survey.

In the examination of the relationship between teacher educators' uses of technology and preservice teachers' attitudes toward technology, similar method used to answer the second research question was applied. Sequential multiple regression analysis was again used. Students' technology attitude score in pre-survey was used as covariate. Two models were identified:

| Models | Variables included |
|--|---|
| 1. Students' technology attitudes (TA) are predicted by the frequency that instructors use software (software) and the frequency of their having students' use technology in constructivist way (CW) | $y = b_0 + b_1X_1 + b_2X_2 + b_2X_3 + b_2X_4 + b_2X_5 + b_2X_6$ X_1 – Students' technology attitude score in pre-survey (TA) X_2 – software-Frequency of course A instructors X_3 – CW-Frequency of course A instructors X_4 – software-Frequency of course B instructors X_5 – CW-Frequency of course B instructors X_6 – Indicator of course C instructor |
| 2. Students' technology attitudes (TW) are predicted by the frequency that instructors use software (software) and the frequency of their having students' use technology in traditional way (TW) | $y = b_0 + b_1X_1 + b_2X_2 + b_2X_3 + b_2X_4 + b_2X_5 + b_2X_6$ X_1 – Students' technology attitude score in pre-survey (TA) X_2 – software-Frequency of course A instructors X_3 – TW-Frequency of course A instructors X_4 – software-Frequency of course B instructors X_5 – TW-Frequency of course B instructors X_6 – Indicator of course C instructor |

Results

Relationship between Teacher Educators' Beliefs and Technology Use

An ANOVA examination found that graduate instructors and faculty members were different in learner-centered beliefs (LB), relationship between instructors' beliefs and their technology uses was examined with the two groups of instructors separately.

For graduate instructors ($N = 18$), their learner-centered beliefs (LB) were positively related to their software use ($r = .47, p = .05$), the frequency that they had students use technology in both constructive way (CW) ($r = .57, p = .01$) and traditional way (TW) ($r = .54, p = .02$). Their non-learner-centered beliefs about learners (NLB-L) were negatively related to their software use ($r = -.51, p = .03$).

Since there were only 6 faculty member participants, only one significant result was found. The frequency that these faculty members had students use technology in traditional way (TW) was positively related to their non-learner-centered beliefs about learners (NLB-L) ($r = .89, p = .02$).

Relationship between Teacher Educators' Beliefs and Preservice Teachers' Beliefs

When examining the three beliefs models, the regression analysis of the learner-centered beliefs (LB) produced a model of two variables that best predicted students' learner-centered beliefs: students' pre-survey

beliefs and course A instructors' learner-centered beliefs (LB); $R^2 = .13$, $F(2, 97) = 7.15$, $p = .0013$. This model accounted for 13% of variance in students' learner-centered beliefs. Since students' pre-survey beliefs score was used as covariate, the prediction of course A instructors' learner-centered beliefs was the focus of examination. That semi-partial correlation was 0.04 indicated that course A instructors' beliefs can help to explain 4% variance in the students' learner-centered beliefs. A summary of the model is presented as the follows:

| Steps | R^2 | df_1 | df_2 | p | b | sr |
|-------------------------------|-------|--------|--------|-------|------|------|
| 1. Students' LB in pre-survey | 0.09 | 1 | 98 | .001* | 0.32 | 0.1 |
| 2. Course A instructors' LB | 0.13 | 1 | 97 | .048* | 0.19 | 0.04 |

Note. df =degree of freedom; b =standardized regression coefficient; sr =semi-partial correlation
* $p < .05$

Relationship between Teacher Educators' Technology Uses and Preservice Teachers' Technology Attitude

When regressing the students' technology attitudes score as functions of the instructors' using of software and having students use technology in constructivist way (CW), the regression analysis produced a model of two variables that best predicted students' technology attitude: students' pre-survey attitudes score and course A instructors' having students' use technology in constructivist way (CW); $R^2 = .62$, $F(2, 97) = 80.52$, $p < .0001$. This model accounted for 62% variance in students' technology attitudes.

When regressing the students' technology attitudes score as functions of the instructors' using of software and having students use technology in traditional way (TW), two variables were significant predictors of students' technology attitudes: students' pre-survey score and course A instructors' having students use technology in traditional way (TW); $R^2 = .62$, $F(2, 97) = 79.64$, $p < .0001$. This model also accounted for 62% variance in students' technology attitudes.

Since students' pre-survey attitudes score was used as covariate, the prediction of the course A instructors' having students use technology in constructivist way and traditional way was the focus of interests. The semi-partial correlation was 0.02 for the two significant variables, which indicated that the frequency of the instructors' having students use technology in either constructivist way or traditional way accounted for 2% variance respectively in students' technology attitudes. The following tables presented the summary of the regression analysis.

Model 1. Students' technology attitudes were predicted by the frequency that instructors use software and their having students' use technology in constructivist way (CW)

| Variables | R^2 | df_1 | df_2 | p | b | sr |
|--|-------|--------|--------|------|------|------|
| 1. Students' technology attitude in pre-survey | 0.60 | 1 | 98 | .00* | 0.78 | 0.61 |
| 2. Course A instructors' CW-Frequency | 0.62 | 1 | 97 | .03* | 0.14 | 0.02 |

Model 2. Students' technology attitudes are predicted by the frequency that instructors use software and their having students' use technology in traditional way (TW)

| Variables | R^2 | df_1 | df_2 | p | b | sr |
|--|-------|--------|--------|------|------|------|
| 1. Students' technology attitude in pre-survey | 0.60 | 1 | 98 | .00* | 0.78 | 0.61 |
| 2. Course A instructors' TW-Frequency | 0.62 | 1 | 97 | .04* | 0.13 | 0.02 |

Note. df =degree of freedom; b =standardized regression coefficient; sr =semi-partial correlation
* $p < .05$

Discussion and Implication

The findings of this study revealed that graduate instructors who had more learner-centered beliefs tended to use various software programs more frequently and have students use technology more frequently in constructivist ways. The graduate instructors who had more non-learner-centered beliefs about learners tended to use software programs less frequently. It is interesting to note that those who had more learner-centered beliefs also tended to have students use technology more frequently in traditional ways. This indicated that teacher educators' use of technology was not in a simple dimension. For some reason, those who have more learner-centered beliefs would have students use technology not only in constructivist way but also in traditional way. The inconsistency between teachers' beliefs and their use of technology was reported in Ertmer, Gopalakrishnan and Ross's study (2001). In this study, the researchers conducted an exploratory study with seventeen school teachers who considered themselves to be exemplary technology users to examine their pedagogical beliefs and classroom practices. It was found that although most of the teachers reported to have

constructivist pedagogical philosophy, only five of them implemented in terms of best practice identified by the literature. They articulated constructivist views on technology integration, however, they used both constructivist and traditional methods to implement their teaching practice. The reason that there is inconsistency between teachers' beliefs and practice is the complexity in the classroom situation. The contextual factors in the classroom teaching may prevent teachers from transforming their beliefs into practice and implementing what they would do theoretically (Fang, 1996).

Graduate instructors shared the responsibilities of educating preservice teachers in teacher education program and could be major resources of candidates of faculty members in teacher education field. As such, the examination of this group of participants was very important in the exploration of teacher educators' beliefs and technology use.

Due to the small number of faculty member participants, only one significant result was found in faculty member participants' data. Those who had more non-learner-centered beliefs about learners tended to have students use technology more frequently in traditional way. To further explore the relationship between teacher educators' beliefs and technology uses, in future study, it is necessary to include more instructor participants, especially faculty member participants.

In the examination of the relationship between teacher educators' beliefs and preservice teachers' beliefs, this study revealed that teacher educators' learner-centered beliefs could be able to influence preservice teachers' learner-centered beliefs over a semester, which was found between student participants and the instructors in course A. Richardson (1996) commented that when preservice teachers first came into teacher education program, they already had certain form of beliefs based on their own previous experience as students. These beliefs were deep-seated, therefore, it was hard to have their beliefs be impacted. This is true in the aspect that in current study, students' pre-survey beliefs scores were always the predictors of their post-survey beliefs scores. Since their pre-survey was conducted at the very beginning of the semester, the pre-survey scores can reflect their beliefs prior to their coming to the teacher education program. In addition, the students' non-learner-centered beliefs were not found to be influenced by the instructors' beliefs. However, if previous instruction that students received could help in the development of their beliefs, there is no reason to deny that the instruction that preservice teachers receive in teacher education program could have influence on their beliefs about teaching and learning. In addition, their study in teacher education program and their status of being future teachers could make them think about teaching and learning more seriously and systematically. In this study, in comparison with the fact that students' pre-learner-centered beliefs accounted for 10% variance in their post-learner-centered beliefs ($sr = .10$), the 4% ($sr = .04$) variance accounted by course A instructors' learner-centered beliefs in one semester did indicate that teacher educators' learner-centered beliefs can have influence on preservice teachers' learner-centered beliefs.

This study revealed that the student participants' attitudes toward technology could be predicted by the frequencies of course A instructors' having students use technology in constructivist way and traditional way. Although these two aspects of technology use accounted for just 2% variance respectively in students' technology attitude ($sr = .02$, $sr = .02$), they were significant and did help to explain the students' attitude score in post-survey. The examination of the descriptive data of the instructors' technology use indicated that the frequency of their having students' use technology for either constructivist way or traditional way of obtaining knowledge was barely moderately (several times a semester). Given this, the 2% variance cannot be discounted.

Aiken (1980) pointed out that many attitudes were "learned by observing the activities of people who are perceived as significant" (p. 16). Thinking about the fact that course A instructors had influence on the students' learner-centered beliefs, one can say that course A instructors' instruction impressed the students more than the other instructors' instruction. Therefore, it is reasonable to think that the development of students' attitudes toward technology was more the result of observing how course A instructors used technology. In other words, course A instructors' use of technology can predict students' attitudes toward technology.

According to Wetzel (2002), "For instructional technology to be successfully implemented, teacher beliefs and values need to shift. If they do not, the desired implementation and integration of instructional technology in education will not occur on a broad scale" (p. 46). To better facilitate professional development for teacher educators and better prepare tomorrow's teachers to integrate technology effectively in classrooms, it is necessary to examine teacher educators' beliefs and their uses of technology, and how the two variables are related to preservice teachers' beliefs and attitudes toward technology use. As an exploratory effort, this study helped to enrich our knowledge about helping teacher educators to use technology in teacher preparation courses and engage in preparing technology-using prospective teachers.

Due to the limit of time and resources, this study was conducted in one semester period. In the future when time and funding permitting, further study can be conducted to explore how preservice teachers'

pedagogical beliefs and their attitudes toward technology develop over the whole period in teacher education program. This may help the researchers and practitioners to learn more about the growth of preservice teachers and better prepare them for their future teaching.

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The Integrative Learning Design Framework: Combining Research Methods and Design Processes

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Introduction

Articulating a clear definition and process of design research is a current and prominent topic among educational researchers. Design studies involve complex interactions and feedback cycles that can significantly blur the roles of researchers, teachers, curriculum developers, instructional designers and assessment experts (Kelly and Lesh, 2000). As educational researchers struggle to clarify this research method, they raise significant questions such as how is design research different from the process of design? What are appropriate methods and processes that can be used in design research? How do we systematically create, test and disseminate design or teaching interventions that will have maximum impact on practice?

Kelly and Lesh (2000) and others (Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003; Collins, 1999; The Design-Based Research Collective, 2003) advocate that these emerging methods call for the articulation of new processes and criteria including factors such as the usefulness and usability of knowledge, its shareability, and marketability, how well it disseminates and the extent to which it positively impacts practice. Sabelli (personal communication, May 16, 2002) cites a need for organizational structure and protocol for the diffusion of research into practice and states that educational research situations are extremely complex systems that can benefit from integrated system research strategies.

There is a need for comprehensive models to guide design research addressing the process of designing, developing and assessing the impact of an educational innovation. Kelly (2004) points to the need for enhanced guidance and specification in challenging design researchers to “clarify in which stage and for what purposes methods are appropriate and inappropriate” to begin to “explore the necessary aspects of frameworks and findings of design studies” (p. 125). Researchers and practitioners in the field of instructional design and complementary design domains such as product design, usage-centered design and innovation development have much to offer in the emergent definition and process of design research. We present a synthesis of existing design and research processes offering a guiding framework that goes beyond the individual domains represented and challenges researchers to provide improved articulation of design research processes and consider the entire scope of research from initial conceptualization to diffusion and adoption.

The integrative learning design study (ILD) framework initially presented in previous article (Bannan-Ritland, 2003) and elaborated in this paper comprises a complementary process model based on several years of implementation in an instructional design evaluative context. Building on processes from multiple fields, ILD present a “meta-methodological” view that attempts to integrate the best of design, research and diffusion of educational innovations across a program of research. Traditional, behaviorist views of computer-assisted instruction development while offering valuable iterative processes, do not fully address the complexity inherent in a cognitively informed, contextually-based and data-driven decision-making process situated in educational practice. In response, the ILD model attempts to provide a comprehensive yet flexible guiding framework that positions design research as a socially-constructed, contextualized process of producing the most educationally effective product that has the best chance to be used in the classroom. The framework attempts to move past isolated, individual efforts of design research by clearly articulating a logically-ordered structural frame that considers the full spectrum of applied and experimental research methodology in advancing toward systemic impact in education and may be applied in a variety of contexts. Collins (1990; 1993) advocates for a similar overt, systematic methodology for conducting design experiments. He refers to many design efforts that do not adhere to systematic and rigorous processes stating:

“When designing a learning environment, whether computer based or not, there are a multitude of design decisions that must be made. Many of these design decisions are made unconsciously without any articulated view of the issues being addressed or the tradeoffs involved. It would be better if these design decisions were consciously considered, rather than unconsciously made (1993, p.1).”

Even in the best applications of systematic instructional design, many decisions are made in the

absence of a clear rationale and analysis of data. In attempting to combine research and design processes, design research strives to build knowledge about teaching and learning while also engineering an effective learning environment. In this manner, design research is a unique form of educational research because it requires investigators to pursue several questions across a program of research, often in concert. Barab and Squire (2004) describe this multi-level effort of design research as attempting to promote pragmatic change in local educational contexts while also advancing theoretical understanding about learning and cognition. Fishman, Marx, Blumenfeld, Krajcik, and Soloway (2004) propose a series of demanding research questions for the field related to the sustainability and diffusion of design research efforts that consider complex factors such as teacher learning, assessment, technology planning and organizational structure. Given the complexity of these multi-layered efforts, it is not surprising that design research demands multiple research questions and methods (Middleton, Gorard, Taylor & Bannan-Ritland, 2004). However, to promote "...a theory-driven process of designing and a data-driven process of refining" (National Research Council, 2002, p.122) educational artifacts that generate knowledge as well as address pragmatic problems in education, better articulation of the types of questions and methods appropriate for specific points in the process are needed.

The ILD process presents one step toward a systematic framework for the articulation and documentation of common phases and complementary stages based on multiple design and research processes promoting more conscious design research (Collins, 1990; 1999). It is presented here as a starting point for researchers to consider with the goal of eliciting questions, suggestions, limitations and criteria that may need to be considered as researchers struggle with the implications of this emerging form of educational research. In this paper, we briefly describe the progression of a design-based research study currently underway that illustrates an ILD. Then, the general ILD framework is abstracted from this example primarily represented through Figure 1 (Bannan-Ritland, 2003) with related implications and conclusions. The ILD example is described according to broad phases including 1) the informed exploration phase; 2) the enactment phase; 3) the evaluation phase; and 4) the dissemination phase that emerged from a recent design study, Literacy Access Online.

LiteracyAccess Online – An Integrative Learning Design Study

The LiteracyAccess Online (LAO) project¹ provides an example of the application of the integrative learning design framework illustrating the intersection and systematic expression of multiple design and research methods. LiteracyAccess Online is an effort to utilize Web-based technology to provide support for teachers, tutors, and parents (literacy facilitators) in addressing literacy goals for all children with a particular focus on those with disabilities. LAO provides a technology-based learning environment that promotes the use of specific literacy strategies for the improvement of tutoring and reading performance as the child and facilitator collaboratively engage in the process of reading online.

Related to the instructional and performance support goals of LAO, it was well established in the literature that one-to-one tutoring is one of the most effective forms of instruction for improving reading achievement but increased success often depends upon the skill of the tutor or facilitator and the establishment of consistent roles and expectations (Wasik, 1998). What was not well known was whether a technology system could support the complex interaction between parents, teachers, or tutors and children by providing a consistent environment and reading support for both members of the dyad.

The Informed Exploration Phase

The research objective of the LAO integrative learning design study was to investigate the nature of interaction, tool use and activities that occur as literacy facilitators and children simultaneously engage in the reading process using embedded metacognitive strategy and assistive technology supports. This objective resulted from extended investigation into the provision of literacy support for facilitators and children. Initial explorations into target audience and stakeholder perceptions, related products and literature and documentation of the complex nature of supporting literacy revealed many plausible paths for design research.

The interdisciplinary research team involved in the LAO project were charged with determining the research direction and consisted of educational researchers, teachers, graduate students, content experts in literacy, special education and assistive technology as well as parents involved in an advocacy group for children with disabilities. The research focus evolved from the team's perceived lack of support for children who were struggling with the literacy process based on direct observations of this problem in both classroom and home environments. Aligned with Confrey and Lachance's (2000) notion of drawing key inferences from dissatisfaction with current educational practices and direct experiences with children, initial theoretical

conjectures were developed that advocated for reading, writing and assistive technology support for children with or without disabilities to increase their engagement and performance in literacy.

While these initial theoretical conjectures provided a central premise and broad direction for design research, more information was needed to refine these conjectures resulting in a comprehensive needs analysis and literature review that provided a firm foundation for the intended design. Extensive exploration into appropriate literacy strategies, tutorial programs and processes, surveys of experts, teachers and parents as well as observations of children and facilitators engaged in a literacy experience all informed this phase of the research. Many potential design research directions were considered based on the initial conjectures, however, data drawn from conducted interviews, direct experience with potential research participants and literature review converged and pointed the team in a particular direction.

A prominent theme that emerged across initial interviews, surveys and observations with experts, parents, teachers and children revealed that literacy facilitators had a crucial role in providing support for children struggling to gain literacy skills and the question remained how to best support this role. These findings and related literature provided insight for informed theory and improved conjectures based on results indicating that 1) children can but often do not use effective metacognitive reading strategies; 2) explicitly teaching these strategies can greatly enhance children's comprehension of text; 3) teachers (as well as other literacy facilitators) need to be trained in how to provide cognitive structure for their students so that children can learn to guide their own generative processes in reading; and 4) one-to-one tutoring is one of the most effective forms of instruction for improving reading achievement but increased success often depends upon the skill of the tutor or facilitator and the establishment of consistent roles and expectations (Wittrock, 1998; National Reading Panel, 2000; Wasik, 1998).

This exploration into the literature and perspectives of those involved in these issues greatly refined our initial conjectures and dramatically changed our intended design direction for this research from a didactic, tutorial, child-focused intervention to a collaborative, story-based reading experience providing embedded metacognitive strategy support for both the literacy facilitator and the child's use. The rationale for this research direction was documented in a comprehensive needs analysis that detailed the data collection, conclusions and related literature review (see Literacy Access Online Phase Two, 2000).

The next stage of our research involved the analysis and description of the range of learners and facilitators that would potentially use the LAO system. Direct experience with 4th-8th grade children with or without disabilities, teachers, tutors, and parents provided data that characterized our audience. These descriptions were depicted as role models (Constantine & Lockwood, 1999) or personas (Cooper, 1999) that comprised abstract composite profiles of audience characteristics gleaned from actual interviews and observations and provided a focal point for design. Role models or personas are similar to Graue and Walsh's (1998) qualitative vignettes that strive to capture the substance of a setting, person or event to communicate a central theme of qualitative data, based on multiple direct observations.

Exploring the nature of the identified educational problem, related products and literature as well as creating and refining theoretical conjectures and descriptions of the audience provided an informed perspective for grounded design of a learning environment based on articulated theory. These activities resulted in specific research artifacts including a needs analysis that contained an extensive literature review, an articulated and congruent design and research direction and detailed audience analysis based on qualitative and quantitative data. These documents were housed on a project Web site (see for example, LAO Phase Four, 2000; LAO Phase Six, 2003) that provided a communication mechanism between team members as well as an archive of shareable design research processes, products and evidentiary data.

The Enactment Phase

The embodiment of the results of our informed exploration and theories about providing literacy support for children in a usable learning environment were collaboratively constructed across several stages and feedback cycles culminating in a Web-based prototype. The initial design of the LAO learning environment resulted directly from the design implications articulated in the previous phase of exploration, analyses and review. These implications were translated into an articulated prototype initially developed by building an abstract, paper-based model of the system for researcher and teacher input according to procedures adapted from usage-centered design (Constantine & Lockwood, 1999). The abstract representation of the LAO learning environment allowed for a fluid, flexible instantiation of theory through design that was described and presented to facilitators, teachers, an expert panel and researchers for feedback. Abstract modeling of the instantiated or enacted design provided opportunities for input and co-construction of LAO with several audience members prior to the more time-intensive computer-based production of the learning environment.

After several iterative cycles of feedback and revision of the articulated prototype, detailed design then took place through the production of flowcharts, technical specifications and storyboards eliciting feedback at each stage from the entire team and leading to the creation of a Web-based prototype. The methods of data collection employed at this stage included designer logs posted on the project Web site, expert panel reviews of the design and documented reviews of the design by content experts, audience members and the research team.

The Evaluation Phase

Once a physical prototype was in place, formative testing could commence and characterized the highly iterative nature of the evaluation phase as it informed and refined both our theories and redesign efforts. The complex interactions between facilitators and children that can occur in multiple settings formed the series of studies in LAO examining: 1) parent-child dyads in an informal setting with extensive involvement by researchers; 2) parent-child dyads in a structured workshop experience supported by researchers and; 3) pre-service-teacher dyads in a field trial closely modeling authentic conditions. When a fully functioning prototype was not yet available, studies attempted to closely mimic the tasks that would be embedded in LAO. The data gathering across these three studies incorporated observations, interviews, child and parent journal entries, videotaped use of system and pre- and post-online surveys. This multi-tiered, multi-method evaluation scheme generated useful knowledge and subsequent results from each stage of inquiry were then cycled into changes in theoretical conjectures, research design as well as system design. This process revealed insights into the core principles that may support the collaborative learning and implementation of metacognitive processes by literacy facilitators and children. Among the multiple findings of these initial studies were that 1) parent literacy facilitators could develop greater awareness and skill in implementing reading activities and identify supports for their child in a structured setting; 2) children showed improvement in literacy skills using technology-based support when participating in a guided workshop environment; and 3) pre-service teachers felt that the strategies and activities embedded in the LAO environment facilitated children's comprehension, motivation and interest when working with them in this environment. More rigorous evaluations are planned systematically increasing number of participants and varying contexts. These studies involve detailed tracking of computer-based activities of the dyads in school and home settings, assessment of facilitator and child use of metacognitive strategies prior to using LAO and pre- and post comprehension measures after several weeks of using the system.

The Dissemination Phase

The last phase of this design-based research effort involves disseminating LAO into the broad educational system. Although the LAO research has not yet fully progressed through this stage, initial explorations in this area have yielded some unique insights into the dissemination process. LAO, as a Web-based learning environment, affords the opportunity to publish current working prototypes online for open use and input that has resulted in an early and unique diffusion and adoption process begun prior to the completion of a fully functioning system. While still in development, we have tracked over 100 potential adopters that have discovered and explored the LAO site. The profiling and data-base capabilities of the site permit tracking and analysis of this information that has provided detailed information on potential adopters of the system providing significant insight and impact on sources for our later diffusion efforts. We plan to incorporate more sophisticated computer-based data collection and analysis techniques such as datamining (Tsantis & Castellani, 2001) that may yield even more insights into early adopters' behaviors, profiles and use of this new tool. We have just begun to publish our results of the design based research conducted related to LAO in traditional academic journals and non-traditional Web publishing that provide avenues for additional forms of review and evaluation. The results of our initial studies have prompted new research directions such as exploring the interaction of an online community for parents of children with disabilities incorporated in the LAO environment. Given the iterative nature of this type of research, it is highly likely that determining the consequences of the LAO design research effort will yield new theoretical and applied questions that will prompt the entire process once again.

Characteristics and Implications of the Integrative Learning Design Studies Framework

The LAO research represents the combination of existing empirical methods and applied practices that characterize the ILD framework (see Figure 1) incorporating the creativity of design communities with integration of and adherence to appropriate quantitative and qualitative methodology in education. Drawing

heavily upon traditions of instructional design (Shrock, 1991), product design (Ulrich & Eppinger, 2000), usage-centered design (Constantine & Lockwood, 1999), and diffusion of innovations (Rogers, 2003) as well as established educational research methodologies (Isaac & Michael, 1995), the ILD approach provides a combination of processes that in total represent an emergent perspective for viewing the spectrum of design research.

Mapping the individual stages in each phase presented in Figure 1 illustrates the limitations of individual design or research processes. For example, the basic educational research process demonstrates pronounced emphasis on the initial informed exploration phase that promotes the development of theory or hypotheses and a lack of attention to the enactment phase that involves development of educational interventions characterizing the primary difference between basic research and design research. Also incomplete are the design processes that do not clearly integrate empirical methods of reviewing the literature or formulating a research design.

The Informed Exploration phase of the LAO design research reflected in the ILD framework and other design research cycles or models resulted in a general design and research direction investigating technology-based reading strategy support in collaborative interaction between a literacy facilitator and child. While the team's explicated theoretical conjecture that a well-designed Web-based system may promote quality interactions and a high level of reading guidance by the facilitators, the specifics of this system were yet to be determined. Initially establishing clear learning targets or objectives for the enacted design allows the design researcher to characterize, describe and eventually test the intervention based on more specific learning criteria.

However, the integration of processes represented at the top of Figure 1 show that the series of actions reflective of different domains involved in design and research are highly complementary and can be synthesized into a comprehensive, highly iterative design research cycle that was followed in the LAO research. The individual processes have identified limitations. Limitations will certainly also exist for the ILD framework, however, it is through application in different design research contexts that these will begin to be unveiled and begin to inform the process presented here.

The LAO project employed evaluation procedures from different fields in the products' life cycle, progressing from high levels of involvement by the evaluators to authentic contexts and conditions. The questions at the Evaluation phase for the LAO project were how to ensure that the design was usable, effective and that the enacted theory of design had local validity or relevance to the potential target audience and context. Methods were employed based on usability testing and formative evaluation (Rubin, 1994; Tessmer, 1993). The LAO project has gone through at least four iterative cycles of development, usability and formative evaluation testing. During each evaluation cycle, different research methods were used to characterize the learning context, assess the interaction between literacy facilitator and child and determine learning/performance outcomes for the participants. In product development work, the testing and refinement phase is characterized by field testing the product and implementing any necessary design or assembly process changes. Similarly, usability testing involves identifying weaknesses in the product's interface and function to provide a design that fits the human user's capabilities and natural work processes. In the field of instructional design evaluation processes includes several stages of formative testing different from usability testing in that formative evaluation focuses on "...the strengths and weaknesses of the instruction" rather than the interface "to improve its effectiveness and appeal" (Tessmer, 1993, p.11). The formative evaluation process includes several types including expert review, one-to-one evaluation, small group evaluation and field testing.

The impact of a systematic process of conducting design research that incorporates the exploration and articulation of design direction and rationale, documentation of data-driven decision-making and multi-tiered, multi-method evaluations appropriate for specific phases of the research and design process remains to be seen in education. The LAO example briefly presented here attempts to 1) characterize the informed exploration and evolution of significant theoretical conjectures based on the convergence of multiple sources of data; 2) describe a progressive, socially-mediated design process that aligns with and operationalizes theory and is fluid and flexible; as well as 3) present a systematic and graduated scaling up of situated evaluation in multiple contexts. The example also provides an opportunity for capitalizing on small amounts of initial data yielded from highly accessible Web-based learning environments in a "proto-diffusion" form of evaluation.

Shavelson, Towne, Phillips and Feuer (2003) advocate that design studies are process focused in nature seeking to trace participant's patterns of learning as well as the impact of the educational intervention on that learning. We would argue that the ILD framework subsumes this perspective while also offering a process focused approach *for researchers* to trace their learning through the patterns of data generated in a design study to inform theory and provide documented evidence or warrant of educational impact based on the integration of established design and research methodologies. The nature of the educational phenomenon under study and

number of iterative cycles may vary, however, the ILD articulates a systematic process that may promote more conscious, data-driven, decision-making that researchers can follow and document.

Conclusion

This paper has presented a brief example and introduction to the ILD framework that comprises a meta-methodological view of the design research process in an attempt to elucidate common phases and stages in this specific research methodology. The framework initially presented in previous work (Bannan-Ritland, 2003) and elaborated here is presented to begin to establish common terminology and processes that can promote conscious design research. Most importantly, the ILD framework is an attempt to provide a roadmap for future design researchers to investigate, articulate, document and inform educational practice.

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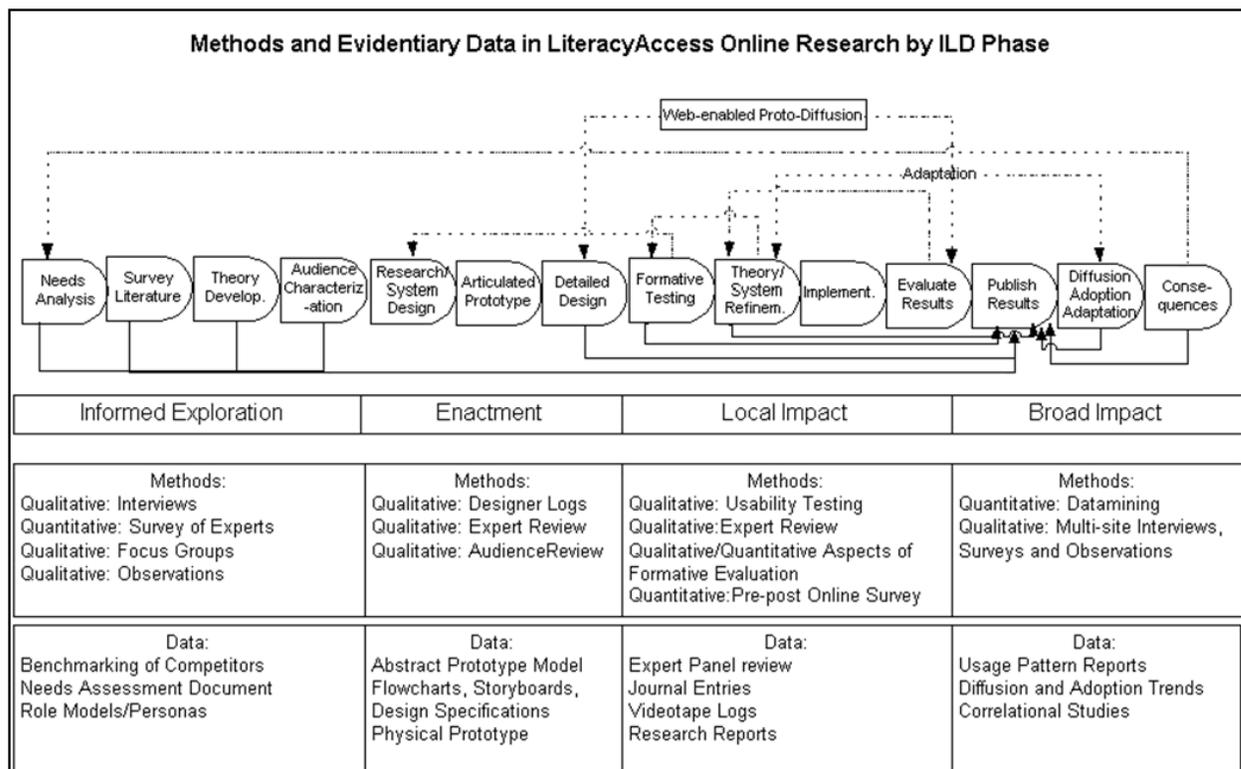


Figure 1: Integrative Learning Design study (ILD) framework.

Sustaining Motivation for Self-Learning in IT Experts: A Phenomenological Inquiry Based on a Model of Expertise Development

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Introduction

Much research has been done on the nature of expertise, and the differences between novices and experts in several domains. According to Anderson (2000), skill acquisition has a cognitive phase in which people learn the steps of a procedure, an associative phase in which the method is worked out and errors are reduced, and an autonomous phase in which skill becomes rapid and automatic. Experts have declarative knowledge about their domain proceduralized for greater efficiency of performance, and remember information about their domains in chunks rather than as individual items. They tend to reason forward from the givens of problems rather than backward from the problem statement, and can focus on the constructs underlying problems (bottom-up reasoning) rather than on surface features such as knowns and unknowns (top-down reasoning). When making decisions, as with chess players, for example (Horgan, 1988), experts do not require the exhaustive evaluations of alternatives that novices do, because their experience, memory, and domain-specific knowledge help them narrow the range of choices quickly.

Studies of experts in different domains have diversified the view of expertise. For example, expert computer programmers use top-down reasoning, as thinking about the breadth of their programs before the depth of each component leads to better-designed systems (Anderson, 2000). In a study of genetic counselors and biology professors, the genetic counselors focused more on surface features such as knowns and unknowns than did the professors, but still outperformed them on genetic problem-solving (Smith, 1992). The nature of particular domains, and the context in which skills are used influence what expertise looks like in terms of problem representation and solution techniques.

However, while aspects of the nature of expertise are becoming known, the research on explanations for differences in people's rate and level of expertise development is sparser than that examining how experts differ from novices (Alexander, 2003). Conclusions range from differences in deliberate practice, talent/ability, and motivation to differences in metacognition and cultural surroundings.

Here I will review the literature on the major explanations offered for individual differences in the development of expertise, propose a model of the interactions of several factors to produce differences in expertise development, and present the results of an initial qualitative study with information technology experts.

Deliberate Practice

We may watch an Olympic athlete or concert pianist and marvel at the "talent" these individuals possess. Some researchers, however, write that the extraordinary expertise of these accomplished performers is not proof of superior talent (Sloboda, 1996). Ericsson (1996, 2002) advocated *deliberate practice*, versus either talent or mere participation, as the explanation of differences in the development of expertise. In his studies of domains such as music, sports, and dance, where competitions can help identify and measure clearly superior performance, he concluded that expert performance is primarily acquired through many thousands of hours of deliberate training and practice, because he found direct positive correlations between hours of practice and achievement. Ericsson defined deliberate practice as periods of intense concentration and work that constantly push the limits of current capacity, four to five hours per day, preferably guided by the best teachers or coaches. This type of practice leads to cognitive, psychological, and physiological changes that produce expert performance. Ericsson wrote that in order to reach an international level of competition, people need at least 10 years of this type of guided deliberate practice, rather than special talent. Expert performers tend to start practicing two to five years earlier than less-accomplished performers, so over time tend to accumulate more hours of deliberate practice (Ericsson & Charness, 1997).

Anderson (2000) also stressed the role of practice, writing that chess masters, for example, were not more generally intelligent than other people; they just had practiced more. In his view, the improvement from practice was continuous, if at an ever-diminishing rate, and was virtually unlimited for cognitive skills.

According to Ericsson (2002), Anderson's three-step model of expertise applies to everyday skills, but once performance reaches the third stage of automaticity, one risks stagnation. To be truly expert, deliberate practice and specially designed training activities are necessary. In this way, performers can develop skill but retain cognitive control over aspects of the performance.

Underlying deliberate practice are motivation and the acquisition of domain-specific knowledge that can help one monitor learning activities (Ericsson, 1996), although Ericsson did not explore these factors extensively. Innate ability is a trivial consideration. Ericsson noted that athletes do not have better simple reaction time, memory, or perception of stimuli than other people. Although he acknowledged that musicians are more likely to have perfect pitch and that better typists can tap their fingers faster, he asserted that these abilities can be skills acquired through training and deliberate practice rather than being precursors to expertise.

Ericsson studied elite musicians and athletes who were guided intensely by coaches and teachers. Davidson, Howe, Moore, and Sloboda (1996), however, studied the involvement of parents with young musicians to see precisely how motivation and deliberate practice (and thereby expert performance) could be facilitated by parents. Although all the children experienced some parental involvement in practice, such as their listening to or requesting practice, successful children were found to have the most parental involvement in lessons as well, across an entire learning period of 12-15 years. When parents attended lessons and found out what the teachers were asking for, they were better able to guide practice at home. Davidson et al. (1996) acknowledged that children with greater talent might elicit greater parental involvement, but asserted that this would not explain the difference in rate of improvement over time, nor would it increase parental involvement in lessons. They envisioned a cycle in which parental behavior enhances achievement, which motivates further parental support, which in turn enhances achievement, and so on.

While Ericsson (1996, 2002) and Davidson et al. (1996) studied experts whose development was fostered by teachers and coaches, Charness, Krampe, and Mayr (1996) studied chess champions. While they found that deliberate practice carried the most weight in determining skill level, they also discovered that tutoring was relatively unimportant in this group. Although coaches early on might have helped to provide motivation and set up practice schedules, most champions studied and practiced alone. There was a significant correlation between the number chess books owned and achievement rating. At least in some domains, it may be possible to establish self-learning situations that facilitate expertise development at least as well as teachers and coaches do.

Ability and Talent

Sternberg (1996) wrote that much of the deliberate practice research is fundamentally flawed. According to him, it ignores contradictory findings, such as work in behavior genetics. He also cited cases in which students who perform better have worked less; for example, in one of his statistics courses, students who reported studying longer made lower midterm scores, which he took to mean that practice without ability does not produce rewards. In addition, Sternberg pointed out that studies of deliberate practice involve correlation, not causation, and do not use control groups, making it difficult to compare experts with those who have had as many hours of deliberate practice but have not become experts. Deliberate practice studies, according to Sternberg, ignore the fact that many people who seek a high level of expertise in a domain often drop out due to dissatisfaction with their performance, so naturally those who remain display a correlation between expertise and practice. Finally, Sternberg argued that deliberate practice studies ignore common sense. What Mozart accomplished as a child is seldom matched by those who accumulate as much practice as he had had at that time, for example. Some graduate students are better teachers after one semester than are professors who have taught for many years, despite their inexperience. Deliberate practice, therefore, is responsible for only part of expert performance.

According to Sternberg (1996), trying is not enough, even when it takes the form of deliberate practice. It is likely that Winner (1996) would agree. In a study of children's drawings, she found evidence to support the existence of an innate talent in the domain of the visual arts. She found that children who have high ability at a young age tend to learn more rapidly in the domain, are intrinsically motivated because of the ease of their learning, make artistic discoveries, such as perspective, without scaffolding from adults, and tend to do creative things that ordinary children do not think to do. These children tended to draw constantly without being told, with progressively better results. "Regular" children may work hard, but their progress over the years was much slower than that of artistically gifted children. Although she agreed that hard work is necessary, she argued that it is not sufficient, and moreover it is difficult to separate hard work and ability. They are confounded because we are likely to want to work hard at something that we can do easily. In any case, Winner

found it illogical to ascribe mental retardation to a biological bases yet claim that high performance is due only to hard work.

Metacognition

Apart from the debate over deliberate practice versus the role of ability, other factors contribute to individual differences in the development of expertise. Sternberg (1998) wrote that along with abilities, metacognition contributes to the development of expertise. Reasoning that metacognition operates independent of domain, intelligence, and knowledge (as mere knowledge does not always lead to action), Veenman and Elshout (1999) investigated the role of metacognition along with intelligence, to see whether metacognition would contribute separately toward developing expertise. They found that the advanced students had higher metacognitive skillfulness in comparison to novices of both high and low intelligence levels. However, highly intelligent novices nearly reached the metacognitive level of advanced students, and tended to rapidly gain knowledge in the physics domain. For both novices and advanced students, metacognition contributed on its own, apart from intelligence.

However, very complex problems were solved by the high-intelligence students only. At that high level, metacognitive skillfulness was no longer helpful for problem solving. The authors conclude that routine metacognitive skills are more important than intelligence for routine problems but not for very difficult problems, perhaps because at that point problems no longer concern students' proceduralized knowledge but rather require knowledge at the conceptual level, which higher-intelligence students may be better able to use.

Cultural Factors

In considering how and why experts are motivated to work longer and harder than others, thus acquiring knowledge, skills, and the useful psychological and physiological changes that come from practice (e.g. Ericsson 1996), Gleespen (1996) sought other sources of motivation support than the aforementioned parents and coaches. His cultural theory of expertise development states that the cultures of experts tend to support learning and development, and are replete with resources and opportunities in the relevant domain. This can include teachers and parents where children are concerned, or colleagues and communities of practice for adults. In a setting in which experts and learners acknowledge each other's skills, collaborate and critique each other's performance, and share advice, an attractive environment for achievement is created. When people are separated from this environment, either by finding themselves in an unfamiliar environment or by returning from a supportive environment to a normative environment that does not support the domain, their performance levels are likely to drop.

The idea of community support leading to expertise in certain domains may also apply to those who study relatively alone, such as the chess players observed by Charness, Krampe, and Mayr (1996). While these chess champions generally did not have coaches or live in communities of other chess players, they participated regularly in tournaments that allowed them to receive feedback with which to gauge their progress, and learning opportunities that may have helped to refine their future solitary practice. In addition, with the Internet it may now be easier than ever for people who had pursued a passion in relative isolation to create a lively virtual community that provides all the expertise-supporting advantages mentioned by Gleespen (1996), and that is less sensitive to changes in a participant's physical location than is the neighborhood in which one lives or the workplace in which one is employed. Now that cultural support is more accessible and portable for many domains, it remains to be seen whether levels of participants' expertise, or the number of existing experts, has risen.

Toward A Multifaceted Model of Differences in Expertise

A unitary model (deliberate practice only, talent only, for example) is too simplistic to capture the range of factors underlying differences in the development of expertise. Sternberg (1999) proposes that intelligence is the same as developing expertise, and while ability affects the rate and asymptote of development in a domain, expertise has five elements: metacognitive skills, learning skills (ability to distinguish relevant from irrelevant information, for example), thinking skills (creativity, critical thinking, practical and applied thinking, etc.), declarative and procedural knowledge, motivation, and context (familiarity of material, importance to the student, for example). Presumably individual differences in any of these factors could lead to individual differences in expertise development itself.

Sternberg's multifactorial explanation of expertise is welcome in the face of overly simplified models. However, it does not explain how these elements may be related, and does not elaborate on the motivation

component. That motivation is required on the path to expertise is unsurprising; those with no motivation for developing expertise are unlikely to persist in the domain. However, what form this motivation may take has been largely unexplored in studies of expertise. Despite the paucity of research, the theories of achievement goals, self-efficacy, and flow suggest connections to other factors in expertise development.

Achievement goals

People often describe developing experts as “goal-oriented.” In Dweck’s study of adaptive and maladaptive motivational patterns (1986), she described goal-oriented activity with two factors, learning and performance goals. Individuals with learning goals “seek to increase their competence, to understand or master something new,” while those with performance goals “seek to gain favorable judgments of their competence” (p.1040). In their work, Elliott and his colleagues have further divided performance goals into performance-approach and performance-avoidance goals. Those with performance-approach goals wish to do better than others, while those with performance-avoidance strive to avoid doing worse than others (Elliott & Church, 1997; Elliott & Thrash, 2001). Performance-approach goal regulation can include either a need for achievement, in which people eagerly approach the task, or a fear of failure, in which people approach the task and work very hard (overstrive) because they do not want to fail (Harackiewicz, Barron, Pintrich, Elliott, & Thrash, 2002b). Performance-avoidant people try to escape the achievement situation altogether, or as Dweck (1986) also described, choose very easy or very difficult tasks.

Because achievement goal studies often focus on subjects who are not necessarily experts, it is difficult to hypothesize about the specific goals of experts by relying on previous research. However, the expectation of high self-efficacy in experts, and the fact that experts are people who perform well on challenging domain-related tasks, imply that experts are likely to hold learning goals as well as performance-approach goals. Recent research addresses the possibility that people may not be dominated by either learning or performance goals but may endorse multiple goals, and that a combination of learning and performance-approach goals is beneficial to achievement. *Harackiewicz, Barron, Tauer, Carter, and Elliot (2000) studied introductory psychology college students over three semesters, and found that performance-approach goals predicted short- and long-term academic performance and that mastery goals predicted short-term interest in the course and enrollment in subsequent psychology courses. Therefore they suggested that optimal goal adoption consist of both performance-approach and mastery goals, because both grade performance and continued interest are important to success in college. When the researchers followed some of these students to graduation (Harackiewicz, Barron, Tauer, & Elliot, 2002a), they found the same predictive pattern, although the effects of performance goals weakened over time.*

Accepting that practice is one factor leading to expertise, and that deliberate practice involves intense concentration and continuous striving for progress, it would seem that learning/mastery goals would be effective in expertise development, since learning goals tend to foster persistence, effort, and improvement (Dweck, 1996). Because expertise requires years of involvement in a domain, the interest-sustaining properties of learning goals (*Harackiewicz et al., 2000, 2002a*) would also be important. However, many expertise domains, such as music and athletics, are dominated by the need to perform for others, and even in settings such as the workplace one must be concerned with performance and others’ judgments of one’s ability. It is also possible that people with little inclination to demonstrate their competence to others would not become known as experts. Therefore, those who have been successful in developing expertise are likely to have both learning goals and performance-approach goals to some degree, similar to the successful college students in *Harackiewicz et al. (2000, 2002a)*.

Self-efficacy

Perceived ability, also known as self-efficacy (Bandura, 1994), interacts with achievement goals, as mentioned above. When perceived ability is high, people tend to persist when challenged regardless of goal type, but when perceived ability is low, they give up quickly if driven by performance goals, which is incompatible with the development of expertise. High self-efficacy also leads people to set higher goals, which in turn raises the level of motivation for and attainment of the task (Bandura, 1989), all of which would contribute to expert performance.

However, self-efficacy also affects expert performance directly (Bandura, 1989, 1994). In a difficult performance situation, people with high self-efficacy believe that they can cope with challenges, and therefore are not unduly bothered by them and can remain task-oriented. However, people with low self-efficacy become consumed with self-doubt during a challenging performance. The self-doubt is distracting, causing anxiety and

interfering with thinking and concentration, thus leading to a lower quality of performance. The lower quality of performance then leads to lower self-efficacy for the future, and the cycle continues. In the road to expertise, then, self-efficacy exerts an influence on motivation by interacting with goals, but also has a direct connection to task performance itself.

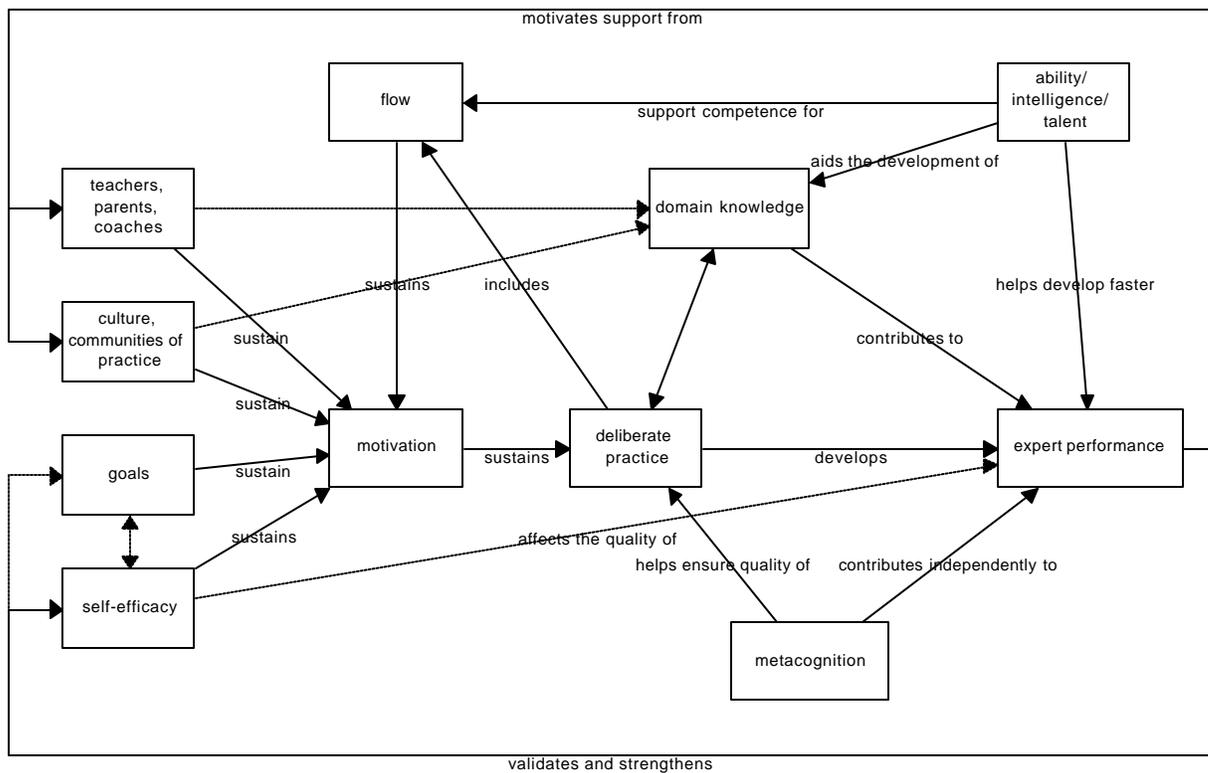
Flow

Given the importance of deliberate practice as a component of expertise development, and given that deliberate practice is characterized by intense concentration that pushes the boundaries of capacity, it is possible that individuals engaged in deliberate practice experience flow (Csikszentmihalyi, 1990). Individuals in flow are in a self-chosen and optimally challenging environment in which their ability and the task challenges are well matched. The task is difficult enough to require some skill, and the performer is no longer a complete novice (or her skill level would be too low to be able to perform well enough to achieve flow). Self-efficacy is high, so intrusive feelings of self-doubt do not interrupt the performance of the task. The task has a clear goal, and the task environment provides feedback that is comprehensible to the performer and to which he is able to react appropriately. The intense concentration drives out distracting extraneous thoughts and worries, and leads the performer to lose track of time. In this state the performer has a sense of control and competence, but is still challenged. While during flow the performer loses the habitual sense of self-consciousness, afterward people often feel a stronger sense of self. At the time the flow experience may be too intense to feel pleasurable (or people are too engaged in it to stop and think about whether it is pleasurable), but later one looks back on it with happiness, accomplishment, and satisfaction, which is rarely the case with more relaxing pursuits. In the context of expertise, flow and deliberate practice may sometimes be one and the same, or flow may be a particularly rewarding component of practice and performance that in turn motivates further practice.

A Model of Factors Influencing the Development of Expertise

In Figure 1, “Factors Influencing the Development of Expertise,” I propose a set of relationships between aspects of expert performance described in the literature summarized above, such as deliberate practice, motivation, support from teachers and coaches, support from culture and communities of practice, metacognition, domain knowledge, and talent/intelligence. I also include factors not previously linked explicitly to individual differences in the development of expertise, such as goals, self-efficacy, and flow.

Figure 1. *Factors Influencing the Development of Expertise*



Description of the Model

In the model, four primary elements lead to motivation: support from teachers, parents, and/or coaches; support from one’s culture or community of practice; goals; and values. Support from teachers, parents and coaches would tend to be individualized and more intense than that from culture and communities of practice, but both serve to add to domain knowledge and sustain motivation. Having specific goals, perhaps especially learning goals, also contributes to motivation, as does placing value on the goal or domain. Motivation in turn sustains the work of deliberate practice, necessary for expert achievement. Deliberate practice may include periods of flow that sustain motivation to engage in further practice. In the model, ability/ intelligence/talent helps expert performance develop faster and farther. It also aids in the faster accrual of domain knowledge, and supports flow, because a fairly high level of competence is necessary to achieve flow. Domain knowledge in turn contributes to the effectiveness of deliberate practice and in turn is increased by it, and also contributes to expert performance directly. Metacognition helps ensure the quality of deliberate practice as well as contributes independently to expert performance. Finally, expert performance starts the cycle again, as it tends to foster further support from teachers and the like, along with cultures and communities of practice to whom one’s accomplishments become known. It also validates and strengthens the original goals and values that led to motivation in the first place.

This preliminary model can help to illustrate some of the ways in which individuals may differ from one another in the development of expertise. A failure in any node of the structure has the potential to imperil or delay expertise development. For example, lack of support from one’s culture or lack of proper instruction diminishes motivation and domain knowledge. Failure to engage in deliberate practice detracts from performance, but also fails to develop domain knowledge. Low talent or intelligence puts domain knowledge, the possibility of flow, and expert performance at risk. Just as expert performance is the result of many related factors, differences in the achievement of expertise can be due to one or more of several causes.

Rationale for a Qualitative Study

Pursuing a new, complex model such as “Factors Influencing the Development of Expertise” with quantitative methods first may be presuming too much about the experiences of experts. Therefore, I conducted

an initial qualitative study of a group of experts in order to have a better understanding of if and how the hypothesized elements in the model exist in people developing expertise.

Although the nature and development of expertise in general have been widely studied, little work has been done on the motivational characteristics of developing experts, or on those who teach themselves to the level of expertise. Since there remains much to be learned about those who self-teach, a qualitative approach would allow for a full exploration of the phenomenon by allowing those who do it to explain and describe it as they experience it. A qualitative study may help identify categories and themes that will allow for further, more narrowly -focused quantitative work.

Purpose

For this purpose, any group of experts would arguably be appropriate. At least in initial studies, however, the domain of expertise should be the same or similar for all members of the subject group, because the characteristics of the domain itself may influence the nature of its experts so much that the results of qualitative studies with experts from multiple domains may be difficult to interpret. I chose self-taught information technology (IT) experts for this study. Information technology is a complex and varied field that is constantly changing. Experts in this field must acquire and continuously update a large amount of domain knowledge, such as network structures and programming languages, and be able to use it effectively. Although the field is demanding and often stressful, information technology products and people are present throughout the economy (Hilton, 2001), so this domain of expertise is less exclusive than that of the elite athletes and musicians studied by other expertise researchers.

Unlike many other professions, the field of information technology is made up of people who come from a variety of educational backgrounds. Employers are more interested in the hands-on experience and technical knowledge of potential hires than in their degrees. One-third of IT workers have only a high school diploma or two-year degree, and of the two-thirds that have at least a bachelor's degree, less than half have a major or minor in a computer-related field (Hilton, 2001). Therefore, most IT workers have come by their knowledge from informal learning or self-teaching, similar to the chess players studied by Charness, Krampe, and Mayr (1996). Achieving expertise is effortful in all domains, but self-taught IT workers seem to have accomplished it with less formal support (teachers, coaches, degree programs) than have experts in areas where the path to success is less self-determined. Therefore self-taught IT experts might be exemplary in their ability to forge their own path to expertise, and their techniques illuminating to others who are attempting to do so, or to figure out how expertise development happens.

The purpose of this initial qualitative study is to explore the self-teaching strategies and behaviors of developing IT experts, and to see whether there is support in the data for the factors included in the expertise development model. The central questions of the study are:

1. What are the characteristics of self-taught IT workers?
2. How do those who become experts on their own find and utilize appropriate resources to support their development?
3. How do they measure their progress?
4. What sustains their motivation?

Since many other workers today must learn and adapt to new technology quickly, often without formal training, the strategies of self-taught IT experts could help others learn technology easier and more thoroughly.

Phenomenological Approach

A phenomenological approach describes the meaning of the experiences of a group of individuals who have undergone the same phenomenon. Its roots are in the philosophy of Husserl, Heidegger, Sartre, and Merleau-Ponty. Phenomenological study involves the search for the essence of the meaning of an experienced phenomenon. Data analysis in phenomenology aims to reduce the information into a set of themes (Creswell, 1998). Those who are participants in a phenomenological study must have experienced the phenomenon to be in the study group. Researchers allow the participants to explain their experience of the phenomenon from their own perspectives and in their own voices.

Sampling

Because a phenomenological approach requires participants to have experienced the phenomenon of interest, criterion sampling was used. In this study, the criterion was met if participants answered “yes” to both of the following questions: “Are you currently working in the information technology / computer science field? Is the knowledge of information technology that you are using in your work derived mainly from self-study (as opposed to formal university coursework or training classes)?”

However, another qualification is that the workers have to be well along the path to expertise. Testing the IT knowledge of the interviewees with some sort of task was impractical, not only because it would have been overly demanding of the time of the subjects but also because the IT workers can come from various subfields which may not share all of the same content (although according to Hilton (2001) they do share roughly the same percentage of informal learners). The best-performing IT workers, however, build communications with other IT colleagues and spend a lot of time gathering and sharing information (Hilton, 2001). IT work also has results that are easily observable by others—whether the application works, whether the database is useful, whether or not the servers run well—so workers’ level of performance is not easily hidden, especially from other IT professionals. Through these methods IT workers can come to know the skill levels of others. Therefore a snowball sampling technique, in which knowledgeable people recommend other cases who in turn recommend other cases, and so on (Gall, Gall, & Borg, 2003), was appropriate in conjunction with the qualifying questions. The initial cases were experienced IT managers known to the researcher. Six people were interviewed for this study.

Data Collection

Data collection included audiotaping interviews conducted questions derived from the elements of the model “Factors Influencing the Development of Expertise.” An initial interview was conducted with each participant, and followed up and verified as needed while data analysis continued. To ensure confidentiality, each participant chose a code name; in the results all participants are indicated by their code names. Other forms of qualitative data collection, such as observation, were less helpful in this specific study. When a learner sits at the computer, perhaps with a manual or some other study material, there is little in the way of conversation or interaction to observe. In future studies, however, conversations between IT workers, chat logs, or discussion board postings could be useful.

Data Analysis

The modification of the Stevick-Colaizzi-Keen method for analyzing qualitative data in the phenomenological tradition, as described in Creswell (1998), was the model for handling the qualitative data collected. Beginning with transcripts from audiotaped interviews with the subjects, I listed out significant statements (sentences, clauses, or phrases) about how individuals experienced the phenomenon, giving them equal worth. Using statements instead of codes allowed for longer units of meaning, since some of the participants’ thoughts cannot be adequately summed up in a word or two. I eliminated statements that are not relevant to the topic of interest, and removed or combined statements that overlap with other statements. I grouped the statements into clusters, or categories, of meaning, and displayed them in tables. Finally I constructed a blended description of the overall meaning of people’s experiences, and then took the information back to the participants for verification.

Results

The following tables list some significant statements from interviewees on the categories that emerged from the data. Each category is labeled with its title and followed, in parentheses, by the element of the expertise model to which the category relates, or the topic of the research question addressed. Each table is followed by a brief composite description.

Table 1. *Curious about Technology Early On (Talent/Ability, Research Question 1: Characteristics)*

| Subject code name | Statement |
|-------------------|--|
| Bigglesworth | “Ever since I was a kid I pulled knobs off of things, pulled things apart.” |
| Skippy | “I got curious about the operating system and I broke our brand-new computer.” |
| | “When I was in 5 th or 6 th grade in elementary school...that was my first system administration gig.” |

| | |
|----------|--|
| | “They shipped them with books, and I read them and played around....Reading the manuals, and error and error.” |
| Bub | “I always enjoyed building things, putting things together and seeing how they worked.” |
| Robotech | “I started taking programming classes when I was in the eighth grade. I just kind of steered towards it. It was just a natural fit.” |
| | “I’ve always been real gadgety, taking stereos apart, things like that.” |

The subjects reported being interested in taking things apart to see how they worked. They often began using computers in elementary school. Instead of merely running programs on them or playing with them, they examined their inner system structures, sometimes with unexpected results, and started programming them.

Table 2. *Current Duties (Research Question 1: Characteristics)*

| Subject code name | Statement |
|-------------------|--|
| Bigglesworth | “I am an IT Analyst. My primary duties—I am lead programmer, so I am also assisting the other coders in my department, helping with direction and everything like that. My primary task is just to develop applications.” |
| Skippy | “I’m the alpha geek.” “I keep the machines running right, I write a bit of code here and there. I think my main responsibility is as the fallback guy in the office.” |
| Bub Robotech | “It’s largely user support. There’s also network maintenance and some [database] design.” “We do all the technical manuals....We’ve got our network servers, work stations, about 25 users...Right now I’m developing three training courses...I’m a system administrator.” |
| Elroy | “Mostly administrivia, much to my chagrin.” “Every chance I get..I’m either doing systems work, which is my home, or I tend to try to work on database and web applications of one kind of another.” |
| Trogdor | “Systems administration...secondly, programming, because that’s really what I enjoy most of all.” |

The IT workers came from different areas of the field, and had multiple duties. The current responsibilities of the IT workers include programming and systems administration, user support and training, database design, administration, and serving as a resource to less experienced workers.

Table 3. *Enjoying Optimal Challenge, Learning (Flow, Research Question 4: Sustaining Motivation)*

| Subject code name | Statement |
|-------------------|---|
| Bigglesworth | “It’s not so challenging it just drives you insane, but it’s not so easy that you’re bored.” “When you conquer it you go, ‘Cool, now I know how to do that.’” “It keeps you right on the edge.” |
| Skippy | “Solving problems and making lights turn green, that’s where it’s at.” “Not knowing how stuff works itches.” |
| Bub Robotech | “Finding a solution is definitely a major relief.” “I’ve conquered it. That’s my biggest feeling. I’ve defeated it. I’m the master of the world.” |
| Elroy | “A different manifestation of the theory of relativity....It literally seems like minutes and it’s been hours. It applies to the high and low moments, the breakthrough and really frustrating moments. They both pass as part of one big continuum” “I don’t have any trouble blocking out distractions.” “...Being happy about getting my mind around it.” |
| Trogdor | “I get something to work, and it’s like, ‘Wooh, yay!’ I probably get up and dance around.” |

The participants enjoy the challenge of problem-solving and learning how new technology works. When they solve a problem or figure something out, they experience feelings of happiness, satisfaction, or relief. Some describe a state of optimal challenge, where they are working at the edge of their skill level and the task is neither impossibly difficult nor too easy, which is consistent with the concept of flow.

Table 4. *Sense of Focus while Learning and Working (Flow, Research Question 4: Sustaining Motivation)*

| Subject code name | Statement |
|-------------------|--|
| Bigglesworth | “I’d come into work at 8 and wouldn’t leave until 8, learning it.” “I put headsets on and listen to music.” |
| Skippy | “It’s called larval stage. You just kind of shut out everything and turn completely inside, and you re-emerge later.” “I don’t hear people’s voices and I don’t hear the phone. I certainly don’t see the clock.” “On some level your mind is trying to protect your process.” |
| Bub | “It can happen. It doesn’t happen often, just because of the nature of this job. I wear so many hats.” |
| Robotech | “I get there about 6:15 in the morning, and the next thing I know is it’s already 2:00, and I leave at about 10 after 3:00.” |
| Elroy | “A different manifestation of the theory of relativity....It literally seems like minutes and it’s been hours. It applies to the high and low moments, the breakthrough and really frustrating moments. They both pass as part of one big continuum” “I don’t have any trouble blocking out distractions.” |
| Trogdor | “If the circumstances are right, I can definitely get sucked in, and get in the whole flow experience, however you pronounce that guy’s name that wrote that book... In fact I’m very much influenced by that goal in choosing what I try to do.” |

The interviewees are capable of intense focus while learning new information technology—what Skippy called “larval stage.” They block out external distractions, such as others’ voices, and sometimes lose the sense of the passage of time. Trogdor (unprompted by the researcher) even used the word “flow” to describe his experiences, and mentioned that it was a motivator in choosing tasks. However, the nature of the job can interfere with this sense of focus; Bub reported that he is constantly getting interrupted.

Table 5. *Making Connections to Prior Knowledge (Metacognition, Domain Knowledge, Research Question 1: Characteristics)*

| Subject code name | Statement |
|-------------------|---|
| Bigglesworth | “If you’ve learned one language sometimes it translates into another. I was able to translate some of the knowledge I had previously in C to Perl.” |
| Skippy | “It’s as much of a shift between the old version and the new version as between Windows NT and 2000.” |
| Bub | “The basics are always there, it’s just new applications for them.” |
| Robotech | “If it’s a Windows-based product or an Apple product, I can pick it up within a couple of months.” |

The interviewees described how they used prior knowledge to help with the new learning task. In Skippy’s case, he had experience shifting from one server version to another, and had used some of the components of the current system, such as Active Directory. Bigglesworth, who was learning a new programming language, found connections between it and a language he had previously mastered. Bub based his approach to computer security on the basics of how computers work, and Robotech used his knowledge of operating systems to understand new applications.

Table 6. *Finding Resources with Help from Others (Culture, Research Question 2: Finding Resources)*

| Subject code name | Statement |
|-------------------|--|
| Bigglesworth | “[The book] was by recommendation, a lot of my friends that I know who are in IT.” |
| Skippy | “Geeks talk about books a lot.” |
| Bub | “There are a number of web sites that I check on a regular basis....We also have a mailing list here...of IT people, called Tech Support.” |
| Robotech | “The course that they sent me to was helpful.” |
| Elroy | “If I had seen someone swear by a book I would just order it or buy it.” |
| Trogdor | “After Amazon.com, I’d say wait, let me check that book out. And everybody trashed that book. Aha! OK, it wasn’t me, it was the book.” |

The interviewees got information from a variety of sources about which resources to use when learning new technology. When the technology is new, only the manufacturer's documentation is available. However, when there are multiple sources, information can be obtained from fellow "geeks," either in person, through the World Wide Web, through mailing lists, through e-mail, or on Usenet. Both interviewees mentioned books as an important source, and that other IT people make recommendations about good books. Trogdor followed the reviews on Amazon.com, while Robotech said that they vary too much to be useful.

Table 7. *Learning Activities (Deliberate Practice, Research Question 2: Using Resources)*

| Subject code name | Statement |
|-------------------|---|
| Bigglesworth | "I came up with problems for myself." |
| Skippy | "The first thing I did was read the documentation front to back at a sitting." "You think of a configuration, 'Can I get it to do this?'" |
| Bub | "I will experiment with ideas at home on my smaller systems that might be translatable to the larger systems here." |
| Robotech | "Usually I sat there and hacked away at it." |
| Elroy | "Many, many, many nights of just staying in the server room until it got resolved in some way." |
| Trogdor | "Assembly language is the hardest language, except for maybe direct machine code...so if I could write in assembly language, then I was a real programmer." |

When setting out to learn new software or a new language, reading the documentation was an important first step. Then the learners moved to the keyboard to apply the knowledge, using problems or scenarios they made up that either teach general principals or resemble situations in the workplace. When difficulties are encountered, they often stay working on the problem for a long period of time until it is resolved, sometimes referring to documentation or the Internet for advice.

Table 8. *Measuring Progress (Metacognition, Research Question 3: Measuring Progress)*

| Subject code name | Statement |
|-------------------|---|
| Bigglesworth | "I usually go back and look at what I've done before." |
| Skippy | "While learning, keep checking, 'OK, now what am I missing?'" |
| Bub | "The fact that we haven't had a major attack in a long time is probably the best indicator." |
| Robotech | "Hopefully I have people henpecking me a lot, because if they do it means they trust me to help them fix whatever it is....If I go in there in the morning and not get badgered every 30 minutes, I know something's wrong. Or everything's working really well." |
| Elroy | "Most of the time, my thought is really, am I enjoying it or not. And as long as it's yes, I keep going." |

With these IT workers, the indicator of progress was idiosyncratic. For Skippy, measuring progress with a new software package included repeatedly going through the options to see what has yet to be learned. For Bigglesworth, learning a new language involved looking at one's old code with more experienced eyes, to detect differences between what was done in the past and how much better it could be done now. For Bub, the absence of attacks on the system indicated that he was keeping up with security information. Robotech gauged his knowledge by the amount of questions other workers asked him. Elroy used a feeling of enjoyment as a barometer of how much he was learning.

Table 9. *Reluctance to Ask Questions (Culture, Research Question 1: Characteristics)*

| Subject code name | Statement |
|-------------------|---|
| Bigglesworth | "I've worked on the same problem for about two weeks before I'd finally given up and asked." "If someone tells me something it kind of goes in one ear and out the other a lot of times." "I feel like in order for me to learn, I have to actually sit down and go through the process for me to be getting it." |
| Skippy | "The harder the question, the less likely it is that somebody else will know the answer off the top of their head." "You'd better be damn sure it's a good question." |

| | |
|----------|---|
| Robotech | <p>“It’s about the worst thing you can do in the world, to waste a geek’s time.”</p> <p>“It’s easier to go ask somebody and have them show you than it is to spend hours looking the answer up.”</p> <p>“I only want to ask them if it’s absolutely necessary. If I’m going to do something that I know will cause problems if I do it wrong, I might ask first.”</p> |
|----------|---|

While learning, some of the IT workers tried to figure things out for themselves using sources such as books and the Internet, rather than asking someone a question. Even when the answer was not found quickly, they continued to search on their own—up to two weeks for Bigglesworth. The reasons for this reluctance to ask questions include the perception that the question is too difficult for someone else to answer easily, the desire not to waste another’s time, the belief that getting answers from others diminishes one’s own learning, and the satisfaction resulting from figuring it out oneself. Robotech was more willing to ask questions, but only when the task was important and the time savings was significant.

Table 10. *Goals for Self-Learning (Goals, Research Question 4: Sustaining Motivation)*

| Subject code name | Statement |
|-------------------|---|
| Bigglesworth | <p>“Learning it because I needed to for a project or a problem that I needed to solve, that’s definitely a big factor.”</p> <p>“I also went above the knowledge I needed to learn. I went and learned more simply because you know it may come in handy later.”</p> <p>“I enjoyed it.”</p> <p>“But it’s just one of those things that stimulates you to go and try to do more because you know you’ve ... got to show off your skills in front of somebody else.”</p> |
| Skippy | <p>“There’s the utility of it, if you have this you can do this.”</p> <p>“There’s a little ego thing, being the guy in the office who can say yeah, actually that’s done this way.”</p> <p>“Mostly it’s just fun digging around. It’s a video game, it’s a new toy at Christmas, take it apart, see how it works.”</p> |
| Bub | <p>“It’s keeping the information stores here safe that are entrusted to me, and making the computer and information resources available to the people that I serve without interruption.”</p> |
| Robotech | <p>“The more I knew, the less stress I’d be under. That was the real thing, was just to make my job easier.”</p> |
| Elroy | <p>“If it is something I’m just curious about...my goals would differ from something from work that I have to learn. Usually those are where you have to get to where you can satisfy the business need by this time.”</p> |
| Trogdor | <p>“I almost see fun as a given.”</p> <p>“I feel very, very motivated to constantly be making sure that I’m learning stuff.”</p> <p>“So I also like technologies based on, how’s this going to benefit my resume.”</p> |

The participants’ statements regarding their goals reveal many different goal types operating at the same time. They mentioned learning for future utility, solving current problems in the workplace but also learning more than is needed immediately because the knowledge might be useful later. In addition, they intrinsically enjoyed working with the new technology and learning new things. Some also reported concerns about others’ opinions of their abilities, which could be characterized as performance goals. It is important to some of them that they are seen as a source of information on new technology, and that others realize what they have accomplished.

Discussion

Overall, the responses of the IT experts supported many of the elements in the proposed expertise model, even though they worked in different areas of IT. Participants reported having a talent for working with technology, getting support in their learning from others in their physical or virtual community, experiencing flow while learning, using metacognitive strategies, engaging in deliberate practice, and holding multiple goals. Self-taught IT workers had been using technology from an early age, linked new knowledge to prior knowledge when learning, and were reluctant to immediately ask questions. They found learning resources based on

recommendations from friends or strangers in person or online, weighing the advice they got against their own experience. While learning they set up tasks for themselves and persisted in the face of problems or difficulties, but measured progress each in their own way. The challenge, focus, and satisfaction of the flow experience kept them motivated, especially when they had uninterrupted time. The IT workers acknowledged a variety of goals, including learning, performance, and future utility goals, either acting at different times or simultaneously.

One limitation of the study concerns the difficulty of identifying experts in the domain, even though development of expertise, as opposed to a specific level of expertise, was the issue at hand. Although the snowball method identified IT workers who were at a level of expertise, they still might not have been at the same level of expertise. In addition, the IT experts studied may have learned in a variety of settings in the past, even if they were primarily self-taught. I eliminated from the study any IT worker whose undergraduate or graduate degree was in computer science, computer engineering, management information systems, or a related field. Eliminating those who had taken shorter-term training courses would have been impractical and probably unnecessary, as an IT worker with several years of self-taught experience along with a few one-week training courses is arguably more influenced by the self-teaching than the short courses. Therefore those whose formal training was limited to short courses were not excluded, but this training experience may still have affected the participants' descriptions of independent learning in information technology.

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The Effects of Synchronous and Asynchronous Distance Education: A Meta-Analytical Assessment of Simonson’s “Equivalency Theory”

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Abstract

Simonson, Schlosser and Hanson (1999) argue that a new theory called “equivalency theory” is needed to account for the unique features of the “teleconferencing” (synchronous) model of DE that is prevalent in many North American universities. Based on a comprehensive meta-analysis of the comparative literature of DE (Bernard, Abrami, Lou, Wozney, Borokhovski, Wallet, Wade, Fiset, & Huang, in press), we are able to assess empirically whether equivalency has been achieved in prior comparative DE research. This paper includes a brief summary of the results of the split between synchronous and asynchronous patterns of DE, and addresses the implications these data have for developing separate theories of DE for synchronous (i.e., group-based) and asynchronous (i.e., individualized) applications. We examine data based on achievement, attitude and retention outcomes and coded study features (i.e., methodological, pedagogical and media) relating to them.

Introduction

Over the past several decades, two distinctly different patterns of distance education (DE) have emerged, along with a variety of combinations of them. Synchronous DE derives from early applications of closed circuit TV on college campuses (e.g., Carpenter & Greenhill, 1955; 1958). In this pattern, two or more classrooms in different locations are joined in real time and run, synchronously, usually from the originating site. Today, various forms of audio and video interactive teleconferencing technology are used to unite originating and remote classroom sites. According to Mottet (1998) and Ostendorf (1997), this form of “emulated traditional classroom instruction” is the fastest growing form of DE in U.S. universities, and so it is important for us to know how it affects learners who are involved in it.

Modern asynchronous DE is a derivative of correspondence education, where the “medium of instruction” was the post office and asynchronicity was a result of postal delay. In this pattern, students in remote locations work independently or in asynchronous groups, usually with the support of an instructor or tutor. Communication between the instructor and student and among students typically involves the Internet, although contact through other media is (e.g., telephone) is often used. Asynchronous DE, then, fits within Keegan’s (1996) definitional criteria of teaching and learning “anyplace, anytime,” whereas synchronous DE is both time and place dependent.

Simonson, Schlosser and Hanson (1999) argue that separate theories of DE are needed to account for the different underlying premises of these two models. What we have referred to as asynchronous DE springs from theoretical perspectives that emphasize “independence and autonomy of the learner, industrialization of teaching, and interaction and communication. These classical theories emphasize the notion that distance education is a fundamentally different form of education” (p. 74). By contrast, Simonson et al. argue that a theory of synchronous DE should focus on providing individual but equivalent experiences for the classroom and DE learners. They say that “Recent emerging theories based on the capabilities of new interactive telecommunication-based audio and video systems suggest that distance education may not be a distinct field of education” (p. 74).

We can take no position on the theoretical arguments contained in the above quotations, except to say that there is one important distinction that is evident in the two patterns. Synchronous DE, by definition, is inextricably tied to classroom instruction. In this sense, it may be viewed as an extension of, or as a special case of classroom instruction. Asynchronous DE, by contrast, is not necessarily bound by conditions that exist in a classroom. This fact suggests that the two patterns may encompass different, but related, sets of teaching and learning skills.

An issue that arises is upon what grounds should “equivalence” be judged. Simonson et al. (1999) offer this suggestion: “. . . the outcomes of a learning experience are those obvious, measurable, and significant changes that occur cognitively and affectively in learners because of their participation in the course or unit” (p. 72). They distinguish between “instructor-determined outcomes” and “learner-determined outcomes.” The former are presumably the traditional measures of achievement and course satisfaction (e.g., attitude measures), while the latter are delayed measures of skills application and follow-up enrollment in similar courses. We argue that another related measure of learner-determination is the retention rate (or conversely, the dropout rate) in a course.

The research literature of DE contains many studies of both synchronous and asynchronous DE as they compare to traditional classroom instruction. In 2001, we undertook to review, quantitatively (meta-analysis), these comparative studies dating from 1985 through 2002. These were some of the findings: 1) there is wide variability in achievement, attitude and retention outcomes (i.e., some classrooms vastly outperform DE and vice versa); 2) study features describing differences in research methodology account for a substantial proportion of the variance in outcomes; 3) overall, elements of pedagogy account for more variation than elements of media usage (Clark, 1983, 1994); and 4) a number of study features (both pedagogy and media) are predictors of the differences between DE and classroom instruction (Bernard, Abrami, Lou, Wozney, Borokhovski, Wallet, Wade, Fiset, & Huang, in press). Here we will present a subset of these results relating to synchronous and asynchronous DE to describe how these patterns differ in terms of achievement, attitude and retention outcomes. We will focus especially on the comparative effects of synchronous DE and consider whether the DE part of this dyad differs from its classroom counterpart. We will also examine the effects of individual pedagogy and media study features in an attempt to suggest what might be changed in synchronous DE, in particular to increase its “equivalence” to classroom instruction.

The Nature of Meta-Analysis

An axiom of modern cognitive science is that knowledge is situated. Likewise, the evidence from a primary investigation should also be situated in the larger context of other investigations so that evidence is organized, accumulated and otherwise synthesized—a cornerstone of any science. Meta-analysis, or quantitative research synthesis (Glass, McGaw & Smith, 1981; Hedges & Olkin, 1985), is the most unbiased way of conducting a systematic review and estimating the treatment effects associated with a collection of primary studies addressing different facets of a common question. The methodology also provides ways of asking and answering more detailed questions concerning the influence of coded moderator variables. Arguably the greatest contribution of meta-analysis is the introduction of the concepts of precision, systematicity and replicability to the conduct of research reviews (Abrami, Cohen, & d’Apollonia, 1988; Bernard & Na idu, 1990).

Method

Definition of DE

Our definition of DE derives from Keegan’s (1996) basic set of characteristics that distinguish DE from other forms of instruction. This definition allowed for the inclusion of both synchronous and asynchronous patterns of DE.

- The semi-permanent separation (place and/or time) of learner and instructor during planned learning events.
- The presence of planning and preparation of the learning materials, student support services, and the final recognition of course completion by an educational organization.
- The provision of two-way media to facilitate dialogue and interaction between students and the instructor and among students.

Inclusion/Exclusion Criteria

To be included in this meta-analysis, each study had to meet the following basic inclusion/exclusion criteria:

1. Involve an empirical comparison of DE as defined in this meta-analysis. Studies comparing DE with national standards or norms, rather than a control condition, were excluded.
2. Involve “distance from instructor” as a primary condition of the DE condition. DE with some face-to-face meetings (fewer than 50%) was included.
3. Report measured outcomes for both experimental and control groups.
4. Report sufficient statistical data. Studies with insufficient data for effect size calculations (e.g., with means but no standard deviations or no inferential statistics or no sample size) were excluded.
5. Be publicly available or archived.
6. Include at least one achievement, attitude or retention outcome measure.
7. Include an identifiable level of learner. All levels of learners from kindergarten to adults, whether informally schooled or professionally trained, were admissible.
8. Be published or presented no earlier than 1985 and no later than December of 2002.
9. Include outcome measures that were the same or comparable. If the study explicitly stated that different exams were used for the experimental and control groups, the study was excluded.

Data Sources and Search Strategies

The studies used in this meta-analysis were located through a comprehensive search of publicly available literature from 1985 through December of 2002. Electronic searches were performed on the following databases: *ABI/Inform*, *Compendex*, *Cambridge Scientific Abstracts*, *Canadian Research Index*, *Communication Abstracts*, *Digital Dissertations on ProQuest*, *Dissertation Abstracts*, *Education Abstracts*, *ERIC*, *PsycInfo*, and *Social SciSearch*. Web searches were performed using Google, AlltheWeb, and Teoma search engines. A manual search was performed in *ComAbstracts*, *Educational Technology Abstracts*; in several distance learning journals, including *The American Journal of Distance Education*, *Distance Education*, *Journal of Distance Education*, *Open Learning*, and *Journal of Telemedicine and Telecare*; and in several conference proceedings, including *AECT*, *AACE*, *AERA*, *CADE*, *EdMedia*, *E-Learn*, *SITE*, and *WebNet*. In addition, the reference lists of several earlier reviews were examined for possible inclusions. Although search strategies varied depending on the tool used, generally, search terms included “distance education,” “distance learning,” “open learning” or “virtual university,” AND (“traditional,” “lecture,” “face-to-face” or “comparison”).

Outcomes of the Searches

In total, more than 5,000 research abstracts concerning DE and traditional classroom-based instruction were examined and 862 full-text potential includes retrieved. Each of the studies retrieved was read by two researchers for possible inclusion using the inclusion/exclusion criteria. The initial inter-rater agreement as to inclusion was 89%. Any study that was considered for exclusion by one researcher was crosschecked by another researcher. Two hundred and thirty-two (232) studies met all inclusion criteria and were included in this meta-analysis; 630 were excluded.

Extraction of Effect Sizes

Effect sizes were extracted from each study. Where possible, descriptive data (i.e., means and standard deviations) were used to calculate Cohen’s *d* (see Equation 1).

$$d_i = \frac{\bar{Y}_{Experimental} - \bar{Y}_{Control}}{S_{Pooled}} \quad (1)$$

Where these data were not available, effect sizes were calculated or estimated from statistical test data (e.g., *t*-ratios, probabilities) based on equations provided by Glass, McGaw, and Smith (1981) and Hedges, Shymansky, and Woodworth (1989). Cohen's *d* was converted to Hedges' *g* (Hedges & Olkin, 1985) to correct for the influence of sample size. Hedges' *g*+ (i.e., average effect size) was then calculated for each relevant subgroup and for each of the three measures along with homogeneity of effect size statistics.

Results

Meta-analysis is a descriptive review technique and as such provides a characterization of a large body of quantitative evidence. While effect sizes are tested for significance ($g+ = 0$), this does not involve the same sort of inferential testing that is often done in original research. One way of thinking of a comprehensive meta-analysis is as an approximation of differences in the population that far surpasses the evidence provided by any single study.

Statistical Analysis

In total, 232 studies yielding 688 independent effect sizes (i.e., outcomes) were analyzed. This was based on totals of 57,019 students ($k = 321$) with achievement outcomes, 35,365 students ($k = 262$) with attitude outcomes, and ($N = 57,916,029$) students ($k = 105$) with retention outcomes. The *N* reported here for retention was reduced proportionally to 3,744,869 to avoid overestimation based on a longitudinal California study of retention in junior colleges. The number of outcomes was further reduced when they were classified as either synchronous or asynchronous patterns.

The statistical findings that are relevant to the question being examined in this paper are shown in Table 1. In this table, zero defines no mean difference between the DE condition and the classroom condition. Positive mean effect sizes favor DE over the classroom. Negative effect sizes indicate the reverse. Bear in mind as you examine these mean effect sizes that wide variability surrounds each of them (i.e., homogeneity of effect size was violated). Hedges and Olkin (1985) warn against a strong interpretations of mean effect sizes when assumptions of homogeneity of effect size are violated. To dramatize this point, we found effect sizes for synchronous achievement outcomes to vary from -1.14 to 0.97 . For asynchronous outcomes, the minimum *g* was -1.31 and the maximum *g* was 1.31 . That says that some applications of DE, both synchronous and asynchronous, far outperformed their classroom comparison group and some far underperformed it. However, the pattern of results is interesting and bears consideration.

First, all but two average effects sizes are significantly greater than zero. As with all statistical tests, higher degrees of freedom provide more power and a more sensitive test, so that at least one test (synchronous, retention outcomes) may represent an artifact of this.

There is evidence for synchronous DE, based on an analysis of achievement outcomes, that students in the DE condition are not performing as well as their classroom companions, on average. This effect in favor of the classroom condition appears to be even more dramatic for attitude outcomes. By contrast, DE student experiencing asynchronous DE outperformed their classroom equivalents on achievement measures and performed equally well in terms of attitude outcomes (although the effect size is negative).

Table 1. Weighted Mean Effect Sizes for Achievement, Attitude and Retention Outcomes (Synchronous and Asynchronous)

| Categories of DE | Achievement | | Attitude | | Retention | |
|------------------|----------------------------|-----------|----------------------------|-----------|----------------------------|-----------|
| | <i>g</i> + | <i>SE</i> | <i>g</i> + | <i>SE</i> | <i>g</i> + | <i>SE</i> |
| Synchronous DE | -0.102^* ($k = 92$) | 0.024 | -0.185^* ($k = 83$) | 0.022 | 0.005 ($k = 17$) | 0.034 |
| Asynchronous DE | 0.053^* ($k = 174$) | 0.012 | -0.003 ($k = 71$) | 0.019 | -0.093^* ($k = 53$) | 0.021 |

* $p < .05$ Note: All mean effect sizes are heterogeneous.

The situation for retention outcomes is essentially the reverse of the above. The retention rate (i.e., opposite of dropout) for synchronous comparisons was zero, while significantly more students dropped out of asynchronous DE than their classroom equivalents. This problem with DE has existed from the early days of correspondence education (e.g., Bernard & Amundsen, 1988).

This analysis does not suggest that DE and classroom conditions in synchronous DE cannot be equivalent, just that when they have been compared in a large number of studies, they are not. Beyond the intuitive notion that remote-site students, being on the receiving end of a technologically mediated classroom (virtual classroom), may not feel as included, may not get to participate as much, find it harder to concentrate, and/or may not get the timely feedback that they need, we have little evidence to explain this apparent disparity. A scarcity of information in the literature, especially of the conditions in the classroom, made it difficult for us to find sets of robust predictors that would have helped us develop a more complete picture or empirical model of the instructional characteristics that make a difference. See Bernard et al., (in press) and for the complete analysis and Bernard, Abrami, Lou, and Borokhovski (in press) for an extended discussion of the methodological state of DE research.

Study Feature Predictors of Outcomes

In an attempt to further explain the results just presented, we used weighted multiple regression (WMR, where the weighting factor is the inverse of the population variance, $1/\hat{\sigma}_d^2$, approximated in an equation from Hedges & Olkin, 1985, p. 174) using individually coded study features as predictors and g as the outcome variable. The study features were categorized as: 1) 13 methodological predictors; 2) 9 pedagogical predictors; and 3) 9 media use predictors, and were entered into blocks in WMR. Methodology was entered first, followed by pedagogy. In a second analysis, methodology again was entered first, followed by media use. In this way we were able to assess the effects of pedagogy and media use, independently, after variation due to methodological differences was removed. We did this for synchronous and asynchronous DE outcomes separately. In presenting these findings, we must warn against the over-interpretation of individual study features. While all of the ones that are described here were significant, a certain degree of collinearity among them makes drawing strong conclusions problematic.

Synchronous DE. The question that we will be attempting to answer here is: If synchronous DE and its classroom counterparts are not equivalent, how can we make them more so? Since from our overall analysis, we have established that in synchronous DE, the classroom condition had better achievement and better attitudes towards instruction than the DE condition, what can be added to or changed about the DE condition to ameliorate the situation? In looking at Table 2, which displays the significant predictors of achievement and attitudes (an analysis of retention outcomes produced no significant predictors), we see study features that favor the classroom on the left and those that favor DE on the right (this was determined by the sign of the regression weight associated with each predictor).

The most striking feature contained in the set of predictors for synchronous DE is the large role that personal contact with the instructor and other students, either face-to-face or mediated by technology, plays in achievement and attitude outcomes. This agrees with much of the previous literature of DE, which cites feelings of isolation as a significant contributor to problems such as dropout. Two other predictors were significant, "Use of one-way TV-video" and "Use of systematic instructional design." In this case, TV-video does not refer to the means of communication (i.e., videoconferencing). It is, instead, the use of televised materials and content delivered at a distance. It is conceivable that such materials offer a welcome alternative to lecture and other forms of teacher-dominated instruction. It is not surprising to find that explicit prior planning improves the quality of DE. Had there been more information about classroom conditions, we might have found the same thing for face-to-face instruction.

Table 2. Summary of Study Features that Significantly Predict Outcomes in Synchronous DE

| Synchronous DE | |
|--|---|
| Favor Classroom Instruction (–) | Favor Distance Education (+) |
| <p>Achievement</p> <ul style="list-style-type: none"> • Face-to-face meetings with the instructor • Use of the telephone to contact | <p>Achievement</p> <ul style="list-style-type: none"> • Face-to-face contact with other students • Use of one-way TV-video |

| instructor | |
|---|--|
| <p>Attitudes</p> <ul style="list-style-type: none"> • Opportunity for face-to-face contact with other students • Use of one-way TV-video | <p>Attitudes</p> <ul style="list-style-type: none"> • Use of systematic ID • Opportunity for mediated communication with the instructor • Instructor/student contact encouraged • Use of the telephone to contact instructor |
| <p><i>Asynchronous DE.</i> Table 3 is structured in the same way as the previous table. Here again, communication and the use of mediated content delivery play important roles. However, in contrast to synchronous DE, an explicit learning strategy, “Problem-based learning” emerged as an important predictor of both achievement and attitude outcomes. This is particularly interesting when combined with the appearance of computer-mediated communication. It is possible that this pairing suggests a positive effect for computer-based collaborative learning.</p> | |
| <p><i>Table 3. Summary of Study Features that Significantly Predict Outcomes in Asynchronous DE</i></p> | |
| Asynchronous DE | |
| Favor Classroom Instruction (–) | Favor Distance Education (+) |
| <p>Achievement</p> <ul style="list-style-type: none"> • No significant predictors | <p>Achievement</p> <ul style="list-style-type: none"> • Use of problem-based learning strategies • Opportunity for mediated communication with the instructor • Advance information given to students • Use of one-way TV-video |
| <p>Attitudes</p> <ul style="list-style-type: none"> • Use of the Web | <p>Attitudes</p> <ul style="list-style-type: none"> • Use of problem-based learning strategies • Use of computer-mediated communication • Use of computer-based instruction |

Discussion

One of the things that meta-analysts quickly come to realize is that they are “prisoners” of the data and the previous efforts of primary researchers. Findings are based, by necessity, on what can be gleaned from the literature; nothing new can be added. In this study, lack of study information, particularly regarding to the unreported characteristics of the classroom condition, frustrated our efforts to delve more deeply into the nature of instructional study features and their relationship to the overall findings. Why do effect sizes vary so widely, even after they are categorized as synchronous or asynchronous? What should be included in synchronous DE to make it as effective as (equivalent to) classroom instruction, or at least the best it can be? What practices should be avoided? What are the ranges of instructional practices and learning strategies that best support achievement and satisfaction in asynchronous DE? Answers to these kinds of questions did not emerge as clearly as they could have if the literature were more complete.

Nevertheless, some interesting findings did emerge concerning the nature of synchronous and asynchronous DE. We found that synchronous DE, in particular, produced average effect sizes that favored the classroom condition for both achievement and attitude outcomes. We also found wide variation around these means. This suggests that synchronized DE classrooms can produce outcomes that are at least equivalent to “live” classrooms but that this doesn’t always happen (in fact, in a majority of cases it doesn’t). The reasons for this may be manifold, ranging from the application of teacher-centered instructional techniques, which might not be as engaging in a mediated form, to failures associated with the technologies involved (either through poor application or failures of the technology itself). It is very likely that a new set of instructional skills, beyond those applied in the classroom, is required for instructors to meet the challenges of synchronous DE. While the tested principles of pedagogy (e.g., motivation, engagement, interactivity, evaluation, feedback) may generally apply, their application in synchronous mediated DE environments may require experience and

possibly even special training. It is likely that many of the students involved in these studies had little if any prior experience with DE, and consequently did not know what to expect from DE or how to engage effectively in this new form of educational experience. If that is the case, this situation may change radically as more learning opportunities are offered and more students partake of them.

One of the prescriptions that did emerge regarding synchronous DE, in particular, is that it should involve more direct personalized contact between students and the instructor and among students. This is tantamount to saying: “make synchronous DE more like face-to-face instruction,” and it is arguable that this is not a bad idea if in fact synchronous DE is to be regarded as a special case of face-to-face instruction. If this is not feasible, as it often is not in DE, serious efforts should be made to compensate for this deficit through various mediated options (Simonson, Schlosser & Hanson make this very point).

We also found some interesting relationships regarding asynchronous DE. In another paper (Bernard et al., in press) we provide evidence of the precedence that pedagogy takes over media in DE, especially in asynchronous settings, a point that Richard Clark (1983, 1994) has made for years regarding all forms of technology applied to instruction. While it is axiomatic that DE requires technology, it must function in the service of something—content delivery (e.g., TV/video, Web resources), communication between student and instructor (e.g., clarification and feedback), and/or communication among students (e.g., mediated communication)—that leads to learning success. We have found direct evidence here of all of these elements. We have found indirect evidence that collaborative learning (i.e., the combination of mediated communication and problem-based learning) is present. Direct evidence of the effectiveness of collaborative learning strategies may emerge as more studies of this relatively recent approach to learning are conducted. It is also possible that advances in multi-media, CBI, simulation media etc. may herald the new era of interactiveness posited by Ullmer (1984) and Cobb (1997).

This empirical assessment of the comparative state of affairs in studies of synchronous and asynchronous DE begs the question of whether a new theory—“equivalency theory” or any other, for that matter—is required to understand and to make progress in the development of DE. Meta-analysis cannot answer such questions, even when the question involves a testable hypothesis. This meta-analysis has demonstrated, however, that we have a long way to go before we can say with certainty that either form of DE will reliably offer educational opportunities that equal or exceed that which is currently called “traditional classroom instruction.”

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Effects of Long-term Professional Development Training in Technology Integration on Teacher and Student Performance

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Introduction

The Arizona Classrooms of Tomorrow Today (AZCOTT) program was a twelve-month graduate level professional development program designed to aid Grade 3-8 teachers with infusing technology into their instruction and to support student achievement. Originally a Preparing Tomorrow's Teachers to Use Technology (PT3) grant from the U.S. Department of Education funded the AZCOTT program, a partnership between five suburban school districts and one university in the southwestern United States. An Arizona Board of Regents Improving Teacher Quality Grant provided funding for the evaluation year of 2003-2004.

The AZCOTT Advisory Board requested an evaluation of the effectiveness of the program to enable them to make data-driven decisions regarding future funding and expansion of the program. Over the last few years, billions of dollars have been spent on educational technology and related professional development across the nation ("Technology Counts", 2004), it is then reasonable to examine the return on that investment. This study was designed to examine the technology skills and use of AZCOTT teachers and their students and a comparison group of Non-AZCOTT teachers and students. Many professional development program evaluations analyze the types of activities teachers plan (Becker and Ravitz, 2001) and teacher attitudes (Christensen, 2002). In addition to these two data types, this evaluation also examined student performance data.

The four primary questions addressed by the evaluation were: 1) Does the AZCOTT program influence the frequency of digital technology activities that teachers use with their students and that students perform in the classroom? 2) Does the program influence student performance of computer skills? 3) Does the program influence student self-reports of their technology skills? and 4) Does the program influence student self-reports of their use of technology for classroom activities? Also, investigated were the students' ability to select appropriate software tools for given tasks and teacher attitudes toward the AZCOTT program.

Description of the AZCOTT Program

The Arizona Classrooms of Tomorrow Today professional development program had two main components: a long-term professional development program and increased access to technology for teachers and students. A team of teachers from each of the five partner districts, 17 teachers total, participated in 60 hours of professional development over 13 months. In its publication of standards for professional development, the National Staff Development Council (2001) asserts that long-term/sustained professional development programs are necessary for effective learning to take place. The focus of the program was on the acquisition and integration of technology integration strategies into standards-based instructional units and on increasing technology skills. Each school district increased the access AZCOTT teachers and their students had to computers by purchasing new equipment, redistributing existing equipment, or providing increased computer lab access.

The professional development sessions were conducted on 13 Saturdays between May 2003 and May 2004. All sessions were held in a computer lab at the partner university. The curriculum addressed the National Educational Technology Standards for Teachers (NETS-T, 2000) and the Arizona Technology Education Standards (Arizona Department of Education, 2000). The curriculum focused on developing standards-based instructional units that integrated technology into both teaching and learning activities, supporting learners through the use of graphic organizer creation software (e.g. Inspiration[®]), identifying Internet resources, and implementing technology integration strategies. The 60 hours consisted of 45 classroom hours from Technology Integration in the Classroom taught by the partner university and an additional 15 classroom hours addressing project-based learning and the use of video to document classroom practice.

Support materials and resources included \$80 per AZCOTT teacher to purchase instructional materials to support the implementation of the program. A yearlong subscription to the online resource site TaskStream[®] was provided for creating and publishing instructional units. Each teacher received a copy of *Teaching with Technology: Creating Student-Centered Classrooms* and of *National Educational Technology Standards for Students: Connecting Curriculum and Technology*. To expand the AZCOTT teachers' exposure to technology integration strategies, the registration fees for two state educational technology conferences were also paid.

The increased access to technology component of the AZCOTT program was deemed essential since teachers often state that if they had more access to technology, they would integrate it better into their instruction (Kopcha, 2004). Strategies employed by AZCOTT partner districts for increasing teacher and student access to computers included: 1) ten to 20 laptop computers were placed on a mobile cart with wireless connectivity to the Internet; 2) the number of desktop computers in a classroom was increased by five, and 3) the amount of computer lab time allotted to AZCOTT teachers was increased. Some districts and schools provided additional peripheral equipment including LCD projectors, digital cameras, digital video cameras, and printers. The sustained professional development training design is critical if the increased student access to computers is to reach its full potential in the classroom (Sandholtz, Ringstaff, & Dwyer, 1997).

Method

Participants

Participants were 32 Grade 3-8 teachers and approximately 800 students from five school districts in the southwestern United States. Four of the five districts had different teachers participate in the AZCOTT program during the 2002-2003 school year. Free or reduced lunch percentages ranged from 38% to 89% and minority populations ranged from 20% to 80%. The participants were divided into two groups, those participating in the AZCOTT program (AZCOTT teachers and students) and a comparison group (Non-AZCOTT teachers and students). The comparison group was selected prior to the study from within the same five partner school districts to represent the same grade levels and similar demographic characteristics. Data collected at the beginning of the study indicated very similar beginning-of-study technology skills and use between the AZCOTT and Non-AZCOTT teachers.

Each of the two teacher groups included three teachers from 3rd grade, five from 4th grade, four from 6th grade, three from 7th grade, and two from 8th grade. The AZCOTT teacher teams volunteered to participate in the program as a team. The Non-AZCOTT teachers were asked to participate in the evaluation by their site administrator.

Materials

AZCOTT teachers and Non-AZCOTT teachers had access to "normal instructional materials" and technological resources provided by the districts. Each AZCOTT teacher received the materials developed for Educational Media and Computers 598 taught at the partner university, a copy of *Teaching with Technology: Creating Student-Centered Classrooms* and *National Educational Technology Standards for Students: Connecting Curriculum and Technology*, and an increase in access to computers for their students through one of the three strategies described above.

Procedures

The AZCOTT program operated without modification during the 2003-2004 school year. Each AZCOTT teacher participated in the 60 hours of professional development training and completed the assignments. Both AZCOTT and Non-AZCOTT teachers participated in other professional development opportunities provided by the district or other entities.

Evaluation Measures

The primary evaluation measures used in this study were: 1)Teacher Technology Use Questionnaire, 2)Student Technology Skills Performance Assessment, 3)Student Technology Skills Questionnaire, 4) Student Technology Activities Survey, 5)Teacher Program Evaluation Survey, and 6) Teacher Interviews.

The Teacher Technology Use Questionnaire was administered to the AZCOTT teachers and Non-AZCOTT teachers in May 2004. The questionnaire addressed the amount of time a teacher used a computer for planning and instruction during the school year, the types of professional tasks performed on the computer, the amount of time their students used computers, and the types of technology activities participated in by their students.

The Student Technology Skills Performance Assessment was administered in May 2004. Ten students

were randomly selected from each participating teacher's classroom to complete the assessment. The assessment consisted of asking students to perform 18 steps required to produce and modify a word processing document. The skills needed for this performance were selected from the Arizona Technology Education Standards for grades 3-8 (Arizona Department of Education, 2000). A pilot of the assessment was conducted with 25 fourth graders and some wording was modified to increase clarity. The assessment was completed in a computer lab and printed as the final step. No explanations of the steps were provided to the students. The assessments were scored on a 1-0 basis, 1 indicating that the step was performed correctly on the student's document and 0 indicating that it was not. All performance assessments were scored by the evaluator without knowledge of the student's group.

AZCOTT and Non-AZCOTT students completed the Student Technology Skills Questionnaire in May 2004. The questionnaire addressed how well they could perform a total of 21 different tasks on the computer.

In addition, AZCOTT and Non-AZCOTT students completed a Student Technology Activities Survey in May 2004. The survey addressed how frequently they performed 15 different tasks on the computer during the past school year.

All 17 AZCOTT teachers completed a Teacher Program Evaluation Survey at the end of the last professional development session in May 2004. The 20 items addressed the overall effectiveness of the AZCOTT program, the program's impact on teaching and learning, the support provided to the teachers, unexpected outcomes, and the program's most and least effective elements.

Two AZCOTT teachers from each of the five participating districts were randomly selected to be interviewed. The interviews occurred either in person or by telephone. The interview protocol consisted of five open-ended items. The interviews averaged about 15 minutes in length.

Results

The results are reported in this section for AZCOTT and Non-AZCOTT teacher reports of their use and student use of technology and related activities, the performance assessment of students on computer-related skills, student self-reports of their computer skills, and student self-reports of their computer activities in the classroom. Student selection of appropriate software tools and teacher attitudes towards the AZCOTT program are also reported.

Teacher Reports of Teacher and Student Technology Use

Data from the Spring 2004 Teacher Technology Use Questionnaire are reported in Table 1. The table reveals that nine of the 17 AZCOTT teachers, but only two of the 15 Non-AZCOTT teachers, reported using computers more than 60 minutes a week to deliver instruction. Similarly, ten AZCOTT teachers, but only two Non-AZCOTT teachers reported that their students use computers more than 60 minutes a week in the classroom.

Results were quite similar for the AZCOTT and Non-AZCOTT teachers on the six professional tasks listed in Table 1, with two exceptions. Fifteen of the 17 AZCOTT teachers, but only eight of the 15 Non-AZCOTT teachers, reported using computers to make student handouts and 13 AZCOTT teachers, compared to eight Non-AZCOTT teachers, reported using the computer at least once a week to get information from the Internet for lessons.

AZCOTT teachers also reported their students used computers for more time than Non-AZCOTT teachers for each of the seven student activities in Table 1. The largest differences in frequencies were for "Searching for information" (13 of the 17 AZCOTT teachers reported once a week or more, but only one of 15 Non-AZCOTT teachers), "Producing multimedia presentations" (7 AZCOTT teachers reported once a week or more, but only one Non-AZCOTT teacher).

Table 1 *Spring 2004 AZCOTT and Non-AZCOTT Teacher Survey Frequencies*
 AZCOTT N=17 Non-AZCOTT N=15

| Item | AZCOTT | | Non-AZCOTT | |
|---|---------------|-------------|---------------|-------------|
| | 60+min/wk | < 60 min/wk | 60+min/wk | < 60 min/wk |
| Minutes per week teachers use computers to deliver instruction | 9 | 8 | 2 | 13 |
| How often during a week do you use computers for these tasks? | about once/wk | < once/wk | about once/wk | < once/wk |
| Record or calculate student grades | 16 | 1 | 12 | 3 |
| Make handouts for students | 15 | 2 | 7 | 8 |
| Write lesson plans | 17 | 0 | 15 | 0 |
| Get information from the Internet for lessons | 13 | 4 | 8 | 7 |
| Exchange files with other teachers electronically | 4 | 13 | 1 | 14 |
| Participate in discussion boards, listservs, etc | 16 | 1 | 13 | 2 |
| Minutes per week students use computers in the classroom | 60+min/wk | <60 min/wk | 60+min/wk | <60 min/wk |
| | 10 | 7 | 2 | 13 |
| How many minutes per week do your students spend using computers for these types of activities? | 30+min/wk | <30 min/wk | 30+min/wk | <30 min/wk |
| Composing (no paper involved) | 7 | 10 | 4 | 11 |
| Publishing written work (drafted on paper) | 9 | 8 | 6 | 9 |
| Communicating | 2 | 15 | 1 | 14 |
| Searching for information | 13 | 4 | 1 | 14 |
| Producing multimedia presentations | 7 | 10 | 1 | 14 |
| Organizing information/planning | 4 | 13 | 0 | 15 |
| Practicing computer skills | 7 | 10 | 2 | 13 |

Assessment of Student Performance

The 18 steps of the Student Technology Skills Performance Assessment were ordered based on predicted difficulty using the Arizona Technology Education Standards as the guide. The skills from the Student Technology Skills Performance Assessment are shown in rank order by the performance of AZCOTT students in Table 2.

The table reveals that the total mean scores across the 18 skills were 12.28 for the AZCOTT students and 10.29 for the Non-AZCOTT students. A one-way analysis of variance (ANOVA) conducted to test the overall mean scores of the AZCOTT and Non-AZCOTT students for significance revealed that the mean of the AZCOTT students was significantly higher than that of their Non-AZCOTT counterparts, $F(2,382) = 7.64, p < .001$.

Table 2 *AZCOTT and Non-AZCOTT Student Performance Assessment Mean Scores By Skill*
AZCOTT N=195 Non-AZCOTT N=187

1.0= highest possible mean for each skill and 0 lowest possible mean for each skill

| Skill | AZCOTT | Non-AZCOTT | Overall |
|--|--------|------------|---------|
| 1 Open your word processing program | 1.00 | .82 | .91 |
| 2 Type the title of your story | .98 | .98 | .98 |
| 3 Make the title font size 36 | .93 | .83 | .88 |
| 4 Type three sentences | .87 | .82 | .84 |
| 5 Type your grade level under the title | .79 | .81 | .80 |
| 6 Center the title | .77 | .72 | .75 |
| 7 Underline the title | .69 | .68 | .69 |
| 8 Add a piece of clipart to your document | .69 | .51 | .60 |
| 9 Make a copy of the clipart and paste it in your document | .55 | .42 | .49 |
| 10 Enter two blank lines between the title and three sentences | .55 | .26 | .41 |
| 11 Go on the Internet | .54 | .44 | .49 |
| 12 Go to the web site www.zoo.org | .54 | .44 | .49 |
| 13 Make one of the two clipart pictures bigger | .53 | .38 | .46 |
| 14 Copy a picture from the web site and paste it into your story | .52 | .42 | .47 |
| 15 Draw a smiley face | .44 | .36 | .40 |
| 16 Copy and paste web address into the document | .41 | .28 | .35 |
| 17 Copy and paste the web address under the picture | .33 | .24 | .28 |
| 18 Change the top margin to 2.0 inches | .14 | .13 | .13 |
| Total Score | *12.28 | 10.29 | 11.31 |

18.0 = maximum score (1.0 per skill)

*AZCOTT students scored significantly higher ($p < .001$) than Non-AZCOTT students on the total score.

Table 2 also reveals the AZCOTT students scored higher on 16 of the 18 individual skills in the performance with one additional skill being a tie. Non-AZCOTT students scored higher on only one skill. The individual skills in Table 2 are listed in rank-order by AZCOTT performance from highest to lowest. Comparison of the observed difficulty of these 18 skills with the order of difficulty in which they appear in the Arizona Technology Education Standards yielded a significant ($p < .001$) Spearman rank-order correlation of .92, indicating a very high correlation between their order of difficulty in the state standards and the order obtained by this study.

Student Reports of Technology Skills

The percentage of AZCOTT and Non-AZCOTT students choosing each response on the Student Technology Skills Questionnaire is reported in Table 3. The table reveals that the mean percentage score across the 21 skills for students who reported that they can do the skills well was 40% for the AZCOTT students and 28% for the Non-AZCOTT students. In contrast, the means for “Cannot do it” were 32% for the AZCOTT students and 45% for the Non-AZCOTT students. The AZCOTT students had a higher percentage score than the Non-AZCOTT students on all 21 items. They also scored 20% or more higher in the “Can do it well” category on seven items: write a story, letter or report; change font size and style; save a copy of a document with a new name; add clipart; change the size of a picture; copy pictures from the Internet into a document; and make a multimedia presentation.

Table 3 *Spring 2004 AZCOTT and Non-AZCOTT Student Technology Skills Reports in Percentages*
 AZCOTT N=401 Non-AZCOTT N= 240

Student Reports of Technology Activities

| Item | AZCOTT | | | Non-AZCOTT | | |
|---|----------------|-----------|---------------|----------------|-----------|---------------|
| | Can do it well | Can do it | Can not do it | Can do it well | Can do it | Can not do it |
| 1 Write a story, letter or report | 61 | 35 | 4 | 40 | 51 | 9 |
| 2 Copy and paste text | 48 | 32 | 20 | 31 | 25 | 44 |
| 3 Change tabs and margins | 31 | 33 | 36 | 27 | 27 | 46 |
| 4 Change font size and style | 75 | 19 | 6 | 55 | 23 | 22 |
| 5 Save a copy of a document with a new name | 68 | 24 | 8 | 48 | 23 | 29 |
| 6 Add clipart | 59 | 26 | 15 | 38 | 20 | 42 |
| 7 Add a digital picture | 25 | 31 | 44 | 15 | 33 | 52 |
| 8 Change the size of a picture | 67 | 23 | 10 | 44 | 35 | 21 |
| 9 Copy pictures from the Internet into a document | 58 | 24 | 18 | 35 | 25 | 40 |
| 10 Make a spreadsheet | 20 | 29 | 51 | 14 | 31 | 55 |
| 11 Create a database | 8 | 23 | 69 | 7 | 14 | 79 |
| 12 Make a multimedia presentation | 40 | 27 | 33 | 17 | 24 | 59 |
| 13 Make a web page | 18 | 26 | 56 | 15 | 31 | 54 |
| 14 Scan a picture and insert it into a document | 23 | 23 | 54 | 19 | 21 | 60 |
| 15 Download video onto a computer and edit it to make a movie | 17 | 27 | 56 | 13 | 21 | 66 |
| 16 Create graphics/pictures | 32 | 38 | 30 | 27 | 35 | 38 |
| 17 Send email | 53 | 22 | 25 | 45 | 25 | 30 |
| 18 Add attachments | 30 | 20 | 42 | 25 | 23 | 52 |
| 19 Write a citation for an electronic source | 26 | 30 | 44 | 7 | 15 | 78 |
| 20 Use a digital camera | 53 | 29 | 18 | 41 | 32 | 27 |
| 21 Use a projector to present work | 35 | 27 | 38 | 18 | 30 | 52 |
| Mean Percentage Score | 40 | 27 | 32 | 28 | 27 | 45 |

Data from the Student Technology Activities Survey reveal that of the 15 activities on the survey, an average of 39% of the AZCOTT students and 29% of the Non-AZCOTT students said they had done each activity often during the last school year. The five activities most commonly reported as being done “Often” versus “Sometimes” or “Never” by AZCOTT students are: “Researched a topic on the Internet” (62%), “Learned math” (52%), “Worked with other students to create projects” (51%), “Typed or published a paper” (48%), and “Learned language arts” (48%). The five activities most commonly reported as being done “Often” versus “Sometimes” or “Never” by Non-AZCOTT students are: “Took a test” (73%), “Learned math” (48%), “Worked with other students to create projects” (48%), “Practiced math skills” (40%), and “Researched a topic on the Internet” (30%).

Student Selection of Appropriate Software Tools

The last section of the Student Technology Activities Survey required students to select an appropriate software tool to use for a given task. For six of the seven tasks the percentage of AZCOTT students that selected the “Correct” tool versus the “Incorrect” or responded “I don’t know” was greater than for the Non-AZCOTT students. The one exception was “Draw a picture” with AZCOTT scoring 70% correct and Non-AZCOTT scoring 77% correct. The AZCOTT students scored 20% or higher more than the Non-AZCOTT students for four of the seven tasks. The tasks were: make an idea or concept map, write a story, create a presentation, and locate information.

Teacher Attitudes

Each of the AZCOTT teachers completed a 20-item Program Evaluation Survey consisting of 17 Likert scale items and three open ended items to assess teacher attitudes towards the program. The overall mean was 3.1 for the 17 Likert items on a scale from 4 (Strongly Agree) to 0 (Strongly Disagree). The most positive responses were for “My students react positively to technology-rich classroom activities.” (M = 3.9), “I use technology more with my students this year.” (M = 3.6), “It was helpful to use TaskStream® to create my instructional plans.” (M = 3.6), and “AZCOTT was a beneficial professional development experience.” (M = 3.5). The least positive responses were for “Past AZCOTT teachers provided helpful feedback.” (M = 1.8) and “AZCOTT was responsible for me taking on a leadership role this year” (M = 2.0).

Responses to the open-ended items were collected and categorized by common themes. The most common response to “What were the most effective elements of the AZCOTT program?” was an increase in the use of technology due to of access to additional equipment, which was mentioned by 16 of the 17 AZCOTT teachers. The most frequent response (N=5) to “What were the least effective elements of the AZCOTT program” was “Creating two units of instruction,” which was a requirement of the AZCOTT program.

The teacher attitude data were supplemented by information obtained in individual interviews with ten AZCOTT teachers. In response to the question, “How did AZCOTT impact your teaching?” the teachers reported a variety of ways the program influenced their teaching. These included an increase in their efforts to integrate the technology into their teaching (N=8) and making their instruction more learner centered (N=5). The responses to “What do you wish you had learned?” revealed three themes: teachers wanted more technical training on hardware and software, more ideas for managing technology use, and more technology integration strategies.

Discussion

This evaluation was conducted to investigate the effect of the Arizona Classrooms of Tomorrow Today program on: 1) the types and frequency of digital technology activities that teachers use with their students and that students perform in the classroom, 2) student performance on a technology skills assessment measure, 3) student perceptions of their technology skills, and 4) student reports of their use of technology for classroom activities. Other factors examined included AZCOTT and Non-AZCOTT students’ ability to select appropriate software for given tasks and teacher attitudes toward the AZCOTT program.

The AZCOTT teachers reported using computers for more time per week to deliver instruction than Non-AZCOTT teachers. They also reported using computers to perform professional tasks more frequently than the Non-AZCOTT teachers. The teacher reports also indicated that AZCOTT students spent considerably more time using computers in the classroom than Non-AZCOTT students and that the time was distributed across a greater variety of activities. Thus, based on teacher reports the long-term professional development training and increase in technology access under the AZCOTT program had the desired effect of increasing both teacher use

of technology for instructional purposes and student participation in technology-based instructional activities. Searching for information, producing multimedia presentations and practicing computer skills were the student activities for which the greatest differences were reported between AZCOTT and Non-AZCOTT students.

The reported greater overall involvement of AZCOTT students with technology appears to be the most likely reason for their significantly better performance than Non-AZCOTT students on the performance measure. The overall mean of the AZCOTT students on this measure was approximately two points (12.28 to 10.29) higher than that of the Non-AZCOTT students, not a huge absolute difference but one that was highly significant statistically ($p < .001$). Furthermore, the fact that the AZCOTT students scored higher on 16 of the 18 skills comprising the performance measure indicates that their participation in the program produced quite a consistent effect across the individual skills.

The self-report by AZCOTT and Non-AZCOTT students on their technology skills is consistent with the findings from both the teacher questionnaire and the performance assessment. AZCOTT students reported a higher ability to perform all 21 activities presented in Student Technology Skills Questionnaire than did the Non-AZCOTT students. Interestingly, two of the greatest differences favoring AZCOTT students were on “big picture” types of tasks: write a story, letter or report and make a multimedia presentation. The greater self-efficacy for computer use reflected in the AZCOTT students’ reports may indicate they are more likely to choose to use computers at school or home. In turn, their greater current skills and self-efficacy could contribute to an increase in continuing motivation, defined as one freely returning to a task (Maehr, 1976), to use technology and an increase in performance in the future.

Of course, higher ability to perform technology skills well as indicated by AZCOTT students on both the performance measure and self-the report of student technology skills, should be associated with greater participation in technology activities. That was indeed the case in the present study. An average of 39% of AZCOTT students, but only 29% of Non-AZCOTT students reported that they had participated often in the 15 computer-related activities in the survey. Further, the activity cited “often” most frequently by AZCOTT students was “researched a topic on the Internet” (62% to 30% for Non-AZCOTT students) while the activity cited as “Often” most frequently by Non-AZCOTT students was “took a test” (73% to 45% for AZCOTT students). The AZCOTT professional development program stresses student-centered uses of technology, which may have been a contributing factor to this difference in the most common type of activity between AZCOTT and Non-AZCOTT students.

The data on student selection of appropriate software tools were also supportive of the AZCOTT program. The fact that AZCOTT students scored 20% or higher more than Non-AZCOTT students on selecting the appropriate tools for making an idea or concept map, writing a story, creating a presentation, and locating information, was particularly impressive. The writing a story, creating a presentation, and locating information items are consistent with student self-reports showing 20% or greater differences between AZCOTT and Non-AZCOTT students in their self-reported technology skills for the first two items and in their frequent classroom activities for the “locating information” item.

The AZCOTT program was a year-long experience that involved professional development training in the use of technology for instructional purposes as well as increased access to computers in the classroom. This evaluation yielded clear evidence that the teacher and student use of computers for instructional purposes, students’ computer skills, and students’ perceptions of their own self-efficacy with regard to computer use were higher for those that participated in the program versus the comparison group. These results, while not overpowering in their effect, were consistently positive across both teacher and student measures. The study indicates that a focused longer-term effort to increase the technology training of teachers and access to computers for their students can lead to improvements in their students’ computer skills and in their use of computers to enhance their learning in the classroom.

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Investigating Student Learning in a Constructivist Multimedia-Rich Learning Environment

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Abstract

It has been suggested in the existing literature that the use of constructivist approaches in the educational setting contributes to active learning and knowledge transfer for students. This paper provides an overview of constructivist approaches used in a graduate-level instructional media production course at a mid-western comprehensive university. Qualitative data collection techniques were used to investigate the perceptions and learning of students in an environment in which both students and content were the center of the learning experience. The findings suggest the use of active learning approaches, in which students have the opportunity to interact with peers and the instructor, discussion and reflection on learning experiences, and encouragement of knowledge sharing, contribute to student learning.

Introduction

Constructivism has gained acceptance and, today, is highly valued by many educators. Constructivism is an educational theory about how knowledge is acquired and how individuals learn (Brooks & Brooks, 1993). Constructivism is about thinking and understanding. Grounded in this theory is that individuals obtain knowledge by creating constructs and by interpreting and reflecting on their experiences (Jonassen, Peck, & Wilson, 1998). Only constructs, which can be a schema or a concept, can be stored when we process information.

Central to this idea are self-regulation, active learning, individual differences, social learning, and reflection (Gagnon & Collay, 2001; Jonassen, Peck, & Wilson, 1998). Individuals learn by investigating, discovering, and creating structures; actively attaching meaning to a concept; and integrating new or modified constructs into existing knowledge. According to Novak (1998), meaningful learning involves “thinking, feeling, and acting” (p. 9). Because knowledge construction is different for individuals, learning has many varieties. For a constructivist the absolute truth cannot be verified.

Constructivists do not argue that constructivist approaches lead to learning and others do not. However, Stahl (2003) points out that everyone is a constructivist because we are constructing knowledge at every conscious moment. Constructivists share the opinion that students have been passive receivers of knowledge for too long. Teachers have given too many lectures and transmitted their knowledge to students by acting as *Sage on the Stage*. Teachers have traditionally been viewed as experts, God-like individuals who are not to be questioned. Because of their status, they are located on the top of a power structure which places students on the bottom level. Students are thought of as empty vessels not capable of thinking for themselves. They study instructional material by memorizing facts but, shortly thereafter, forget what they have learned. The transfer that should take place from theory to practice does not occur. Instead of using the transmission approach (Berge, 2001), in which students receive knowledge in a top-down delivery system from teachers, constructivists argue students should be actively involved in their learning so that they are able to apply what they have learned.

Learning should be fun and not dreaded as mindless activity where students end up reciting facts they stored in short-term memory. Teachers should ask how they can provide students with environments in which teachers can facilitate student learning so that students (a) can “discover, create, and apply knowledge for themselves”, (b) “push themselves”, and (c) “truly understand what they learn” (Marlowe & Page, 1998, p. 5). According to Marlowe and Page, components that need revision include terminology, communication between involved parties, learning activities, learning environments, student motivation, and student assessment.

Perceived Barriers

Instructors who desire to use constructivist approaches or have used them in their classrooms face barriers from administration, peers, and students. Administrators are concerned that the integration of constructivist approaches takes too much time. Learner-centered activities such as discussions or group work take more time than lectures. Because of accreditation requirements instructors must cover content instead of

using up time with student-centered approaches.

The roles of instructors and learners shift in the constructivist environment. Instructors become mentors, coaches, and facilitators. It requires teachers to modify existing materials and activities. Some may oppose constructivist approaches because they feel this process is too difficult and time consuming. In addition, they might not be thrilled to share control because constructivists typically surrender some control to their students. Instructors who see themselves as the experts in the field may feel threatened if students start questioning them about content or facts.

Student roles also change. The learner now becomes responsible for his or her own learning. Many students have been trained to comply with course requirements and have not been taught to think for themselves. Teachers who would like to implement constructivist approaches may find that students resist this change.

The Study

The purpose of this study was to determine how students would perceive constructivist approaches in the classroom and their own learning. The researcher was particularly interested in (a) how easily students would adapt to the approaches, (b) approaches perceived as useful by students, and (c) approaches that were not effective.

Methodology

Setting

The study was undertaken at a public comprehensive university with approximately 16,000 students in the mid-west. The course offered during spring 2003 was a graduate level, computer-based authoring course for individuals who majored in information media. Students in the human resources development and training track were required to complete the course successfully; others could choose the course as an elective. The instruction took place in a classroom-based environment, but was enhanced with a Web-based course management system and other Web tools such as html files, e-mail, and so forth.

The classroom in which the course was held was located in a state-of-the art facility and was equipped with 31 personal computers, projector, and a VCR. Instructors and students in this classroom had a variety of software programs available to them including, but not limited to, Adobe Photoshop; Inspiration; Macromedia Dreamweaver, Fireworks, and Flash MX; Microsoft Office, Visio, and FrontPage; and Click2Learn ToolBook Instructor. The facility also housed several open computer laboratories allowing students access to printers, scanners, digital cameras, and laptop computers.

Participants

Nine students were enrolled in the instructional media production course. Some of the students attended the university on a full-time basis; others were part-time students. Fifty percent of students were employed full-time in the education or training industry, others were employed on a part-time basis. Students in this group varied greatly on distribution of age, progress made in their program and, subsequently, varied greatly on existing computer and authoring skills. However, all students in the course had successfully completed an instructional design course, a prerequisite for the course.

Course Introduction

At the beginning of the course, learners were introduced to course materials and course requirements. The instructor made it clear that the course was not simply owned by her. Students were asked to consider the course to be “their” course because they had a vested interest and were given voting rights. For example, the course syllabus included a sentence informing participants that late assignments would not be accepted. The instructor explained why this stipulation was in the syllabus but gave students an option to vote on the issue, and students voted for flexible due dates. During the first class session, students introduced themselves and took pictures of one another with a digital camera. These pictures were later placed on the course Web site.

Course Material Description

Course information. The instructor designed a course Web site that included a syllabus, schedule, assignments, and resources. Contact information for all participants was also listed on the site. The instructor supplemented the classroom-based course with WebCT, a Web-based course management system. A link to the course Web site was provided there, as well as some course content materials such as PowerPoint presentations

for the first few chapters discussed in class, help notes for special topics, and a syllabus. Other WebCT tools utilized were communication and evaluation tools. The instructor composed six threaded discussion messages to which students replied. Everyone in the course utilized the e-mail function. Students were also able to submit their assignments through WebCT and view their grades and feedback provided by the instructor.

Materials and tools. Students used a variety of software programs which included Macromedia Dreamweaver, Fireworks, and Flash; the CourseBuilder extension for Dreamweaver; Microsoft PowerPoint, Word, and Visio. The two textbooks required for the course were a multimedia development text and a Dreamweaver MX self-study text. In addition, the instructor provided several software-based books in class. Other chapters from instructional design, instructional technology, and test theory were assigned, as well as several current articles pertaining to Web-based and computer-based education and training.

Assignments and requirements. Students completed two types of assignments: mandatory or optional assignments. Mandatory assignments included (a) a Web site on which other assignments were posted, (b) a computer-authored instructional product for a client, (c) a flowchart and storyboards, (d) a formative peer evaluation, (e) a group presentation, (f) and class participation. Students were also able to use some of the class time for working on their projects.

The completion of mandatory assignments made up 80% of the student's grade. Students were able to choose from the following optional assignments: (a) two annotated bibliographies, (b) an image editing project, (c) a Flash MX project, (d) a research paper, and (e) a final examination.

Jonassen (2000) emphasizes the importance of "grounded educational practices" in the learner-centered environment (p. 11). Instructions for assignments, however, were kept to a minimum. For writing assignments, the instructor purposely did not include any parameters such as paper length, research topics, and so forth. The instructor requested students to submit a proposal outlining the purpose, questions students sought to explore, and a table of contents in order to provide guidance and feedback to the students who selected these assignments. Specifications for the production of authoring projects were also limited because the instructor did not want to limit the creativity of students. During the course of the semester, group members were required to share their work in progress with the class. The instructor provided feedback to the groups at various stages, particularly once they completed the flowchart and storyboards. In order to provide students with additional guidance grading rubrics were posted on the Web for all assignments.

Activities. Out-of-class activities included generation of final exam questions, posting to threaded discussions in WebCT, reading assigned chapters and articles, locating resources for writing assignments, group work related to the client project, and taking the final examination. In-class activities included small group and whole class discussions pertaining to assigned readings, threaded discussions, and writing assignments. Students discussed work in progress and shared experiences. They presented completed assignments to the entire class, asked questions of one another, and provided viewpoints and feedback to their peers. Some class time was set aside to work on all elements of the client project.

Instruction. Lectures were kept at a minimum. During the first four weeks, the Dreamweaver sessions were structured like hands-on training session. Students worked through chapters covering basic skills with the instructor. The instructor demonstrated tasks while learners repeated the exercises on their computers. One-on-one assistance was available from the instructor and a graduate assistant. Fireworks and Flash sessions were less structured demonstrations because these assignments were optional. Assigned readings were discussed in either two groups or with the entire class. Students were encouraged to ask questions, share their experiences, express their viewpoints, differentiate concepts, and critique any writings. Only when students could not answer questions raised during the discussions did the instructor provide guidance by clarifying points and concepts.

Method

The instructor and a graduate assistant observed students during the class sessions. The instructor initiated discussions regarding the assignments and tools used. The students were asked to complete a 3-minute evaluation form after each class session to provide feedback to the instructor. The instructor encouraged students to contact her with any questions relating to the course and provided professional and personal contact information on the syllabus. In addition, students had the opportunity to contact a graduate assistant who was available during class and by appointment. The graduate assistant kept the instructor abreast of students who sought his assistance.

In addition, students were asked to provide feedback about the course during a short interview session. Participants were informed that the short session was not a course or instructor evaluation and that the purpose of the interview was not to gather positive feedback. Rather, the interviewer was interested in ascertaining strategies and activities that helped the student learn. The question was: What activities have helped you learn

the materials in this course? After students responded to this question, they were asked to complete a questionnaire with a listing of specific course elements and strategies. Individuals indicated which elements were or were not helpful and identified the five most helpful activities.

Results

In-Class Observation

Students voiced confusion during several class sessions. They were not accustomed to having decision-making abilities pertaining to course structure such as deadlines, time management, and assignment parameters. The limited information about assignments particularly confused students even though online grading rubrics were provided on the course Web site. The graduate assistant who observed the same behavior on several occasions confirmed this perception.

Students at first did not actively take responsibility or ownership for their work. For example, they did not ask questions about the first annotation and did not follow instructions on the Web site. When feedback about this optional assignment was provided by the instructor, several students were surprised by the instructor's expectations. Before that class session began, the instructor posted an example on the Web to provide additional guidance.

In one instance, students inquired about the required length of the research paper. The instructor in turn asked them how long they thought the paper should be. Students turned to each other in disbelief. It appeared they were out of their comfort zone regarding this experience. A discussion followed, and participants decided approximately ten pages were appropriate. The instructor indicated any length was acceptable for as long as they met all requirements listed in the grading rubric.

Another element students were not used to was that they could select some optional assignments and decide which topics they would like to explore. Several times during class sessions students said that they were used to being told what to do. As the semester progressed students became less confused and took responsibility for their own learning; it appeared that they enjoyed working on their assignments. Not surprisingly, students selected different combinations of assignments, chose a wide variety of topics, and used several different tools. For example, tools used by students in designing their Flowcharts were Word, Visio, or PowerPoint; each group used a different tool.

The instructor was perplexed that students were confused. She expected students would access the assignment information on the Web. Surprisingly, not all students accessed this information. The instructor needed to refer them to the Web site on several occasions when questions pertaining to assignments, grading, and scheduling were raised.

Another concern was if students were actually learning or not. Without the use of quizzes and tests, the instructor was not certain if students were learning in the beginning of the course. However, a few weeks into the semester students conveyed content knowledge and understanding during discussions. They demonstrated that they mastered new skills when they submitted completed assignments. Students actively participated in class. They were asking many questions, shared their experiences and viewpoints, and assisted one another during class sessions.

Occasionally, flexible deadlines caused scheduling problems. Discussions about threaded discussions and show & tells needed to be postponed several times due to not everyone having completed the assignment on the proposed deadline. The instructor needed to be flexible and adjusted the schedule accordingly. Flexibility was also required in regard to the use of class time. At times, students were so engaged in discussions that other activities needed to be either eliminated or rescheduled. This structured chaos in the classroom was responsible for some excellent sessions in which information was truly shared and knowledge individually constructed.

One other concern was the rating of course evaluations. The instructor was untenured and held a probationary position. Because the introduction of change can produce a level of dissatisfaction, the instructor was concerned about the possibility of receiving unfavorable ratings. Administration takes course evaluations seriously at this university and results are used in the renewal, promotion, and tenure decisions. This concern was one of the reasons why students were asked to complete a 3-minute evaluation at the end of each session. When students expressed concern about a particular class session, the instructor was able to address the issue in the beginning of the next class session. In addition, the short evaluation form provided the instructor with valuable feedback, which was used to make changes throughout the semester.

Interview Responses

When asked what helped students learn, seven of them reported the hands-on activities were helpful to them because they "learned by doing." The same number of students pointed out the in-class discussions helped

them learn. Interview participants clarified the interaction was good and they appreciated discussions about chapters in the Multimedia textbooks. One student indicated the class discussions “pulled it all together”. These students also enjoyed listening to others’ viewpoints and found it helpful to hear what other groups working on the client project were going through.

Six participants mentioned that the group work on the project helped them in their learning process. Students mentioned the perspectives of other group members were particularly helpful, and they were able to balance the workload between group members. Five students considered the workshop-style Dreamweaver sessions held during the first few weeks in the semester helpful. Two students each mentioned that the following elements were advantageous to them learning in the course: (a) the Web project, (b) Multimedia textbook, (c) assistance of the graduate assistant, (d) threaded discussions, (e) annotations, (f) assigned articles, (g) class schedule, and (h) feedback. Even though students were not asked which elements were not helpful in their learning in the interview, four of them shared some of these elements with the interviewer. They were the course management system, the Flash demonstration, the Dreamweaver textbook, and threaded discussions.

Survey Responses

Activities considered helpful. All participants indicated the following course activities had been helpful in their learning: (a) in-class discussions in small groups and as a whole, (b) showing and viewing completed assignments, (c) completing a research paper draft, (d) designing a personal Web page, and (e) working on all parts of the client project (proposal, outline, flowchart, storyboards, and the product itself), (f) providing and receiving feedback during a formative evaluation, and (g) presenting the final group project to the class. In addition, all students agreed (a) flexible due dates, (b) online grading rubrics, (c) the freedom to select topics for assignments, (d) resources such as example forms posted online, and (e) instructor feedback helped them learn.

Activities with the highest ratings. Students assigned the highest ratings to the following course elements: (1) Web project, (2) hands-on activities, (3) group work, (4) instructor feedback, (5) group discussion, (6) multimedia textbook, (7) selecting assignments, (8) client proposal, and (9) client project.

Activities not considered helpful. One activity not considered helpful by the majority of the students (more than 50%) was reading assigned chapters in the Dreamweaver textbook. A large percentage of students (44.4%) did not consider the threaded discussions helpful, and 33.3% did not consider the image manipulation project with Fireworks, the final examination, and “our” course attitude as valuable in their learning process.

Discussion and Implications

The introduction of constructivist approaches in a classroom with learners who are not accustomed to taking responsibility for critical thinking and learning is difficult. The instructor must truly believe in this theory in order to continue this effort because of the barriers encountered by various constituencies. Instructors must be flexible to accommodate progress, or lack thereof, with course content and requirements.

Many students have been taught to comply with what their instructors tell them without questioning the experts. Critical thinking and reflection can be learned, however. If they have not learned these skills by the time they arrive in our classrooms, we should strive to teach them these skills, because they will need them once they graduate with their college degrees.

It is not surprising to find students reported hands-on activities and discussions, may they be group discussions or exchanges during which they share their viewpoints, were helpful in their learning. Placing content and learners in the center of the learning experience by engaging students in the learning process, giving them the opportunity to take ownership of ideas and products, and providing them with a learning environment in which expression and reflection, enables them to form constructs.

Feedback is critical in student learning. Feedback from not only the instructors but also from peers is imperative in the learning process. Learning does not occur in a vacuum; it is truly a social process. Our students are not empty vessels when they arrive on campus. They have acquired knowledge elsewhere and had prior life and professional experiences they can share with others. Instructors should provide students with the opportunity to revise projects and learn from mistakes in order to facilitate improvement. Good writers do not write by themselves - professionals use a peer-review process. It is also advantageous for students to build good team working and communication skills. Many projects in the business industry are designed and produced by a team of individuals utilizing the expertise of its members.

Conclusion

The researcher hypothesized some of the course activities would be more helpful to learners than

others. In fact, the researcher expected that certain activities would be clearly identified by all students. Indeed, some of the activities that were expected to be rated highly by students in being helpful in their learning process were identified as such. However, there were a wide variety of activities that received high ratings. These results indicate instructors should design a wide variety of activities and assignments in order to support student learning. Because not all students learn the same way, we need to take individual differences and learning styles into account. This approach, however, is more labor intensive for the instructor.

Another hypothesis was that the “our” course attitude would be a successful approach in the course. The instructor expected this approach would set the stage for a relaxed and supportive learning environment. Students did not report that this approach was considered helpful in their learning. One student wrote on the survey, “Graduate students have learned to do what they are told to do so this part is difficult to get used to.” Perhaps students in this course were not quite prepared to encounter this type of learning environment.

Prepared or not, we should provide students with a safe, supportive environment because some already experience a high level of stress while they attend universities. Fear of failure and lack of control and power is the reality of many students in higher education settings. We should create teachable moments by creating supportive environments in which we can assist learners in creating constructs and internalizing them with the goal to increase retention and transferability so that students can maximize application.

Readers must be careful in generalizing findings in this study to other populations. The study involved a small sample of graduate students at one comprehensive university in the mid west. There is a need for replication of the study with other populations and a larger sample size.

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Who's In Charge? A System of Scaffolds That Encourages Online Learners to Take Control

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Abstract

The teaching and learning “dance” is one that traditionally has been led by the instructor with the student following passively. Faculty members in higher education are entering the realm of online learning, many with the previous experience and hopes of facilitating student-centered, active learning experiences. However, due to factors that are integral to this environment, many are returning to their “comfort zones” by providing greater clarity and specificity, stricter accountability measures, and less student flexibility/personalization. To address best teaching practices in adult education within the online environment, a systems model of social, self-direction is presented that allows the student to “lead” and yet learn how to facilitate the self-direction process. This model was used as an instructional intervention in this study, which sought to answer the question: “What are the self-perceived learning gains of students engaged in a social, self-directed learning experience?” A self-rated pre-test/post-test design was utilized with the 8 course sections and 112 subjects that received this instructional intervention. Other data sources were also utilized as triangulation for validating the self-reported learning gains on both the breadth and depth of course material. The model was found to facilitate significant learning gains, while attending to university guidelines and course requirements. Further implications and questions that are resulting from this research are also explored.

Introduction

Online learning can be overwhelming and discombobulating for learners due to uncertainty and lack of clearly expressed expectation. However, in response to student requests for clarity in online environments, structure has been created by assuming a more rigid classroom approach that eliminates many of the benefits of virtual instruction. Rather than assuming new and innovative ways to respond to demands of online education, the trend is to assign quotas, dates, and accountability measures that minimize choice and encourage students to become the type of students that Ponticell and Zapeda (2004) term “compliant learners”. This was substantiated in many presentations at a recent national leadership conference where faculty shared innovations in program development and course delivery via online environments.

Traditional approaches of lecture, readings, and testing do not successfully accommodate the best practices of higher education/adult education, which encourage active, engaged, and authentic learning experiences. Knowles’ work provides a definition of andragogy and self-direction that can be used as a theoretical basis for incorporating adult learning principles into higher educational teaching practice (Knowles, 1975; Knowles, 1986; Knowles, Holton, & Swanson, 1998). The attributive, representative, and situational theoretical philosophies have been posited within the adult education field as different yet critical teaching and learning perspectives and are usually explored as divergent instructional methods. The model presented in this research integrates all three models to attend to learner characteristics (input attributive variables), process and meaning construction (process representative variables), and socially contextual interaction (process learning community, self and group metacognition, and outcome environmental variables) (McGough, 2003). While these practices are important regardless of educational delivery, the advent of online mediums has provided a platform for the exploration of innovative teaching models and an adaptation of “instructor” and/or “student” roles (Harvey, 2002; Jonassen, 2002; Moller, 2002).

Aligning instructional approaches so that online experiences provide both clearly expressed structure and a means for personal learning that incorporates self-direction, metacognition, and learning communities is not an easy linear task. Instead, learning in this framework must be viewed as a complex system where students are granted responsibility for planning, searching, finding and producing learning objectives, while instructors provide the scaffolds, resources, feedback, and expertise that is essential to connect system components. Within this framework, learning becomes an instructional dance, where students lead movements, direction, and pace while instructors follow in step, provide assistance, and enhance the experience. So the question, “Who’s in

charge?” becomes difficult to discern as the swirling dance of learning is in progress, and one must wonder in this design whether the complexity is an exercise in futility, or whether breadth and depth of learning does occur.

Background

A model has been under design that provides both instructional technique and cognitive theory to accommodate the difficulties of structure provision and personal/group direction of learning. (See Figure 1). The systems model of social, self-directed learning considers input, process, and output, which result in outcome variables and is represented by the formula ($I+P+O=Ou$) (Boyer, 2003). In this model, it is hypothesized that a student enters a learning situation with a given set of input variables which include learning patterns, previous experience, content knowledge, personal interests, and a host of other characteristics. These input variables serve to mediate the instructional process that is designed for students in the online environment.

The process portion of the model is centered on individual and group metacognition, which is surrounded by the course learning communities. The instructional design and components then enclose the learning communities. These instructional design components include: a self-directed learning framework (acts as a scaffold for students), online learning tasks, reflection, interaction and engagement, continuous feedback, and integrated authentic learning. The process then gives way to the output portion of the system, which includes in this case, overall learning gain (content specific), final products, course evaluations, group effectiveness, course completion rates, and real world authentication. It is assumed that the model includes a feedback loop that continues to drive the overall learning system.

The model of social, self-direction has been under a constant iteration process. This research study is primarily focused on the resulting output of the model. The question and research guiding the current research study is as follows: What are the self-perceived learning gains of students engaged in a social, self-directed learning experience? A sub-question to this is: Do students improve their learning in objectives that are not specifically selected on self-designed individual/group learning contracts? The results of this research will impact the overall validity of the model and provide fodder for future research and model iteration.

The Instructional Context

The instructional intervention that was applied as part of this research project has been utilized in both web-based (75% or more time spent online) and hybrid course formats (a mixture of face-to-face and online experiences making up either a 40% -60% or 50% -50% split of time in either setting). Technology integration courses at both the Masters and Undergraduate level have been utilized for the described intervention. Student technology experience has quite varied ranging from beginner to expert levels.

As part of the course under investigation, students participated in a one-day face-to-face orientation in which the following elements were introduced: courseware program (Blackboard 6.0), learning patterns assessment, self-diagnostic instrument completed (pre-test), course material reviewed, expectations shared, groups formed, and learning contracts concepts presented. Rough drafts of the group learning contracts were developed prior to leaving the first class meeting.

Individual and group learning contracts were created based on the areas of learning “need” self-determined on the initial diagnostic instrument, which is patterned from Knowles (1986) needs assessment design. Next, the following components were identified during the learning contract process: strategies and resources that would be used to complete their work, dates for completion, evidential products that will demonstrate new knowledge, and authentication procedures to verify product content and quality. The learning contract process is graphically portrayed in Figure 2.

Students were also required to remain engaged through participation in the online discussion board activities and completion of student homepages. Weekly resources (offline content and online materials) were shared throughout the semester to provide students with a breadth of exposure to add to the depth of objective exploration that occurs as a process of the learning contract design. The diagnostic instrument, learning contract, course materials, and reflective instruments were utilized as scaffolds to structure and guide the experience despite the previous level of technological knowledge.

In order to facilitate the development and sustenance of the learning communities, which is primary to the model, students are asked to create at least three group objectives on the learning contract and another two individual objectives. Students can decide to complete all group objectives, but not all individual objectives. The use of group objective building process aims at reducing isolation, building community constructs, establishing team/community and personal learning, developing shared vision, and creating knowledge construction as has been deemed vital throughout the literature on learning communities and communities of

practice (Brown, 2001; Derry & DuRussel, 2000; Tu & Correy, 2002). Also evident in the proposed model and designed environment are elements of Wenger's (2000) modes of belonging: engagement, imagination, and alignment.

Methods

A design-based research methodology has been used for the overall model development to focus on the global perspective of this unique system of learning. Design based research has been found to be appropriate for model design and iteration in complex learning environments (Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003; Sloane & Gorard, 2003). The design-based research methods provide a means for macro analysis that is necessary to bridge multiple concepts in complex learning environments.

This particular phase of study utilized a non-experimental research design with a pre-post assessment of self-perceived level of learning and accomplishment as a result of the instructional design intervention. At the time of presentation there were eight sets of data with an additional three semesters of pilot study. The data collection involved a pre and post self-rated diagnostic instrument, which lists all of the course objectives and asks students to rate their current level of knowledge (pre), and the level of knowledge necessary to be successful in their anticipated profession role (pre-relevancy indicator). The output measure (post) self-rated diagnostic instrument was patterned exactly as the initial pre-assessment with the same competencies listed; however, the students are asked to rate their level of accomplishment as a result of the instructional experience. Students are not "graded" on this and submission of this instrument in no way affects course grades.

Learning contract portfolio documentation and a final course updates were used to validate the data gained from the self-rated diagnostic instruments. As part of the learning process students designed individual and group learning contracts and resulting products and authentication that show evidence of competence acquisition. These portfolios were reviewed using document analysis to further triangulate the post-test instrument data.

The final course update includes a final reflection posted on the asynchronous discussion board asking students to review their learning over the semester and to critically examine the experience.

Population

Two different sample groups were used in this investigation, but all would be considered adult learners ranging from age from 25-65. There were 87 females and 25 males in the sample. The sample group was compiled over eight separate applications of the course intervention with students over a period of 18 months and three different course titles. There was great diversity in student technology competence (course content area) at the outset of each section. Appropriate university approvals and subject consents were garnered for this research study, with students who preferred not to participate being removed from the sample.

The sample groups all utilized the same instructional strategies and formats with some distinction on final expectation, adapting to align with actual course objectives. The student participants' professional backgrounds were diverse with the majority of students coming from educational fields; however, some were from nursing, business, pharmacology, and information systems.

Results

Each instrument, pre and post, were analyzed separately for descriptive statistics. Student scores for the pre self-rating instrument were compiled across semesters with mean values run by question on the pre and post instruments. The pre and post assessment included 24 self-rated questions, in which students ranked their knowledge on the associated course objectives on a scale from 1 (no current knowledge) to 4 (high current knowledge). The pre-test question means ranged from 1.53 to 3.13. The n value for each question varied dependent upon student response and/or course alignment of questions (112-90). There was significant variance in the questions with answers ranging from a minimum rating of 1 and a maximum rating of 4 for most questions, which supports the starting diversity of technology levels. See Table 1 for a listing of the descriptive statistics by question.

The post assessment followed the same configuration as the pre assessment. Students rated the gained knowledge on the course objectives. Means ranged from 2.67 to 3.71 with an n for each question ranging from 90-112. There was less variance in the post scores, but a range of responses were still evident. A quarter of the questions received a minimum of a 2 rating and all questions received maximum ratings of 4. Table 1 provides a listing of the descriptive statistics for the post assessment. Student responses on gained knowledge were in no way used to establish grades and were submitted electronically with no "grade" assigned to this task.

The pre and post data were analyzed using a t-test on the question means of the pre-post differences to determine the significance of the differences. All questions demonstrated significant differences ($p < .001$) indicating that globally learning occurred on all course items. The t-scores range from 7.305 to 15.747. Table 2 provides information on the t-scores by question number with the respective degrees of freedom.

Students received feedback on the learning contract objectives they submitted as their evidence for learning that was predetermined at the beginning of the semester. Students were given detailed, extensive feedback on their initial submission based on a skill rubric that was shared at the outset of the semester and were then provided with the opportunity to improve product quality. Through this process, the self-designed authentic products satisfactorily

Table 1. *Descriptive Statistics on Pre-Test and Post-Test by Question*

| Question | Pre | | | | | Post | | | | |
|----------|-----|------|--------------------|----------|----------|------|------|--------------------|----------|----------|
| | N | Mean | Standard Deviation | Variance | Skewness | N | Mean | Standard Deviation | Variance | Skewness |
| A1 | 112 | 3.13 | .65 | .42 | -.33 | 112 | 3.71 | .47 | .22 | -1.22 |
| A2 | 112 | 2.14 | .85 | .72 | .35 | 112 | 3.2 | .76 | .57 | -.60 |
| A3 | 92 | 2.01 | .78 | .60 | .55 | 92 | 2.93 | .81 | .66 | -.52 |
| A4 | 112 | 2.38 | .92 | .85 | .07 | 111 | 3.64 | .61 | .38 | -1.99 |
| A5 | 110 | 2.17 | .89 | .79 | .38 | 110 | 3.22 | .82 | .67 | -.84 |
| A6 | 91 | 1.79 | .80 | .63 | .67 | 91 | 2.86 | .91 | .83 | -.42 |
| B1 | 92 | 1.73 | .83 | .68 | .91 | 92 | 2.98 | .78 | .61 | -.52 |
| B2 | 92 | 1.85 | .81 | .66 | .54 | 92 | 3.12 | .78 | .61 | -.78 |
| B3 | 91 | 2.16 | .87 | .76 | .29 | 92 | 3.34 | .72 | .51 | -.79 |
| B4 | 91 | 2.14 | .80 | .63 | -.13 | 91 | 3.36 | .66 | .43 | -.55 |
| C1 | 112 | 2.95 | .79 | .63 | -.46 | 112 | 3.80 | .42 | .18 | -1.91 |
| C2 | 112 | 2.76 | .75 | .56 | .04 | 112 | 3.58 | .58 | .34 | -1.03 |
| C3 | 92 | 2.53 | .76 | .58 | -.04 | 92 | 3.64 | .55 | .30 | -1.21 |
| C4 | 91 | 2.66 | .72 | .52 | .06 | 92 | 3.58 | .56 | .31 | -.89 |
| C5 | 112 | 2.55 | .87 | .75 | .08 | 112 | 3.58 | .67 | .44 | -1.70 |
| D1 | 92 | 1.53 | .70 | .49 | .95 | 92 | 3.20 | .73 | .53 | -.67 |
| D2 | 92 | 1.71 | .76 | .58 | 1.01 | 92 | 3.10 | .77 | .59 | -.46 |
| D3 | 92 | 1.88 | .80 | .63 | .47 | 92 | 3.16 | .75 | .56 | -.44 |
| D4 | 111 | 2.65 | .88 | .78 | -.28 | 112 | 3.57 | .65 | .43 | -1.85 |
| E1 | 92 | 2.89 | .87 | .76 | -.09 | 92 | 3.68 | .57 | .33 | -2.03 |
| E2 | 92 | 1.79 | .90 | .80 | .80 | 92 | 2.83 | .98 | .96 | -.50 |
| E3 | 91 | 1.57 | .90 | .80 | 1.53 | 90 | 2.67 | .92 | .85 | -.16 |
| E4 | 91 | 2.70 | .92 | .86 | -.14 | 91 | 3.57 | .63 | .40 | -1.47 |
| E5 | 90 | 2.61 | .87 | .76 | .12 | 91 | 3.58 | .67 | .45 | -1.57 |

Table 2. *T-Test Scores by Question*

| Question | T Statistic | Df | Number of students who selected this objective |
|----------|-------------|-----|--|
| A1 | 7.792 | 222 | 6 |
| A2 | 9.810 | 222 | 59 |
| A3 | 7.897 | 182 | 15 |
| A4 | 11.948 | 221 | 76 |
| A5 | 9.093 | 218 | 43 |
| A6 | 8.391 | 180 | 30 |
| B1 | 10.522 | 182 | 24 |
| B2 | 10.825 | 182 | 16 |
| B3 | 9.943 | 181 | 11 |
| B4 | 11.256 | 180 | 8 |
| C1 | 10.110 | 222 | 30 |
| C2 | 9.169 | 222 | 16 |
| C3 | 11.337 | 182 | 12 |
| C4 | 9.639 | 181 | 8 |
| C5 | 9.929 | 222 | 28 |
| D1 | 15.747 | 182 | 41 |
| D2 | 12.296 | 182 | 11 |
| D3 | 11.280 | 182 | 31 |
| D4 | 8.891 | 221 | 16 |
| E1 | 7.305 | 182 | 29 |
| E2 | 7.463 | 182 | 15 |
| E3 | 8.094 | 179 | 11 |
| E4 | 7.382 | 180 | 8 |
| E5 | 8.430 | 179 | 9 |

** All questions exhibit significance at a $p > .0001$

met the designed objectives and demonstrated gained knowledge. Given that students had the option of actively improving their work based upon rubric feedback, few assignments across the multiple semesters received unsatisfactory evaluations. The significant results from the t-test pre-post means by question were validated through the document analysis of previous work products and instructor ratings.

Significance of achieved breadth of knowledge having been found, it was then necessary to investigate whether the selected objectives placed on the learning contract by students resulted in higher degree of learning. Growth was seen across all questions indicating diffused overall learning despite student concentration on selected objectives. See Table 2 for a breakdown of the number of students who selected each objective for the “depth” portion of the content. Not all students received perfect scores or a high level of learning based upon the objectives that were selected. However, the average growth on those objectives selected was 1.36, with a range of responses between a loss of a point to 3 points growth. The average growth on those objectives not selected was .94, with the range of responses including a loss of a point to 3 points of growth. While it would appear unusual for students to have selected a value indicative of a reduction in amount of knowledge gained, this does perhaps suggest that students might have misjudged their initial knowledge due to lack of understanding of terminology and basic technology skill. These data definitely suggest that perhaps students were not concerned about instructor “acceptance” and did indeed truly self-evaluate knowledge at both points in time.

Conclusion

The question of “Who’s in charge?” was not posed in an attempt to remove the instructor role from the “dance” of learning; rather, the focus was on investigating whether learning did occur when the control of learning tasks were transferred to the students and student communities. Instructors play a critical role, within the model and instructional design of social, self-direction, via instructional design, student facilitation, content development, feedback/critical analysis, and evaluation. However, rather than the instructor guiding the process, the learner becomes the one guiding the “dance” direction, flow, meaning, and pace.

The model, which has been represented in the formula $(I+P+O=Ou)$ is shown in Figure 1, and attempts to merge popular adult education, social learning, and constructivist philosophies and provide a systemic view of the learning process that incorporates what is known about higher education best practices into the online environment. Like all new models, further iteration, development and dimensional visualization will need to occur to generalize and replicate the system elements. However, this particular study was focused on understanding whether learning was occurring given the instructional intervention that was attempted in the online environment.

The data of the pre and post instruments indicate that indeed, students self-rated their knowledge gain as significant. All questions indicated significant learning of the objectives ($p<.001$), which is substantiated by the learning contract products. The gradient range of improvement for each of the question (from a 1-pre value to a 3-post value indicator OR from a 2-pre value to a 4-post value indicator) was different for each individual based upon the beginning level of need, the objectives that might have received greater “depth”, and individual student mediating variables (such as time, available technology, etc.). It was possible that the high level of significance that was found included some “approval” seeking behaviors from the students involved in the study. For instance, given the semesters worth of work and the knowledge of the ongoing research study, it is possible that the students rated themselves higher to “please” the instructor. This effect is somewhat diminished by the lack of feedback and encouragement on this document. Further, given that some individual scores showed negative values in objective growth makes this phenomenon somewhat unlikely. The instructor introduced the post test as a reflective assignment that will in no way affect grading and suggests that the instrument simply be used as a tool for creating a learning plan and reflecting on gained knowledge.

Each learning contract was evaluated by the instructor on pre-established rubrics and was show to either be initially acceptable or through an active learning process improved to demonstrate appropriate knowledge and skill growth. This process was used as a validation indicator to establish if the learning products supported the student self-perceived learning gains. Students did have evidential products that met instructor expectation in the areas that were selected as learning objectives for the course. This substantiates the self-perceived knowledge on only those areas that were included on the learning contract (depth of knowledge in choice areas) and cannot be used as evidence to validate the breadth of knowledge that was rated on the post instrument.

While depth of knowledge gained in the class was found to be significant for the areas selected on the learning contract, further analysis was necessary to determine if growth occurred across all areas to attend to the breadth of content that the course was slated to cover. The data indicate that there was higher average growth in

those areas that were selected on the learning contract. The increased knowledge gain, in areas where depth was obtained, was substantiated by student comments on final reflective updates .

The findings of this study provide support for the significant learning gains that are achieved when using this instructional intervention. The next step in this process will be the need to tie these learning gains to the much more meaningful dimension of outcomes that has not yet been visually designed. The outcomes element provides a way to conceptualize the impact of the individual student learning on others both internally and externally. Were there other valuable and meaningful learnings (outside of course content) that occurred as a result from the use of this model in the instructional design? Do students become more self-directed as a result of the process in this instructional design and model of social, self-direction? Are students better able to assume responsibility for their own learning and generalize this to other learning situations? Does the social, self-directed model increase leadership potential and enhance leadership characteristics?

In fact, a study has recently been conducted showing that this model increases the use of leadership characteristics such as the use of time management skills, organization skills, self-motivation skills, problem solving, and team/group facilitation skills (Boyer, 2004). However, little is known about whether these learned skills continue throughout further coursework given a return to traditionally designed courses, or whether students return to the “comfort” of becoming compliant learners. Further, longitudinal work is needed to determine whether participant comments about changes in their organizational environments and families due to this instructional intervention are indeed signs of significant external impact. In other words, does the instructional design of a social, self-directed environment transform not only the enrolled individuals, but those outside of the course who are touched by those who are involved in the intervention?

The results of the this study, provide additional support for the possibility of designing student-centered, community driven, self-directed, and meaningful environments in online settings that provide the opportunity for significant learning gains. Students can be responsible for personal growth without the mandates and structures that many who have been experimenting with online delivery have determined are necessary. In order to help students be successful in the more self-regulating environments scaffolds may need to be provided (depending upon their current level of development). Providing these scaffolds adheres to positive adult learning practice and is much more conducive and transforming than returning to the “comforts” and “traditions” of instructor –led, instructor-controlled delivery and design.

The dance of learning requires a couple, a partnership, a community, that can move together to transform perspectives and enhance knowledge acquisition. Providing students with the “lead” opportunity is oftentimes not appreciated and/or welcomed given previous training and enculturation. The model of social, self-directed learning is one that required full engagement, participation, and commitment. Some students express a longing for the “ease” of sitting in class for a number of hours being told what to do and how to do it. This perspective limits the personal investment, which has been necessary to be functional citizens in a knowledge society where the need to think, plan, learn, collaborate, and innovate is paramount. The linearity of the “traditional” process was much “easier and simpler”; however, the complexity and commitment that is derived from a systems model such as the one presented has the potential of altering perspectives, instilling personal freedom and responsibility, and extending the learning process to internal and external communities. The systems model of social, self-direction aims at meeting this transitional need as we transform from a populace of compliant thinkers to innovative, self-motivated, community members.

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Figure 1. Model of Social, Self-direction for online environments that includes input, process, output and feedback dimensions.

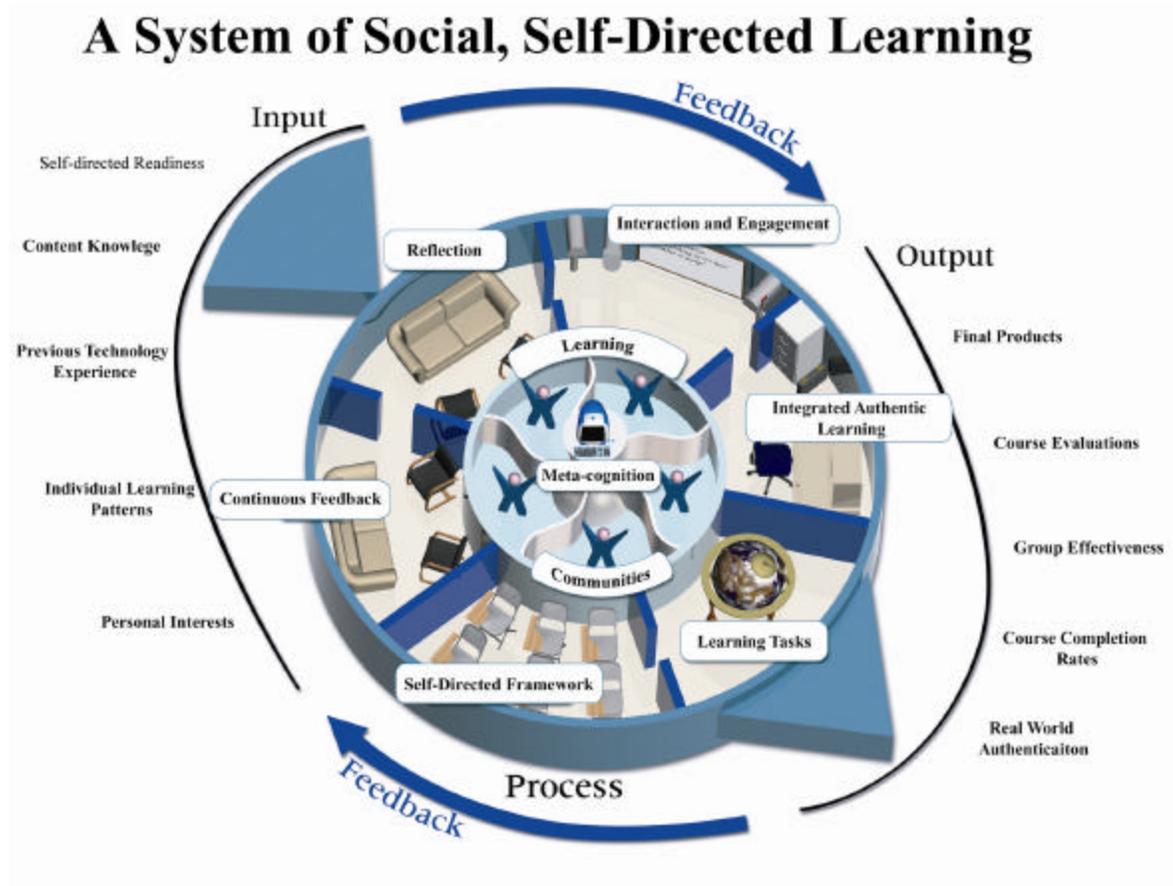
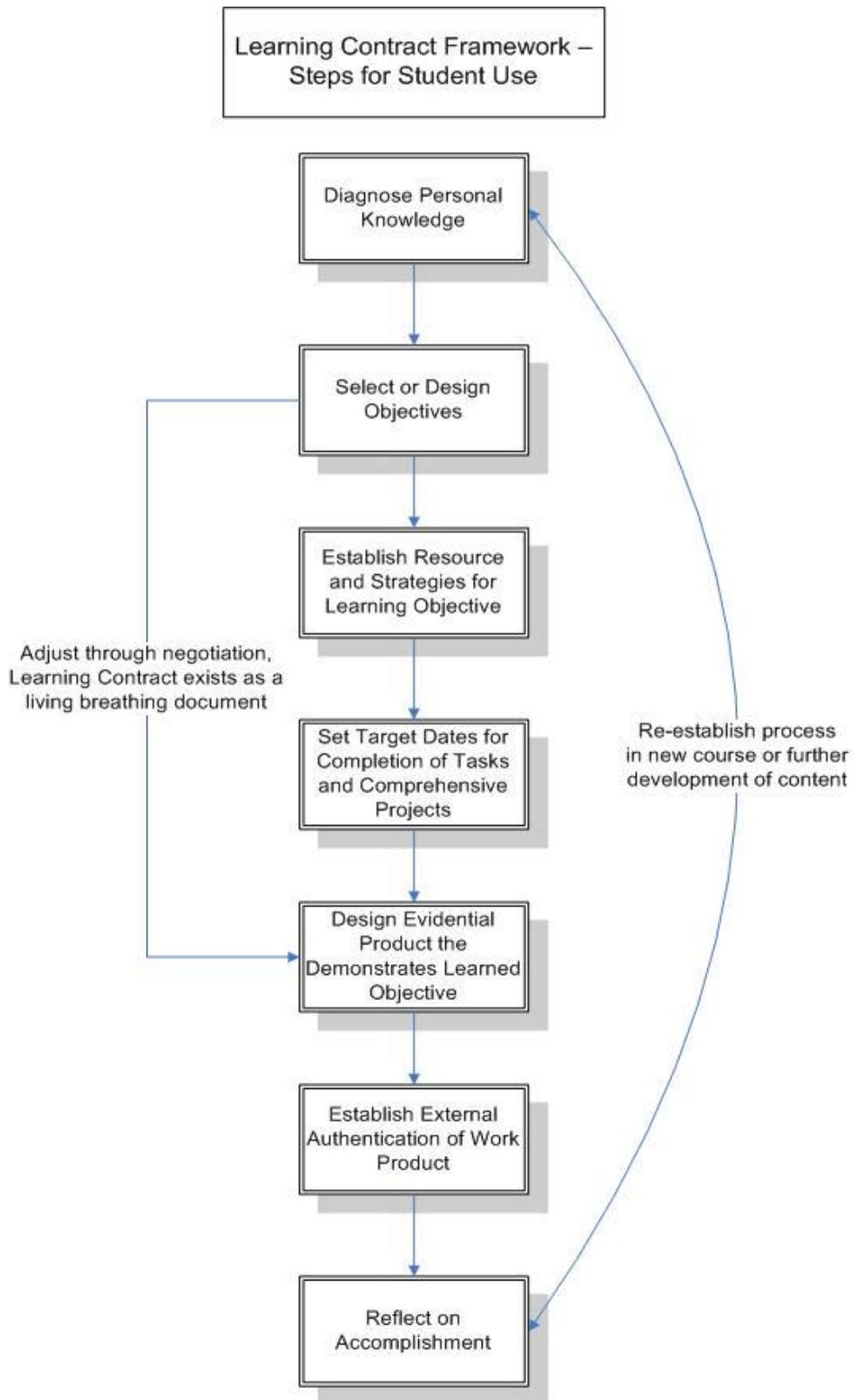


Figure 2. A Process for developing self-directed learning contracts to facilitate personal control of learning.



Type II Technology Applications and the Diverse Learner: Issues, Instruction, and Individuality

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Abstract

Two types of technology integration have been the subject of much discussion and research over the past several years. These two types involve the integration of technology into the classroom and the integration of diverse learners into the classroom. Technology integration can take many forms ranging from simple remedial programs to programs and systems that promote creative thinking in the classroom. Diversity can also be complex in that it can include ELL students, students with disabilities, and issues of gender. This article will explore ways in which technologies that enhance teaching and promote critical thinking can be integrated into the diverse classroom using an instructional technique known as differentiated classroom instruction.

Type II Technology Applications and the Diverse Learner: Issues, Instruction, and Individuality

Two types of integration have been the subject of much discussion and research over the past several years. These two types involve the integration of technology into the classroom and the integration of diverse learners into the classroom. Technology integration can take many forms ranging from simple remedial software to software and systems that promote creative thought in the classroom. Software and systems that promote creativity and intellectual growth among students by allowing the teacher to teach in new and better ways are commonly known as Level II applications (Maddux, 2002). Integrating diverse learners in the classroom can also take many forms. The process of integrating students with disabilities in the classroom is commonly known as inclusion.

While the integration of technology in the classroom can be difficult, it can help teachers meet many of the challenges presented in an inclusive classroom. Although many technological applications for students with disabilities tend to focus on remediation, this article focuses on those applications and situations that move away from remediation and help stimulate students' intellectual abilities and enhance teaching - that is, Level II applications. In addition, this article describes these applications and the instructional techniques that the classroom teacher can use to facilitate the integration of technology into an inclusive classroom, offering illustrative examples based on a combination of the authors' K-12 teaching experiences and observations. Discussions of key concepts and issues such as differentiated instruction and the inclusive classroom are also included.

Differentiated Instruction: What Is It And How Does It Work?

Differentiated Instruction is a well-researched and effective instructional technique that can help the classroom teacher meet the unique needs of diverse students (Tomlinson, 2001). Differentiated instruction differs from individualized instruction, because it provides learners with more options for learning while ensuring that the classroom workload remains manageable for the teacher. A teacher creates this balance by looking at similarities, as well as differences, among the students in his or her classroom. By grouping students together to handle the unique instructional needs of each group, the teacher can strike a balance between meeting the needs of a variety of learners with different abilities and experiences with the reality of the classroom where one teacher is expected to work with as many as 30 students. Another advantage of differentiated instruction is that it can effectively utilize a wide variety of assistive/adaptive technologies. Assistive/adaptive technologies are those that help a person with common tasks, making something physically accessible that would be inaccessible otherwise; wheelchairs, Braille readers, and hearing aids are examples of assistive/adaptive technologies.

Differentiated instruction is uniquely suited to help teachers handle the unique learning characteristics of a wide variety of students by allowing teachers to more effectively integrate limited technology resources into the day-to-day activities of the classroom. In order for technology to be most effective, technology must be fully integrated into the classroom. Because very few teachers have a classroom full of computers or a laptop for every student, an instructional technique that both meets the unique instructional needs of each student while providing accessibility to the available technology is important. Differentiated instruction does this well.

Differentiated instruction can also be thought of as a way of teaching that provides students with many ways to access, process, and output information that best meets his or her instructional needs. In a differentiated classroom, the teacher assesses the students' instructional needs, creates and/or uses instructional techniques that meet those needs; the teacher then reassesses the students' needs to inform the next round of instruction. Carol Tomlinson (2001) describes the key characteristics that form the core of differentiated classroom. The first of these is that the instruction is proactive; the teacher is constantly anticipating the instructional needs of both the individual student and the group. Another characteristic is that the instruction is qualitative; the teacher does not just assign more or less work but tailors the work to the student's unique instructional needs. A third characteristic of differentiated instruction is the use of formative assessment; the teacher uses the assessments given in the classroom to continually modify instruction for the student. In differentiated instruction the teacher takes multiple approaches to the content presented, the instructional process, and student products; the goal of the teacher is to try and find the best match between the student and the instruction.

Differentiated instruction is also student centered, flexible and engages the student at a level appropriate for that student. What makes differentiated instruction different from individualized instruction is that it is a mix of whole-class, small group, and one-on-one instruction. This is important because it allows the teacher to effectively manage the classroom by addressing the needs of four or five groups rather than thirty individual students.

Technology and Differentiated Instruction: A Case Study

To see how differentiated instruction might work in a classroom, we will use the example of Mrs. Winslow's classroom. Although Mrs. Winslow's classroom is a fictional construct, the premises are based upon the authors' experiences in and observations of actual elementary classroom populations and settings. Mrs. Winslow has an inclusive classroom of elementary school students. During a particular instructional unit, all of her students are reading a popular book. She has organized her students into three groups. One group of students has been identified as dyslexic. These students have no problem comprehending the subject matter but have difficulty decoding the text in the book. The second group consists of students in the regular education program. These students have average reading and comprehension abilities. The third group is a group of academically gifted students who have already read the book at least three times.

Normally, Mrs. Winslow has all of her students complete a traditional book report in which each student has to write a book report that describes the story of the book and asks the students to draw their own conclusions about the book. In order to better meet the needs of her students, Mrs. Winslow decides to differentiate the assignment. She begins by assessing the students' technology competencies, asking them about their familiarity with programs such as word processing, Web browsing, and Web page creation. She finds that many of the students identified as academically gifted have at least some experience with Web page production, a fair amount of experience with word processing, and a great deal of experience with Web browsing. The students identified as dyslexic have a wide variety of technical skills from no skills with the computer to being able to develop Web pages. The general education students also have a great deal of experience with computers but their experiences have focused on "Web surfing" and some word processing.

Mrs. Winslow decides to differentiate her instruction at two levels based on this pre-assessment. She begins by having all of the students read the book, but in different ways. The students who have been identified as dyslexic listen to an audiotape copy of the book that Mrs. Winslow has obtained from the Library for the Blind. These students listen in pairs or small groups with multiple headphones plugged into the tape player using equipment also provided by the Library for the Blind. If one student does not understand the text or gets lost, a group leader is assigned to stop and rewind the tape in order to review.

The regular education students are grouped together and read the book to each other in pairs or small groups of three to four students. They are grouped based on their individual reading abilities so that the stronger readers are paired or grouped with the weaker students. The students identified as academically gifted are asked to read the book independently with the understanding that they may ask the teacher for help at any time.

Once all of the students have finished the book, everyone works on writing a book report in pairs or small groups. The groups ultimately present their book reports to the class. After the presentations, Mrs. Winslow guides the class through an activity in which the best parts of each of the book reports are collected and organized to make a "super" book report.

Mrs. Winslow then reorders the students by level of technology skill. The students with high technology skills are challenged to learn new Web authoring software that has been obtained from the district office. These students work together on a computer in the classroom to learn the technology tool. Meanwhile, the students with weak technology skills are asked to begin storyboarding the class project. A storyboard is a document that contains the report's text, descriptions of pictures for the report, and a graphical representation of how the content for the Web site will be organized. The students with moderate technology skills are asked to type the book report so that it is digitally captured in the computer. They are also responsible for gathering multimedia elements such as pictures and links to areas of interest on the Web.

Once the storyboard is completed, Mrs. Winslow then pairs each of the students with strong technology skills with groups of students with moderate to weak technology skills. The storyboard is also divided up so that each group has its own part of the storyboard. The students with advanced technology skills then help the students with weak technology skills create their own part of the class Web site. Because the Web site can be run from the computer's hard drive, each of the groups take turns working on the classroom computer. Each group presents its portion of the site to the rest of the class, once the entire project is completed.

Sensitivity to Gender and Culture While Using Technology in the Classroom

As the use of technology in the classroom to address the needs of diverse learners continues to increase, many issues are being uncovered. One issue that has generated and continues to generate a significant amount of emphasis within education and the press is the use, or more appropriately the lack of use, of technology by minorities, students from low socio-economic backgrounds, and females. Awareness of this issue will help teachers be sensitive to what needs to take place for these students to benefit from the use of technology as it is integrated into classroom instruction.

The term that is commonly used to describe this issue is the digital divide. The digital divide indicates the gap that exists between those who have access to technology and those who do not. Despite the increased availability and use of technology in the classroom, a divide still exists. This divide assists in bringing about a serious disconnect between those who have access to and training in the use of technology and those who do not (Pearson, 2001; Hoffman & Novak, 1998). Those who suffer most frequently from the effects of the digital divide are minorities (Bolt and Crawford, 2000). Historically, minorities have not been exposed to technology in significant ways, often because technology has been viewed as being controlling rather than empowering. This perception is changing as minorities embrace the benefits that technology can provide.

Teachers need to make a conscious effort to help insure that minorities have access to technology. Opportunities should be deliberately created and provided that allow them to have as much time as possible to use technology in the classroom. Teachers should also model the use of technology to show that having skill in using technology can be empowering. By doing this, many of the fears that minorities have about technology are broken down; technology no longer is perceived as a threat and it then becomes an empowering tool. One way in which this can occur is by differentiating instruction in a way that allows students to explore topics that are relevant to their lives.

Technology and the ELL Student

English language learners (ELL) are students whose primary language is not English. ELL students often have difficulties mastering English, which creates several barriers for them in mastering content. Along with the challenges students may face with English literacy, students may well be illiterate in their primary language. This increases the challenges faced by teachers, because not only does the student lack English skills, the student may also lack the basic skills needed to read at all. The ELL student may have a learning disability that can interfere with learning these basic skills. At the other extreme is the ELL student who is gifted. These students pose unique challenges for the classroom teacher who must not only help the student acquire English language skills, but must also challenge them in their native language. A good starting point to help students deal with these issues is for the teacher to have a very good grasp of where each student is in terms of his or her skill development. Once this is understood then ELL students can be grouped appropriately to meet their unique needs.

Technology can provide the teacher with some very useful tools that can help them address these needs. Several Web sites and software programs exist that can translate English into other languages such as Spanish, German, or Portuguese. Conversely, the same Websites or software can be used to translate Spanish into English. ELL students who are academically advanced may benefit from a mini research project that

involves accessing English only Web sites to find about a specific topic. If they have problems interpreting the English text found on these sites, students can translate the text using the translation Web sites or software. Once they have completed the paper in English, the teacher can then have students translate the text back into Spanish to see if the translated text is what they had intended to write.

English language difficulties can also exacerbate the often-difficult endeavor of fitting into the classroom culture. ELL students may experience isolation and frustration from the lack of being able to communicate effectively with the teacher and classmates. This can lead to classroom management and discipline problems. In order to address these issues the teacher should look for occasions to provide ELL students with positive opportunities where they can feel they are part of the classroom culture without denying their own culture.

The fact that ELL students tend to have much less access to technology than do their peers (Neuman, 1994) means that the teacher needs to carefully plan for the inclusion of ELL students in classroom instruction that involves technology. For ELL students, technology needs to be part of a learning environment that encourages discovery learning and connections to larger communities (including their own native community) (Ovando, 1998). Another instructional principal for ELL students is the creation of an active and engaging environment (Liaw, 1997). "Children need to be able to interact with each other so that learning through communication can occur. By using electronic tools such as email, moos, and video conferencing the computer can act as a tool to increase verbal exchange" (Ybarra and Green, 2003).

Typical use of technology by ELL students tends to be through drill and practice software where students interact with English in an isolated manner. Although drill and practice software has its place, it should not be the sole manner in which ELL students interact with technology. With the wide variety of technology tools that are available, teachers have many options for creating meaningful instruction for the ELL student that go beyond the drill and practice software.

There are several principles that can help guide teachers when using technology to facilitate ELL instruction (Butler-Pascoe and Wiburg, 2003; Brown, 1993). The first of these principals is that effective ELL instruction uses technologies that will let students create their own work. This can be as simple as having students create word-processed documents that incorporate digital pictures to video and audiotapes, which illustrate the student's cultural heritage. The most involved examples involve the creation of multimedia Web sites that combine digitized video, audio, and pictures with text and links to create a rich exploration of a particular culture or language. A second principle is to allow ELL students to capture oral records of their work, which can be done using very inexpensive tape recorders. Additionally, most computers in classrooms have audio capture cards that, along with an inexpensive microphone, can also be used to capture examples of ELL students work; this work can then be embedded in PowerPoint presentations or Web sites.

In addition to these two principals, teachers should also take advantage of having students work together in pairs or small groups to write collaboratively. These groups can be a mix of ELL and non-ELL students. By grouping ELL and non-ELL students, ELL students can work on improving their English language skills through immersion and reinforcement. If a writing assignment involves some aspect of the ELL student's culture, then the student can also become an "expert" on a topic, which can help to improve the student's sense of self-worth. If a video camera is available a videotaped book report can be created. The student can then go back to either the audio or videotape to review the report not only for content but also for their mastery of English.

In addition to technology that is used strictly within the classroom, the teacher should also use technology to facilitate communication (using the Internet) with students from other places in the World. This is perhaps one of the most powerful uses of Level II technology tools. By establishing connections with classrooms around the world, students can communicate with others who not only speak their own native language but who can also reinforce cultural ties. At the same time students in the class who are native English speakers can get to know the ELL student's cultural experience better, and thus have a greater appreciation of these ELL students. This can be done with e-mail pals from other classrooms (sometimes referred to as key-pals). Many Web sites exist that can provide the teacher with an international directory of other school sites that can be used as a starting point for teachers wishing to contact other teachers interested in establishing international e-mail pals.

Gender Equity and the Use of Technology

The classroom teacher should also be aware that inequities exist in how often and in what ways females use technology in comparison to males (Gilley, 2002). Boys typically use computers as toys while girls use computers to accomplish specific tasks. Boys often tend to become "obsessed" with using technology while

girls tend to be more occasional users. This has led to boys being encouraged by adults to use technology (Margolis and Fisher, 2001). In spite of this, research indicates that girls are just as capable as boys in effectively using technology even though female perceptions indicate that they believe they have less experience and knowledge than males in using technology (Gilley, 2002; Mathis, 2002). In order to address the unique needs of girls with respect to technology, teachers need to ensure that female students have equal access to technology and encourage them to use it in a variety of meaningful ways.

Creating deliberate opportunities for girls to use technology in a variety of situations as well as providing role models for girls can go along way in helping to bridge the gender gap in the classroom. How this might be done can be found in the case study example of Ms. Martin who uses her computer lab time to introduce new concepts such as scanning to the entire class. After her presentations, however, the few scanners available to the class tended to be dominated by the boys. To fix this problem she decided to conduct small group instruction where she would make sure that everyone in the group had an equal opportunity to learn how to use the equipment; thus allowing the girls in the class to build confidence when using the equipment.

Using Technology in the Content Areas to Facilitate Learning among Diverse Learners

Several examples of how technology can be used within content areas to help meet the needs of diverse learners are provided in this section. Many of the sample activities provided can be used in various content areas. It is important to note that the examples provided are only a representative sample of the almost endless possibilities that exist.

Art

Art is very well suited for the integration of technology. Most relatively new computers are well equipped with the capabilities of allowing students to develop their creativity through the creation of digital artwork. There are numerous graphic software programs available that students can use to create and edit their own artwork. The artwork can be distributed in many different ways - printed, distributed on a CD-ROM or DVD, or simply viewed on a computer or television screen.

Students with physical disabilities can have difficulties manipulating a standard computer mouse. There are numerous alternative devices that can be used instead of a standard computer mouse - trackball, touch-screen, and graphic tablet. Each of these devices makes it easier for students with disabilities to use the computer to develop their own digital artwork.

Language Arts

Technology integration into language arts can be extremely beneficial for students with diverse needs. Technology allows students to work on essential reading and writing skills, and to express themselves in ways beyond writing. The use of digital books in the context of language arts is a great way to meet the needs of diverse learners.

Mathematics

Technology can be exceptionally useful in helping students work on a variety of math skills from basic operations (e.g. addition and subtraction) to more complex math skills (e.g. logical thinking needed to solve geometric proofs or algebraic equations). Computing tools are especially useful in math because of the power that computers have in quickly processing numbers which means that students are free to explore more complex mathematical concepts as well as "what if" scenarios more quickly than if they have to work out problems with paper and pencil.

Science

For years computers have played an important role in scientific exploration. Computers are able to recreate complex models of physical and organic systems. In the classroom, computers can meet the needs of a wide variety from those who need remediation on certain scientific concepts to those who need enhanced instruction. Recent developments in three-dimensional modeling can even allow students new perspectives through the graphical representation of anything from an atom to a galaxy. Lego MindStorms is another product that can facilitate higher order thinking skills in the area of science. It is a robotic development system, which provides students with opportunities to create their own robots (and other devices).

Social Studies

A major goal of social studies education is to teach students to understand what it means to live in a

democratic society. There are numerous elements to this process, some of which are learning to be a productive citizen and respecting other people and their cultures (as well as, understanding one's own culture). Technology can be a wonderful source, especially the Internet, in helping students connect to and learn from others, which can be beneficial in helping reach the major goals of social studies education. The goals of the social studies curriculum provide excellent opportunities for including ELL students such as connecting with students from across the country and around the world. Social studies activities also provide many opportunities for the use and creation of rich multimedia documents that can illustrate many concepts in new and exciting ways. While most students will never be able to travel to different locations around the world virtual expeditions are real-life travels, typically consisting of a team of individuals who explore different locations around the world.

Summary

The integration of various technologies into the classroom can provide learners with unique opportunities to help meet their diverse needs. The strategy of differentiated instruction can help make best use of technologies to support learners without placing an overwhelming burden on the teacher. Technology can be an empowering tool. For it to be empowering, however, teachers must be deliberate and thoughtful in how it is integrated and used in the classroom. This is not only true for students with a variety of impairments but is also true for ELL and gifted and talented students as well. Issues of gender and technology use have also become important to consider as computing becomes more pervasive in our society and schools. Of course, while technology can be used to help develop solutions to these problems, it is ultimately the teacher using and facilitating the use of the technology that can enrich and empower students.

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Small Group Learning in an Online Asynchronous Environment

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Abstract

This article reports the results of a study conducted to examine the use of small group learning strategies in an online college course. The study examined the effect of four types of positive interdependence and the affiliation motive on learning and attitude in an asynchronous, collaborative learning environment. Results indicated no significant differences in achievement by type of interdependence, or by affiliation motive. Correlation analysis revealed a significant positive correlation, indicating that participants with higher numbers of interactions attained higher posttest scores. Participants in reward groups had significantly higher agreement with several attitude statements that reflected benefit from working with others and being able to generate better ideas in groups. Furthermore, participants in all three types of structured interdependence, compared to groups with no interdependence, had significantly higher agreement with being able to learn more because team members knew it was their job to contribute to the group work. In addition, participants with high affiliation motive had significantly higher agreement with several attitude statements. Groups with no structured interdependence had the most cognitive interactions, role groups had the most group processing, and reward groups were most off task. Implications for integrating small groups in computer-mediated learning environments are discussed.

Cooperative Learning and Affiliation Motive

Over the past decade, there has been increased interest in using cooperative methods in college classrooms. During the 1990s, more than 170 studies were conducted to examine the influence of cooperative learning on college students and other adult learners. According to Johnson, Johnson, and Smith (1998), the results of this research are impressive when the magnitude of effect sizes in favor of cooperative over competitive and individual methods are considered. However, other researchers have found less success with cooperative learning for enhancing college student performance (Niehoff & Mesch, 1991; Cole & Smith, 1993; Klein, Erchul & Pridemore, 1994; Klein & Schnackenberg, 2000.) Regarding student motivation, some research on cooperative learning suggests that students working in groups are more motivated than those who work alone, but performance in these settings is influenced by one's affiliation motives (Klein & Pridemore, 1992). Cooper (1995) notes that even though the components of cooperative learning have been well defined, systematic research on the efficacy of each is still quite scarce, particularly for college populations.

Distance Learning for Adult Reentry Students

More than 190 traditional institutions are offering accelerated degree programs with evening, weekend, and distance features that cater to working adults (Wlodkowski, Mauldin, & Gahn, 2001). Accelerated programs for adults use far more active and collaborative learning processes than exist in traditional programs (Scott & Conrad, 1991). In the same manner that small groups in campus-based classes help to overcome anonymity (McKinney & Buxton, 1993), small groups in distance education classes may also reduce anonymity and isolation. Research on computer-mediated collaborative learning indicates that it can be as effective (Johnston, 1996) or more effective (Hall, 1997; Naidu et al., 1999; Uribe, Klein, & Sullivan, 2003) than face-to-face collaboration.

In 1999-2000, eight percent of all undergraduates participated in some type of distance education with one-third of those being enrolled in entirely distance education programs (National Center for Education Statistics, 2002). The prevalence of online collaboration in higher education is supported by the increasing availability of technology-mediated instruction and by growing business and industry demands for working in teams (Ben-Jacob & Levin, 1998; McIsaac & Gunawardena, 1996). In light of the mixed findings on what is motivating and constitutes effective instructional strategies for adults, research is needed to clarify the effectiveness of small group learning for adults in an asynchronous environment. The research questions addressed by this study were:

1. What is the effect of type of positive interdependence on achievement, attitude, and interaction behavior for adult reentry students in an asynchronous collaborative learning environment?
2. What is the relationship between affiliation motive and achievement, attitude, and quantity of interaction when adult reentry students use an asynchronous collaborative learning environment?
3. Do positive interdependence and affiliation motive interact to affect achievement, attitude, and interaction behavior for adult reentry students in an asynchronous collaborative learning environment?

Method

Participants were 280 undergraduate business majors enrolled in a required course in management at a private degree completion university for adult learners. Prior to the study, the affiliation scale of the Work Motivation Inventory (Braskamp & Maehr, 1987) was administered to measure affiliation motive. Participants were blocked by high or low affiliation motive, then randomly assigned to one of four small group treatments--role interdependence, reward interdependence, role plus reward interdependence, or no interdependence.

The dependent variables were achievement and attitude. Achievement was measured by individual posttest scores following asynchronous online instruction and practice. Attitude was measured by a survey that assessed student satisfaction and continuing motivation for working in small groups. Interaction behaviors were observed through the text transcripts of group work and qualitatively categorized according to an observation protocol.

Materials

Three instructional units were derived from the required text for this business management class. Each unit included a learning objective, a 500–750 word online lecture with an open-ended discussion starter, and a practice set. The practice set for each unit provided ten selected-response items, including eight items related to concepts and two application items related to a business or adult education scenario.

The instructor notes included a weekly schedule for delivering the sequentially numbered course components. The course components were the individual text -and- graphic files for the lectures, practice sets, and directive communications to the participants.

An interaction checklist was adapted from instruments used to record group interactions (Klein & Schnackenberg, 2000; Cavalier, Klein & Cavalier, 1995; Hall et al., 1988). Adaptations were made to reflect verbal behaviors that are likely to occur and can be demonstrated in an asynchronous collaborative learning environment through text and graphics (Hillman, 1999; Hall, 1997; Kruger et al., 1996). A sample of interaction behaviors from 40 triad learning teams was observed through the text transcripts of newsgroup posts made by participants during group work. A single post made by one student could contain more than one interaction behavior. The interaction behaviors were qualitatively analyzed according to the three categories of cognitive, group process, and off task. Cognitive interactions included statements about course topics, such as discussing content by providing examples or elaborating, asking questions, answering questions, and disputing others' opinions. Group process interactions included statements intended to accomplish a task by interpreting requirements or establishing due dates; managing group behavior by delegating, accepting, or declining responsibility; encouraging team mates; and commenting on the experimental project in which they were participating. Off task interactions included statements about topics not related to this course, such as discussing self or others in a context other than this class and describing events not related to the course. Inter-rater agreement was established at .91.

Procedures

All procedures took place in an asynchronous environment supported by Microsoft® Outlook Express®, which is the usual delivery modality for participants. Features of the user interface and the activities that take place are referenced with names that mimic typical classrooms. For example, when participants “go to class,” they connect to the Internet and gain password protected access to files for their registered course. When participants “speak up in class,” they submit a text message that is displayed chronologically with comments from other class members, available for all to read. The software interface organizes text -and- graphics messages into newsgroups named Main Classroom, Learning Team A, Learning Team B, etc. Furthermore, the software interface indents replies and subsequent comments, creating a visual representation of the interactions taking place. A topic of discussion shown with its associated dialogue is called a *thread*.

Participants communicated with one another by posting a message to either the Main Classroom newsgroup visible to all members of the class, or by posting a message to their Learning Team visible only to the small group members. This action is similar to sending an email message, except that the recipient is a

group of people rather than an individual. Participants were well oriented to using the software interface because it is the primary means of communication for all of their courses. Additionally, participants had been oriented to working in groups during a required course at entry to their academic programs.

The instructor posted a script in each triad's newsgroup that provided guidelines for working in their small group. All scripts stated, "Throughout this week, use the lectures and practice sets to prepare for the test." Additionally, in the role interdependence condition, each group of three participants was directed to designate the roles of facilitator, answer drafter, and verifier for the group members. Groups were prompted to rotate roles for each unit. In the reward interdependence condition, each group of three participants was informed that they would receive a 5-point (15%) bonus toward this week's assignment if all members of the group attained a score of 24 (80%) or more. In the role-plus-reward interdependence condition, each group of three participants was directed to designate roles, and was informed of the bonus points for all members of the group attaining a score of 80% or more. In the no structured interdependence condition, each group of three participants was informed only that they should discuss the readings and questions and use the practice sets to prepare for the test.

At the end of the week, the posttest was available for one hour in order to simulate a time-limited classroom setting, rather than an open book test that could be taken at leisure. Participants were told to take the test without using notes or reading materials. At the completion of the posttest, the attitude survey was presented.

Results and Discussion

Achievement

Results indicated no significant differences in achievement by type of interdependence in small group work, or by affiliation motive (see Table 1). Overall achievement was about 71% on the posttest, a score not unexpected for this population. A correlation analysis was conducted to determine the relationship between posttest score and quantity of interactions and revealed a significant positive correlation, indicating that participants with higher numbers of interactions attained higher posttest scores.

Participants in each of the small group conditions performed similarly on the posttest, and there are a couple of possible reasons for this result. Although positive interdependence was structured in various ways in this study, other elements of cooperative learning were present in all treatments. Participants in all small groups had individual accountability and computer-mediated promotive interaction. Furthermore, while group facilitation skills and evaluation of interpersonal and group processes were not specifically directed in the current study, participants had previously been trained on these and other elements of cooperative learning. In fact, all students who enroll at the university where the study was implemented are trained on how to collaborate at the start of their degree program.

The current study points to the challenge of isolating positive interdependence from other elements known to be integral to cooperative learning (Johnson & Johnson, 1998b). Previous research on cooperative and small group learning has focused on comparing individual versus group work, and only recently has the relative effectiveness of various structures of positive interdependence been documented (Jensen, Johnson, & Johnson, 2002). Results suggest that structuring positive interdependence by itself does not affect achievement when college reentry students work in an asynchronous cooperative learning environment.

Secondly, the instructional materials used by participants in all treatment groups were designed with stated objectives and alignment of the lesson content, practice exercises, and posttest. Consideration must be given to Bossert's (1988-89) assertion that researchers comparing individual and cooperative learning do not consistently find differences between these methods when well-designed instructional materials are used. The effect of structuring positive interdependence is likely to be weak when well-designed instructional materials are used.

Posttest achievement may have been improved with the use of specific feedback from the instructor to students. Kruger et al. (1996) found that, in both face-to-face and computer-mediated adult training environments, messages from the expert were rated as most valuable in learning to accomplish the task. Furthermore, specific feedback was more highly rated than global feedback. In the current study, practice exercises were debriefed by group members, but without feedback or remediation from the instructor.

Table 1 Means and Standard Deviations for Achievement Posttest Scores by Small Group Treatments and Affiliation Motive.

| | Type of Interdependence | | | | Total |
|--------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|-----------------------------------|
| | Role | Reward | Both | None | |
| Affiliation Motive | | | | | |
| High | 22.40 3.49 (n = 35) | 21.95 3.80 (n = 38) | 20.97 3.87 (n = 41) | 20.47 3.66 (n = 30) | 21.47 3.76 (n = 144) 72% |
| Low | 21.24 3.48 (n = 38) | 20.34 3.77 (n = 35) | 21.52 3.49 (n = 42) | 20.77 3.37 (n = 30) | 21.01 3.53 (n = 145) 70% |
| All | 21.79 3.51 (n = 73) 73% | 21.18 3.85 (n = 73) 71% | 21.25 3.67 (n = 83) 71% | 20.62 3.49 (n = 60) 69% | 21.24 3.64 (n = 289) 71% |

*Note: Total possible score was 30.

Attitude

Participants in the reward condition had significantly higher agreement with several attitude statements that reflected benefit from working with others, being able to generate better ideas than they could have done as individuals, and the importance of fellow team mates earning a high score (see Table 2). Furthermore, participants in all three types of structured interdependence groups (roles, reward, and roles-plus-reward) had significantly higher agreement with the statement "I was able to learn more because my team members knew it was their job to contribute to the group work," compared to groups with no structured interdependence.

Kagan (1994) describes positive interdependence as the "subjective experience of being on the same side" (p. 129). The finding that participants in the no structured interdependence condition had lower attitude ratings corroborates previous research identifying reward structures that increase the perception of positive interdependence and reduce social loafing (Johnson, Johnson, & Holubec, 1994; Webb, 1997). In particular, the identified reward structures are ones that combine the points attained by each member's contributions, or offer a bonus when all members exceed a standard. Similarly, the reward structure in the current study provided that team members would receive a bonus if each member attained a criterion score.

Furthermore, concern for teammates' success was apparently facilitated by reward structures. Attitude statements regarding the importance of team members earning a high score and every member being highly successful were significantly higher in the conditions of reward and role -plus-reward, compared to the no structured interdependence condition. There is considerable support for this finding, including Slavin's (1991) assertion that group rewards are essential to eliciting concern for group mates' achievement. Previous empirical evidence indicates students' greater willingness to explain the material and ask questions (Cole & Smith, 1993) as well as higher peer evaluations for group members when rewards were used cooperatively rather than competitively (Niehoff & Mesch, 1991).

The effect of role interdependence in this study is demonstrated in the responses to the attitude statement, "I was able to learn more because my team members knew it was their job to contribute to the group work," with role groups having significantly higher agreement than groups with no structured interdependence. Table 2 Means for Attitude Item Responses by Small Group Treatments.

| | Type of Interdependence | | | | |
|--|-------------------------|--------|------|------|-------|
| | Role | Reward | Both | None | Total |
| 1. I would have enjoyed this activity more if I had worked by myself. | 1.78 | 1.60 | 1.99 | 1.70 | 1.78 |
| 2. Working with other students in this type of activity encourages me to stick with my degree program. | 2.96 | 3.35 | 3.00 | 2.92 | 3.06 |
| 3. I benefited from working with others during these lessons. * | 3.46 | 3.50 | 3.42 | 2.80 | 3.32 |
| 4. As a group, we generated better ideas than we could have done as individuals. * | 3.36 | 3.69 | 3.40 | 2.93 | 3.35 |
| 5. At the start of the week, I knew how to interact with my team members. | 3.05 | 3.05 | 3.09 | 3.10 | 3.07 |
| 6. I was able to learn more because I knew it was my job to help the other team members understand the material. | 3.02 | 2.83 | 3.05 | 2.62 | 2.90 |
| 7. I was able to learn more because my team members knew it was their job to contribute to the group work. * | 3.00 | 3.06 | 2.98 | 2.32 | 2.87 |
| 8. In future team activities, I would prefer that each member of my team be assigned specific roles. | 3.01 | 2.59 | 2.63 | 2.77 | 2.75 |
| 9. During this week, it was important to me that every team member earned a high score. * | 3.99 | 4.56 | 4.39 | 3.75 | 4.19 |
| 10. For these lessons, it was important to me that every member was highly successful. * | 4.06 | 4.59 | 4.33 | 3.75 | 4.20 |
| 11. Thinking about my score on the final exam helped me work with the team members. | 3.56 | 3.62 | 3.56 | 3.07 | 3.47 |
| 12. In future team activities, I would prefer to work for points based on my team members' performance. | 2.26 | 2.10 | 2.39 | 2.00 | 2.20 |

Note: Likert type scale for responses consisted of 5 = Very true, 4 = Mostly true, 3 = Moderately true, 2 = Slightly true, 1 = Not true.

*significant at $p \leq .01$

Previous research points to increased learner satisfaction when using defined roles in small group work (Cavalier, Klein, & Cavalier, 1995; O'Donnell et al., 1987).

When differences in attitude are examined by affiliation motive, participants with high affiliation motive had significantly higher agreement with six of the twelve attitude statements. This result may be reflective of a general preference for group work, as noted in previous research on affiliation motive in small group work (Chan, 1980; Hall et al., 1988; Klein & Schnackenberg, 2000; Brewer, Klein, & Mann, 2003). Likewise, high affiliation participants' agreement with attitude statements may be reflective of a personality trait, or predisposition to act cooperatively (McClelland, 1976; Johnson, Johnson, & Smith, 1998a; Huitt, 2001).

Interactions

Overall, individual participants in groups with role-plus-reward interdependence had the highest number of interactions, statistically significant compared to those in groups with only reward interdependence or no structured interdependence. This result supports previous findings from studies using roles and from other studies that investigated the use of rewards. Adults using roles during group work had increased interactions (Cavalier, Klein, & Cavalier, 1995; Klein & Doran, 1999), while college students with implicit incentives for cooperative group work used more elaboration and metacognitive strategies (Karabenick & Collins-Eaglin, 1997). The importance of increased interactions is noted in previous findings that increased collaboration results in better problem solving (Flynn & Klein, 2001; Uribe & Klein, 2003).

Looking at the specific nature of the interactions, there were significant differences in the frequencies of cognitive, group process, and off task interactions among the four treatment conditions (see Table 3). Groups with no structured interdependence had the highest number of cognitive interactions, groups with role interdependence had the highest number of group process interactions, and groups with reward interdependence had highest number of off task interactions.

In light of these combined findings, it appears that there is an advantage to using multiple avenues of interdependence for increasing interactions. According to Webb (1997), learning theorists generally agree that students learn most by participating actively in group work. Conversely, passive behavior may have minimal consequences for a group outcome, but is detrimental to individual learning (Webb, 1993). Passive behavior is observed in predictable patterns known as social loafing and free rider and sucker effects (Slavin, 1990; Karan & Williams, 1993).

Implications

The sample in the current study was representative of the target population of adult reentry students, and implications are directed at that group of students. The similar distribution of posttest scores and low variability across all treatment conditions point to a normally distributed population. The median score on the need for affiliation measure was about the same as the average noted for the general adult population.

The attitude findings in this study support the recommendation to use small groups with adult reentry students. Overall, participants did not want to work alone, as evidenced by the low agreement across all groups with the attitude item, "I would have enjoyed this activity more if I had worked by myself." This preference for group work, even when there is no increased achievement, has been previously demonstrated in other studies (Palinscar & Brown, 1989; Klein & Pridemore, 1992; Thompson & Scheckley, 1997; Klein & Doran, 1999; Brewer, Klein, & Mann, 2003).

The positive relationship of interactions and achievement was established in this study. On the one hand, high interactivity may be a feature of top performing students. On the other hand, the importance of interactions may be even greater in an asynchronous computer-mediated environment compared to a face-to-face classroom (Gunawardena, 1995; Bailey & Luetkehans, 1998). In the absence of visual, auditory, and tactile communication cues, text based interactions constitute the entirety of online class communication (Hsu & Sammons, 1998). Given that interactivity is a vital component of asynchronous classrooms, educators and instructional designers should provide structures that maximize meaningful exchanges among participants.

Beyond merely increasing the frequency of interactions, consideration should be given to the nature of these interactions. In the current study, participants with structured interdependence had better attitudes about learning with the contributions of their team members. The cooperative behavior of taking turns does not exist in an asynchronous environment where the messaging software delivers participants' contributions in the time-stamped order in which they arrived.

Table 3 *Summary of Results on Nature of Interactions by Small Group Treatments.*

| Treatment | Result | Interaction | Sample comment |
|-----------|--|---------------|--|
| Role | Role interdependence groups had more group process interactions than did reward groups. * | Group Process | I'm not sure if we are going to be able to count on a third team member. Let's proceed as follows. Whether we get a response from R. or not we need to complete all questions, of which 8 have already been verified. Finally, the summary needs to be completed, which I'll do tonight. |
| Reward | Reward interdependence groups had more off task behaviors than did role and role-plus-reward interdependence groups. * | Off Task | Thanks, J., a lot of rain here also, but my flowers needed it. I'm hoping the humidity drops. |
| Both | Role-plus-reward (both) interdependence groups had more group process interactions than did the reward group. * | Group Process | Here's my thoughts towards session 2. Open for discussion of course. Please post the unit1 final answers, I didn't quite finish moving my oldest two daughters to Baltimore. I won't be back online until after 6 PM EDT. Thanks in advance. |
| None | No structured interdependence groups had more cognitive interactions than reward only or role only groups. * | Cognitive | To an outsider, it would seem that you work for a division of XYZ. Not being an expert on XYZ, I know they provide many services, e.g. disaster relief, fund raising. It would be conceivable to consider your organization a functional structure. What do think? |

Note: Interactions by 10 triad-groups in each treatment.

* significant at $p \leq .01$

Even when messages are displayed together for a single topic, the synchronous quality of having an utterance associated with the one immediately preceding it, and the feedback loop provided therein, does not exist in computer-mediated communications (Hillman, 1999). Therefore, assigning roles for beginning and ending conversations may be beneficial.

Looking further at the nature of cooperative interactions, it is important that adult learners feel that their efforts during group work were worthwhile. In the current study, participants in reward groups had significantly higher attitude ratings for the item, "As a group, we generated better ideas than we could have done as individuals," compared to those with no structured interdependence. Teachers should provide tasks and sufficient incentives to encourage the type of collaboration that results in valuable contributions.

The finding that participants with no structured interdependence had significantly more cognitive interactions than either role only or reward only is noteworthy for educators. When teachers of adult learners use group work, they should ensure that there is opportunity for students to ask and answer questions within the groups. Moreover, it may be less necessary for an instructor to structure positive interdependence when other elements of cooperative learning are present.

Further Research

Further research should investigate the quantity and nature of interactions in asynchronous, computer-mediated environments. Specifically, studies should be conducted to determine whether increasing interactions, or increasing particular types of interactions, is beneficial to learning and persistence. Future research on affiliation motive in small group work may clarify whether the higher attitude ratings found in this study were reflective of a general preference for group work by high affiliation adults, or if group settings do indeed provide an optimal environment for some learners, but not for others. The current study did not compare group versus individual work in the asynchronous online environment, and this aspect should be examined in future studies, focusing on both achievement and attitude.

Additionally, the use of teacher intervention and feedback during group work should be explored. Although the current study systematically excluded teacher feedback, caution should be used in guarding against the implication that copious student interaction is sufficient. Rather, consideration should be given to the conclusions of Kruger et al. (1996) that the free sharing of ideas that can take place in computer-mediated communication does not exclude the need for expert feedback.

Findings from the current study do not support the assertion that structured positive interdependence can affect achievement in a computer-mediated environment (Jensen, Johnson, & Johnson, 2002), but the body of literature regarding cooperative learning in this medium is sparse. In light of the growing prevalence of online distance programs for adult learners, it is worthwhile to continue exploring whether previous assumptions about cooperative learning in face-to-face environments are replicated in asynchronous, computer-mediated, and distance learning settings. Research of this type may help us better understand the conditions under which cooperative learning is most effective for adults in online environments.

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Design, Development, and Evaluation of Electronic Portfolios for Advanced Degree Programs in Technology and School Media

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Abstract

Across the various programs of study, portfolios serve many functions and purposes. Electronic portfolios have been used as a culminating product for students in our Master of Library Science and Master of Education in Instructional Technology at East Carolina University. Two conclusions were drawn from this study - (1) authentic assessment using portfolios is useful for facilitating reflective thinking that results in self-regulated learning, and (2) student products in the form of electronic files can be archived, indexed and used as evidences in program evaluation.

Introduction

The need for authentic methods for assessing educational outcomes has led to a move from quantitative measures to a more an open-ended qualitative format. Through the use of portfolios, students are able to select and evaluate their own products of learning and present these for final certification before entering their respective professions. The portfolio provides, not only a method for assessment, but also is a catalyst for learning. These measures are dependent on process, as well as outcomes from the learning experience. Using the processes for selection, evaluation, and alignment of work samples with a particular standard for excellence would likely help the student transfer what is learned within the laboratory setting to the real world of work (Wolf, 1998).

Portfolio Formats and Functions

One of the earliest reported uses for the portfolio was in the visual arts for the purposeful collection of one's best work (Friedman Ben David, et al., 2001). Many schools continue the use of the showcase portfolio to display exemplary student products as a culminating experience and for prospective employers (Baltimore & Hickson, 1996). When using this type of showcase portfolio, there are no comparisons between entry-level work and expert performance by the student. Thus, the contents do not provide substantial evidence that training or education has had notable impact on the student.

Because of our society's evolution from industrial- lockstep work environments to more open-ended- informational environments, there is an important emphasis on authenticity in student learning experiences. Employers are looking for candidates who can examine their environment, draw logical conclusions, and develop problem-solving strategies based on a given situation (Weiner, 2000). This is accomplished through the use of situated problem solving and authentic assessment of outcomes from learning (Young, 1995).

Another important use of portfolio is program evaluation. Portfolio assessment requires the careful analysis of program goals and objectives and how these are transferred to the course activities and assignments. Student artifacts should mirror program goals. When this is evident within the portfolio, evaluation of the program of study is facilitated (Koretz, 1992; Payne, 2000).

Portfolios and Learning

Regardless of format, function, or purpose, portfolios can be classified as either capstone experience (showcase) or a record of process in learning (assessment portfolio). The capstone portfolio includes stand-alone evidence for mastery of program objectives, examples of student's best work, and documents from culminating experiences. Typically, accomplished students who are about to enter their chosen profession are associated with the "capstone" category. Programs that require the capstone (or showcase) portfolio should specify work samples that will be of interest to prospective employers and artifacts that are cognizant of the profession. In addition, expectations and standards for best practices must be clearly communicated to the student (Skawinski & Thibodeau 2002).

A second category is the "process or learning portfolio." The contents represent processes for cognitive growth, interrogation of the learning environment, self-assessment using recognized standards, and transference of learning to the workplace. For the instructor or faculty member, there is a responsibility to the student to monitor cognitive growth as a result of assigned projects and field experiences. By providing cognitive

scaffolds for reflection, self-assessment, and strategies for making changes, the process approach to learning is exemplified within the contents of the portfolio (Murphy, 1997). The instructor/assessor acts as a guide or proctor during the development of the portfolio, and models collaborative practices as mentor and mentee work together to select artifacts and other evidence that show growth over time. An important role of the instructor/assessor is to provide critical commentary and invite the student to defend, justify, and make adaptations to his or her work samples. The dialog between faculty and student can be very productive during these advising sessions.

In addition to evaluation of student learning, either process or capstone portfolios, are useful for the analysis of a program of studies. Program evaluation is facilitated when key players for the portfolio process are committed to the necessary time requirements, practices for self-evaluation, and adoption of authentic assessment methodologies (Johnson, et al., 2000; Campbell, et al., 2000; Baume & Yorke, 2002). For the student, this means gaining skills as a reflective practitioner. He or she must be willing to adopt the process-approach for learning. This means entering the program as a novice, accepting critical commentary, working through revisions, and planning for the future. For the assessor, it requires a commitment for adequate time with students for mentoring and modeling for reflective practices (Freidus, 1996). In addition, there must be time devoted to careful planning for program goals, objectives, and classroom activities that reflect these objectives.

Reliability and Validity Using Assessment Portfolios

A major consideration with implementation of portfolio assessment is reliability of measures and validity of the assessment. Latrobe and Lester (2000) discovered in their Library Science program that establishing valid measures is difficult because competent performance may... “vary in depth, in approach, and in the specificity of the professional work addressed....”. Although it is difficult to gather data related to reliability in portfolio assessment, (Friedman Ben-Davis & et al., 2001) as a result of this review, several studies were identified, and were supportive of, portfolios for assessment purposes (Baume & Yorke, 2002). Other reports are not as encouraging (Koretz, 1998). There are, however, certain characteristics that were apparent in programs with reports for reliable use of portfolio assessment. Measures are reliable when there is evidence that portfolio contents represent an accurate picture of the program goals/objectives or other recognized standards for the profession (Bullock & Hawk, 2001; Campbell, et al., 2000; Pitts, Coles, & Thomas, 2001; Routledge & Willson, 1997). In addition, correlations among assessors’ scores are high when there is evidence for clear-cut indicators of acceptable performance. Another characteristic associated with the reliable use of portfolios is the selection of artifacts; either specified in advanced or self-selected by the student, these should be representative of program goals and objectives. Along with specific criteria, there are standardized levels of difficulty and consistency in characteristics of the evidence or artifacts. Reports from the literature suggest that correlations can be very low when there are inconsistencies among artifacts. Reliability measures were high when clear-cut criteria for evaluation had been agreed upon by assessors and performance indicators were representative of the standards or competencies adopted by the program. Reliability measures were also high with reports for sufficient training of assessors.

One strategy used by programs to ensure strong reliability and validity measures was through collaborative meetings to reach consensus on scores. When planning implementation of portfolios, faculty should meet to analyze the strength of relationships between program goals, performance indicators, and quality of the portfolio contents. Typically, there are three assessors assigned to a team. Contents are evaluated by the first 2 assessors who score independently. When there are wide differences in scoring, a third assessor reads and evaluates only those sections with disparate scores. (Baume & Yorke, 2002; Friedman Ben David, et al, 2001; Davis, et al., 2001; Skawinski & Thibodeau, 2002) Of the studies reviewed, the third reader usually scores in agreement with “pass” or “marginally pass”. Careful alignment of program objectives with course activities, clear communication of expectations aligned with these objectives, and a specified standard for formatting and presentation of the portfolio were all associated with valid and reliable measures.

Purpose of the Study

The purpose of this study was to identify specific advantages for the use of assessment portfolios and how these advantages might support the graduate programs' goals and objectives. To satisfy these purposes, a formative evaluation of student reflections and faculty satisfaction for use of portfolio as a method for assessment was conducted. Three main areas were the focus of the study - student response to portfolios with reflective writing as a metacognitive process, validity of the evaluation methods, and solutions to management of data for program evaluation.

Self-regulated Learning and Reflective Writing

As a method for evaluating student response to electronic portfolios, end of course surveys were sent to students enrolled in the graduate level course "Development of Electronic Portfolios". The course was offered as an elective for students enrolled in any of the department's three graduate programs. The two main objectives for the course were (1) guide students through the reflective writing process, and (2) teach skills for file management and design of the portfolio using web editors. Students also increased their comfort level in the use of tools for electronic file transfer and online development of the course projects. The course received high evaluations and has been requested for subsequent semesters. There are two reasons for this. First, students recognized the need for developing their portfolios with skill, accuracy, and as a true measure of academic achievement. The course seemed to meet this need. Secondly, students were able to interact with the instructor (also their faculty advisors), and with each other, for feedback on their progress in developing the portfolio. Dialog was constructive within a nonthreatening environment thus students experienced a formative assessment of their work contributing to greater confidence for completing the portfolio.

An important concept built within the course was self-regulated learning using the reflective writings for each artifact. Self-regulation as a method for achieving learning goals leads to increased motivation, self-monitoring, attention control, application of learning strategies, and other metacognitive thinking processes (Ormrod, 1999). Using a theoretical base for self-regulated learning (Zimmerman & Bandura, 1994), questions for the survey were designed to gather information in how students used the development of their portfolios and reflective writings for the following thinking processes - focus their thinking and goal-setting, self-assessment of quality of work based on standards, and time management strategies. Table 1 provides a summary of comments related to each main area of self-regulated learning.

Table 1. *Student comments related to self-regulated learning and use of portfolios.*

For focused thinking, students commented:

Writing the reflection is usually a pretty long process for me that takes a few rough drafts before the final draft is complete. It is almost like I am constantly reflecting on my reflection, if that makes any sense. Hopefully I will become better and more focused on writing my reflections with more experience of doing so. . . . The portfolio definitely forces one to focus upon what one has accomplished. The reflective writings, in particular, has helped me to focus on what I did, why it was important, how it could be improved, and how my future will be impacted by what I did.

For self-assessment of progress, students commented:

I do think that my portfolio will help me assess my progress as I complete more courses during my degree. Hopefully the quality of my artifacts and reflections will improve each course and by adding those to my portfolio will help me see if this happens or not. I also think that my portfolio layout will probably change over the course of completing my degree. I will reflect as well on the layout and design to hopefully make it look even better and more professional for others get a clearer picture of who I am and what I have to offer. . . . The reflective writing process enabled me to assess my progress (where I've been) and decide the future path to take (where I want to go).. . . Through reflection I have learned to assess the strengths and weaknesses of a project, which in turn helps me decide how I can plan the next project more efficiently.

For Time-management, students commented:

I do feel that the portfolio has contributed to my planning and organization, but do not feel the reflections have done the same. . . I would have completed the portfolio in a timely manner regardless of disciplined planning. I have difficulty with time management, and I cannot honestly say that the portfolio has contributed to better organization. . . . the reflective writing did not affect time management.

Students reported less than favorable improvement in time management associated with

reflective writing and the portfolio process. It likely that additional time needed to learn new skills for developing the electronic portfolio had a negative effect on their perceptions for time management. In addition, students may have misinterpreted the survey question and answered as time required to develop the portfolio rather than the actual intent - improved time management skills for course assignments as a result of the reflective writings.

Reflective Writings for Self-assessment

Each artifact in a student's portfolio must be aligned with a standard, professional competency, or program objective. Program areas vary in their decision to allow students' self-selection of artifacts. Reports in the literature suggest student self-selection is beneficial for self-assessment and monitoring of one's own learning. However, for program evaluation, our program area faculty have consistently recommended pre-selected artifacts that can be archived and used for program evaluation and accreditation purposes. Each core course within their degree program includes an assignment that is designated for the student's final portfolio. The student must analyze the requirements and final outcomes from the assignment to determine appropriate standards, competencies, or objectives. Students are taught to describe the what, how, and where of an assignment, describe outcomes ("are you satisfied, what would you change about your final product?") and to align their assigned work sample as evidence for meeting the standard, objective, or competency. Students must also reflect on how the assignment will impact their future career goals. The rationale for including this requirement to the reflection is to aid in transfer of skills and concepts to future work environments. In Table 2, is a student's reflective writing that provides clear and consistent evidence that a competency has been met and that transfer to the workplace is highly probable.

Table 2. *Sample of Student Reflective Writing.*

LIBS 6014 Introduction to Reference. Reflection MLS Program Objective 3: To answer reference questions using print and electronic resources

In LIBS 6014, students were asked to "compile a pathfinder of reference sources on a specific topic designed for a specific user group and based on a review of the existing literature in any given subject field." I chose to create a pathfinder on plants since I am teach third grade Science, and this would be useful to me in my classroom since the North Carolina Standard Course of Study includes plant adaptation and growth as Goal 1 in third grade. . . . Since creating this pathfinder, I have been compiling pathfinders on other thematic units that I currently teach as well as others that I think will help my colleagues. I have shared my pathfinders with my colleagues and media specialist at my school. Whenever a teacher begins a new thematic unit, they now come to me for guidance.

Artifact: Pathfinder for 6018:

"Election Year Politics: The Political Right vs. the Political Left: What Does it All Mean?"

This project exemplifies MLS Objective 3: To answer reference questions using print and electronic resources

A pathfinder is a useful tool that points people to sources of information. I chose this topic because it is very relevant to American culture in this election year. This pathfinder will help someone without a political background read and comprehend an article about the election.

I found most of my sources in Joyner Library on the ECU campus, but many, if not all, of these sources can be found at any public or academic library. . . . In the future I might change the pathfinder by adding a section aimed at school-age children or by re-writing it with that audience in mind. . . . If I added this section to the pathfinder or re-wrote the whole thing, I would actually strengthen my mastery of Objective 3 because I would be helping answer even more reference questions using print and electronic sources. . . . This project was a valuable one for me because I will be creating pathfinders often as a school media specialist. Overall, the project was very time consuming, but in the end, I was able to acquire or hone the above-mentioned skills for future use in my professional field.

There is one disadvantage for designating a specific project for the portfolio. Students may devote an unbalanced amount of time and energy to the identified project and neglect other equally important assignments/projects. See this student's comment and how she has spent the majority of her time on designated projects -

I initially thought that we would undergo several projects in each class and we would choose our best to be presented in our portfolio. However after these last two semesters, I see there's only one main project per course so now I contribute more planning time to that one project b/c I know it will be presented in the portfolio and it needs to be my best work.

This student unwittingly admitted extra time for the portfolio project as she responded to the survey question on "time management".

Inter-rater Reliability

A major challenge was bringing faculty to consensus on collection methods and format for data used as evidence in the portfolio. Initially, faculty envisioned the evaluation process as a duplication of efforts. "Why should I evaluate student products if they've already been evaluated and graded?" was the general response. With time, faculty began to see the evaluation of the reflective writings as one valid measure of students' mastery of key concepts and skills in the courses.

Simple logistics such as how and when to establish evaluation committees also presented obstacles. Rubrics had to be developed with clear indicators that were directly aligned with either the Program Objectives or standards and competencies recommended by state agencies and learned societies. Much deliberation was required before all faculty were in agreement. Once this was accomplished, committees were formed and student portfolios were efficiently and reliably evaluated at the end of each semester. Students were notified of deadlines well in advance of due dates. This allowed faculty adequate time for the evaluation process and provided the student time to make necessary revisions or updates to their final product.

Each portfolio was evaluated by at least three faculty members. Each indicator within the rubric included a scale of 0 to 5. Total points possible for each indicator being 5 and total points for the entire portfolio being equal to the number of indicators for the entire rubric. The expectation was that 100% of the students reached mastery following recommendations for revisions.

Recommendations

Two advanced degree programs at East Carolina University have used electronic portfolios as the culminating project before graduation. The Master of Library Science began using the electronic portfolio in 2001 (Brown & Boltz, 2002), and more recently, the Master of Education in Instructional Technology requires a similar product during the student's final semester. Upon entry into an advanced degree program, students usually must enroll in one or more introductory courses related to their profession. Seminars or modules devoted to the development of electronic files and use of public domain file transfer software (e.g. WSftp) will prepare students to master the basic technical skills needed for their portfolio. Use of a dedicated, and password protected, server is recommended for maintaining the database with all student portfolios. Access should be restricted to the student's personal directory and limited to faculty teaching in the program area. A screen shot of the database is displayed in Figure 1. Only faculty with administrator passwords can view the entire database. Students may provide prospective employers with the URL to their portfolio homepage and these can be viewed by any browser.

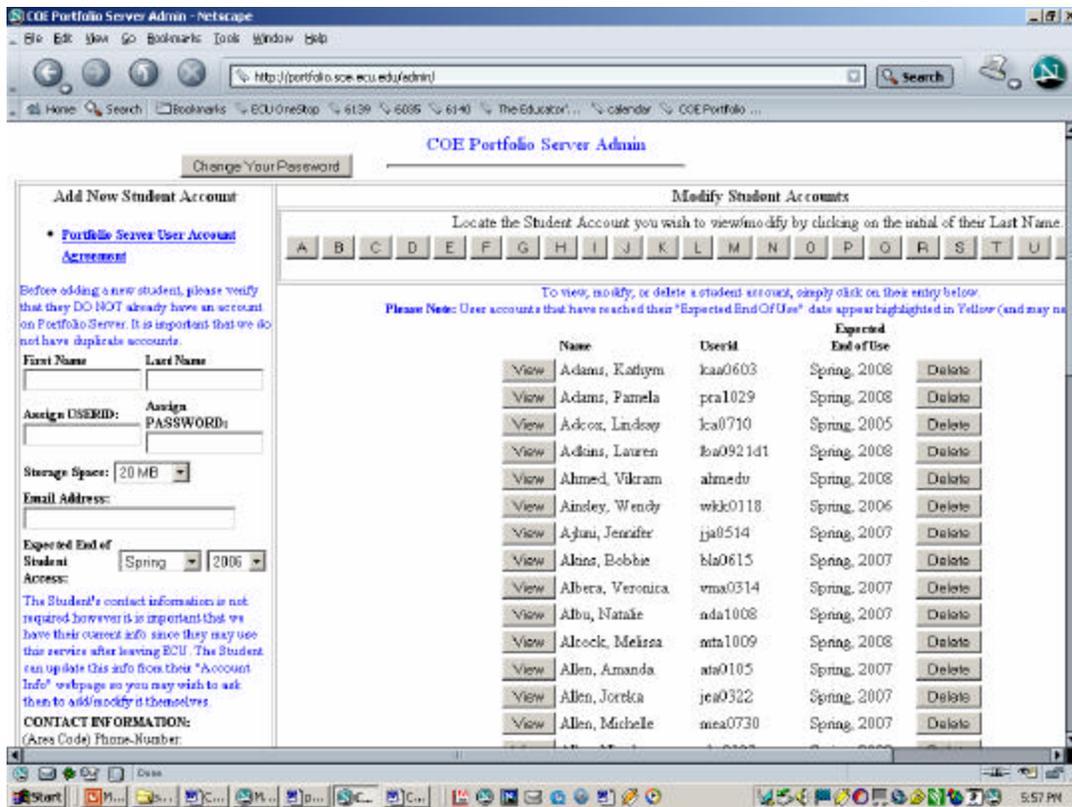


Figure 1. First screen of database with all student portfolios.

This ensures privacy for students and allows a systematic method for indexing student products that can be used for evidences needed for accreditation and program approval by state departments of education. The dedicated server eliminates the necessity for storing student work samples, semester after semester, on faculty hard drives and file cabinets. In addition, students may use the URL to their directory for personal job searches and promotions. The program areas described in this paper allows student access to their personal directory and files for a time period of up to three years after graduation. This provides an incentive for students to invest additional energy and creativity into the quality of their artifacts and design of the portfolio.

Faculty from these programs report favorable responses from students. Students have adopted the use of portfolios as a method for reflectively reporting their personal reaction to course projects and assignments. Support for these conclusions come from (1) anecdotal comments from students and their advisors, (2) written responses to end of course surveys, and (3) reflective writings that justify student artifacts as representative of standards and competencies. Students have become increasingly more sophisticated in their knowledge and understanding in the portfolio as a tool for authentic assessment. Although, many professional programs include the “showcase” portfolio as part of the student’s culminating experience, a higher purpose for the use of portfolios is its use as a tool for constructed learning (Paulson & Paulson, 1994). The student must be able to articulate how his or her products reflect the criteria established by the standard. This facilitates transfer to actual working situations as the student enters his or her initial professional setting.

As the instructor/assessor guides and provides council during the development of the contents of a student’s portfolio, there is opportunity for dialog and exchange of ideas. The student is able to see the modeling of professional behaviors, attitudes, and skills from a closer perspective than the usual interactions within the classroom setting. This is particularly important advantage for virtual classes and online degree programs. Indeed, the continual evaluation of assignments, and how these relate to professional standards, affirms the student’s professional goals, or in some cases, leads to consideration for a change in career paths. For the instructors and faculty of the program, there is opportunity for collaboration with colleagues to examine and evaluate program goals and objectives. Individual evaluation of program objectives and how these are reflected in course syllabi, activities, and assignments are a natural product of the process portfolio.

There is growing evidence that portfolio assessment is a valid measure of skill and concept attainment,

and that there is reliability of measurement for predicting student achievement following graduation. However, research in this area of assessment is still limited. It is difficult to obtain data. There are misconceptions about the purpose and functions for portfolios, and authentic assessment requires a large investment of time. Additional time is needed for training of assessors and for counseling students. From this review and from my own observation of the portfolio process, the additional time needed is outweighed by benefits for student learning and for program improvements. The issues for validity and reliability should be considered before implementation. Faculty should clearly define any or all of the following: program objectives, national or professional standards and competencies, and performance indicators that represent the standards. These should be communicated to the student when entering the program. In addition, students should be advised and mentored with regard to quality of portfolio contents and how these reflect the specified standards and objectives. Finally, assessors should be trained in both consensus scoring and independent scoring procedures, and in determining a holistic evaluation of the final product.

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The Logic, Affectivity and Ethics of Electronic Conferencing Teaching Strategies in Post-Secondary Mixed-Mode Courses

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Introduction

This paper aims to identify and to understand the role of the logical, the affective and the ethical dimensions of knowledge in the online interactions of post-secondary teachers and students. By understanding how these dimensions are interwoven, I intend to demonstrate that the instructor's course design and teaching strategies must take them into consideration in order to achieve a healthy learning environment. By healthy learning environment I mean the online construction of a knowledge building community in which the students can develop arguments in order to acquire a more profound understanding of the topics and develop caring and fulfilling relationships in a respectful atmosphere. I adopt a constructivist perspective based on genetic epistemology (Piaget, 1950, 1991) as well as contributions by socio-constructivism (Vygotsky, 1979) and modern cognitive science distributed approaches (Salomon, 1993). Methodologically, I integrate two research methods: discourse analysis and the case study. Data collected come from transcripts of electronic conferencing, course documents and interviews. The study suggests that online interactions are shape by the teaching strategy adopted by the instructor in the electronic conferences.

Theoretical framework

This paper aims to identify and to understand the role of the logical, the affective and the ethical dimensions of knowledge in the online interactions among post-secondary teachers and students. According to Piaget, social knowledge has three interconnected dimensions: (1) the rules expressed by logical operations, (2) the values attributed to meanings that are of two orders: affective and ethical, and (3) the signs used for communication (Piaget, 1976). Both logical systems and meaning systems are expressed by signs coded through language. In the case of "online language" signs are verbal and non-verbal.

I apply the Piagetian Grize's communication model (1991) with a view of understanding the symbolic ecology of humans as an open system. This model is consistent with the understanding of Habermas, according to whom social theory can not ignore the dimension of discourse (1987). This symbolic ecological approach is interested in the psychogenesis as well as the sociogenesis of communication, integrating genetics and history whenever it is possible. In this paper, I provide examples of two university mixed-mode courses in which electronic conferences were integrated. By studying the communication dynamics of the symbolic ecological environment in which the actions of the professors adopting a given teaching made possible certain kinds of interaction with and among the students, I aim to identify and to understand the role of logics, affectivity and values. Consistent with genetic epistemology, these three interconnected dimensions of knowledge could provide an understanding on the dynamics of configurations of meanings (Campos, 1998). This understanding might shed a light on the complexity of communication and its role on the learning processes of the students.

Methodology and data sources

The core of our multi-method approach is discourse analysis of electronic conferencing and the case study. Our discourse analysis method is synchronic as well as diachronic. Synchronically, it highlights the logical forms and applied meanings present in the equilibration process of conceptual assimilation and accommodation that leads to the construction of arguments. Diachronically, it draws the relationships among configurations of meanings that form the online discourse that is expressed by meaning implication (Piaget, 1991; Campos, 1998, 2000). Further information on the method can be found in Campos, 2004.

Data sources and subjects

Data came from two postsecondary courses:

- a) A Chemistry Lab course
- b) A Medicine course on urology and the kidney

Both courses were mixed-mode (face-to-face and online), built around an online learning environment offering

many tools such as access to online materials, quizzes, self-assessment of the progression of learning, evaluation tools, private internal e-mail as well as a number of online discussion conferences dedicated to different topics (WebCT). We collected transcript data from electronic conferences of both courses, and made interviews with both professors and students.

Results

Chemistry Laboratory This chemistry mixed-mode (face-to-face and online) course was conceived for students registered in science program. In the studied session (fall 2003), the chemistry laboratory had 133 registered students. The goal was that of introducing students to experimental chemistry by adopting an approach integrating analytical, organic and physical chemistry. This one session course was organized around some lectures followed by lab sessions in which the students were requested to perform a number of experiences. The online component was electronic conferencing. The evaluation comprised two elements: laboratory activities and a final exam. The laboratory elements of the evaluation were the quality of lab work (10%) as well as lab reports (55%). The final exam counted 35% of the mark. Online conferencing was evaluated in terms of participation (2%) and quality (3%): these points were comprised within the laboratory elements of evaluation. For the participation mark, the professor used the conferencing statistical tool that shows how many times a student wrote and read messages.

The professor was not a first-timer: he already taught this course a number of times. This session was the second in which he integrated electronic conferencing in this course. This professor also integrates online conferencing in other courses, meaning that this second experience in the Chemistry Laboratory course was not his second experience with online conferencing. According to this professor, online conferencing was used because of its efficacy. First of all, the tool was considered to be useful because students could ask questions about scientific concepts that they did not understand. Secondly, the professor considered essential the mastery of the language to communicate precisely the intended meanings and conferencing was seen as a good writing exercise. Thirdly, electronic conferencing was considered to be a collaborative tool in which students could help each other. The professor decided neither to interfere constantly nor to answer or comment immediately after a question or comment was published. The strategy adopted was that of waiting to see whether the students would try to answer and help their colleagues before any intervention by the professor was needed. According to the professor, intervening happened when the answer already given by a student was incomplete or incorrect, or when nobody had answered a question, or else, to provide information about the course. The professor finds electronic conferencing to be adequate for this kind of course because even if the students demonstrate to be capable of solving chemistry problems, they normally are unable to properly explain what they do and why. The availability of such a communication tool allows them to explain to each other the processes involved in the calculations which would enable learning. The professor also points out that the dynamics enables first year students to do things that only last year students used to do beforehand. The students that we interviewed found participation in the online conferences a rich and useful experience. They considered that the possibility of asking questions online helped them to follow the course. They also found that this tool was particularly relevant for those who are shy and have a difficult time asking questions in the classroom. The students perceived the strategy adopted by the professor in the intended way. According to them, the professor's strategy was one of trying not to give a response right away to encourage discussion. However, they were not in agreement concerning the character of the community: one student considered it a learning community, while the other a "consulting" community, the students did not share the same degree of enthusiasm about the experience although they considered it to be positive.

Discourse analysis We start with a quantitative view of the studied conference to introduce the reader to the major trends of interaction. The study was done upon 45 messages of a general conference, open to everyone. Participation was not mandatory. Messages with and without arguments were split almost equally (Figure 1).

| Messages | # | % |
|-------------------|----|----|
| With arguments | 23 | 51 |
| Without arguments | 22 | 49 |

Figure 1 - Presence of arguments

However, only a third of the total of messages with arguments had a construction (i.e. somebody building upon what another person had written). A significant number of messages with arguments presented no construction

at all, meaning that what those persons wrote died right there, without a continuation. It is expected that most messages without arguments presented no construction at all but it is interestingly enough to see that some messages presented a sort of construction (meaning) anyhow (Figure 2).

| Messages | # | % |
|--|----|----|
| With arguments and construction | 14 | 31 |
| With arguments and without construction | 9 | 20 |
| Without arguments and construction | 3 | 7 |
| Without arguments and without construction | 19 | 42 |

Figure 2 - Arguments and construction

In terms of values, most messages had a positive content. However, an almost even number of messages were negative or neutral. This trend suggests that this conference was not particularly engaging (Figure 3).

| Values 1 | # | % |
|-------------|----|----|
| Positives + | 18 | 40 |
| Negatives - | 14 | 31 |
| Neutral +- | 13 | 29 |

Figure 3 – Intensity of values

When relating the kind of message with the value intensity attributed to it, we verify that most messages with arguments had a negative content, followed by a reasonable number of positive and neutral ones. We also note that messages without arguments were mainly positive but with a fair number of neutral and negative ones (Figure 4).

| Values 1 (%) | Positives + | Negatives - | Neutral +- |
|--|-------------|-------------|------------|
| With arguments and construction | 11 | 11 | 9 |
| With arguments and without construction | 7 | 9 | 4 |
| Without arguments and construction | 2,5 | 0 | 2,5 |
| Without arguments and without construction | 20 | 11 | 13 |

Figure 4 – Intensity of values according to messages with or without arguments, with or without construction

In terms of the content of messages, most messages had an affective value attached to the writing. A non negligible number was just information publishing. A fair number of messages had a moral content (Figure 5).

| Values 2 | # | % |
|-------------------------|----|----|
| Affective | 28 | 62 |
| Moral | 7 | 16 |
| Informational (neutral) | 10 | 22 |

Figure 5 – Type of value

Concerning how the type of value was distributed, it is worth noting that all messages with a moral content were part of a discussion in which participants constructed upon each others' comments. Most messages with an affective content were found in messages without arguments or construction, i.e. manifestations of care that were not responded to (Figure 6).

| Values 2 (%) | Affective | Moral | Neutral |
|--|-----------|-------|---------|
| With arguments and construction | 11 | 13 | 7 |
| With arguments and without construction | 13 | 2 | 5 |
| Without arguments and construction | 5 | 0 | 0 |
| Without arguments and without construction | 33 | 0 | 11 |

Figure 6 - Type of values according to messages with or without arguments, with or without construction

When we cross the values, what is striking is that most messages with a moral content were negative. In addition, affectivity does not mean necessarily to be positive as show in the table (Figure 7).

| Crossing values (%) | Affective | Moral | Neutral |
|----------------------------|------------------|--------------|----------------|
| Positives + | 36 | 4 | 0 |
| Negatives - | 20 | 11 | 0 |
| Neutral +- | 0 | 7 | 22 |

Figure 7 - Crossing intensity and type of values

We would like to provide additional quantitative information that is interesting analyzing. From those messages with arguments and construction (14 messages), 8 were built upon previous questions, 2 upon themes unrelated to any arguments, and only 4 upon a previous argument. Three of these four messages had a moral content. In addition, we verify a phenomenon of over presence: 57.8% of the messages (26) were written by the professor – 56.5% (13) of the total number of messages with arguments (23) – most of them to answer questions. Hereunder we show examples of such a construction dealing with moral dilemma:

Message n (Informational / Neutral value – with argument – no construction)
(Professor)

Premise – I must remember you that you should a copy of your laboratory report with your assignment...
Premise 2 + conclusion – IF you don't do this (THEN) your evaluation will be affected... Good work. (Signed with initials)

Message n' (Negative / Moral value – with argument – with construction upon the previous theme)
(Student A)

Premise 1 – I need to express my deception concerning the delivery of assignments.
Premise 2 – As other students I left my assignment in the requested box left is a corridor without surveillance.
Premise 3 – Anyone could steal or copy the content of one or many of those assignments.

Premise 4 – Some other things that happened in this course make me doubt of the reliability of our colleagues.
Premise 5 – IF this method continues, THEN is because nothing serious had already happened...
Premise 7 – This is another reason not to take a chance...
Conclusion - IF (the previous are true) THEN it would be better to assure security...

Message n'' (Negative / Moral value – with argument – with construction upon the previous argument)
(Student B)

Premise 1 - I agree. (Given what you said, THEN) I would also prefer to give my assignment to the professor...
Premise 2 - We worked hard for this... and it would be a pity to have someone punished by a stealer.
Conclusion – (IF this continues THEN) chances might be low but previous happenings... in this course... do not assure anybody.

Message n''' (Positive / Moral value – with argument – with construction upon the previous argument)
(Professor)

Premise 1 – I will investigate (the previous cases reported).
Premise 2 – I will take measures in the future to avoid risks of fraudulent behaviour.
Premise 3 – As I remember, in a previous case similar to the one that you reported, the student was expelled from the university.
Premise 4 – It's certain, though, that nobody saw him...
Premise 2 + conclusion – IF you have precise facts (THEN), please, let me know... (Signed with initials)

In order to also present one of the few examples of knowledge co-construction (of arguments) among students, we chose one of the longest in which the students help each other in the search of a response to a difficult problem:

Message m (Negative / Affective value – with argument – no construction)
(Student A')

Premise 1 – The table at page 4 (in the college book) that we must fulfill does not respect the rules concerning significant numbers particularly in the mmol column...
Premise 2 – We perform a three rule and the equivalences are expressed with 2 numbers...

Conclusion 1 – THEN, the data that should be written (in the college book) should also have 2CS.
Conclusion 2 – (IF) One could not be more precise than the least precise data. THEN, why it is written 3CS in the correction (of the exercise)?

Message m' (Positive / Moral value – with argument – with construction upon the previous theme)
(Student B')

Premise 1 – I also noted that it seems that the rule was not respected...

Premise 2 – In addition... I do not understand why the uncertainty value of 0.05ml is multiplied by 2... From where this information come from??? Thanks in advance

Conclusion 1 – (Given this) THEN, an explanation is needed to avoid problems in the exam.

Message m'' (Informational / Affective value – with argument – with construction upon the previous question)
(Student C')

Premise 1 – Hi, IF there are two additive measures measured with the same instrument, THEN the respective absolute uncertainty values should be summed up.

Premise 2 – For example... IF you want to measure 10.00ml...

Conclusion 1 – (Given this) THEN, the result is a volume of 10.00 +- 0.02ml.

Medicine Course This mixed-mode (face-to-face and online) course on urology and the kidney was conceived for students registered in the medicine program. In the studied session (fall 2003), the chemistry laboratory had 123 registered students. The goal was that of introducing students to understanding the functioning of the urological system having kidneys at its core. The course had the help of 24 tutors (15 nephrologists, 5 urologists, 3 residents in nephrology and 1 generalist). In addition, it had 4 non expert teaching assistants. The professor coordinated this team during the session. This one session course was organized around lectures, working groups focusing on problem-solving processes, modules of self-learning, modules of self-assessment, online conferencing, and other materials. The course had strong online components. In addition to online materials (course notes, Power Point presentations, a calendar and a private e-mail system), sessions of self-learning were prepared to follow discussions of the problem-solving working groups. The students could repeat the online modules until mastering the content. The self-assessment tool had a similar goal but could only be used once. Electronic conferencing was used as an online peripheral complement of the face-to-face working groups. The evaluation comprised three elements: final exam (75%), evaluation of the student by a mentor (20%) and participation in the online learning environment (5%). The last item was broke down in 2% for participation in the online conferences, 2% for answering the self-assessment quiz, and 1% for answering an online questionnaire about the learning environment.

We needed to explore the mechanics of the problem-solving working groups to understand how the conferences were used. The problem-solving working groups had, each one, a dozen students tutored by an expert. There were seven problems to be solved and hence seven online conferences were created. Given the high number of students in the course, for each problem (and related online conference) there were a number of assigned groups. These groups had as goal a problem-solving assignment that was structured in the course notes published in the online learning environment used in the course. The first task of the group was one of clarifying what the objectives of the discussions were so as to enable the resolution of the discussed problem. All this process was followed by a tutor and had a working group student assigned to lead the process. Parallel to these face-to-face discussions, the students were requested to participate at the online conferences open for each of the seven problems. The students were requested to participate in those conferences in order to clarify and define the objectives specific to a given problem. Other online conferences were open (for discussion, for instance) but did not work. The only online conferences that worked were those related to the problem-solving working groups. However, most students just "listed" the requested objectives with no discussion and sense of politeness. Although the professor had presented a netiquette link, the resulting discussions could hardly be called a "conversation", so unattached were they.

There are already two years that the professor is using electronic conferencing in this medicine course. The goal, according to the professor, was to make homogeneous the objectives of the problem-solving working groups that were discussing the same problem. In order to help them to fix the objectives, the professor found that electronic conferencing would be ideal. Although the professor believes that students did not like electronic conferencing, there are doubts about whether it was really useful. The intervention strategy was one of waiting for student-student interaction and answering questions in the hope that conferencing would create a need of mutual help. However, the professor recognizes that the online conference strategy adopted to facilitate logistics

provided, in fact, minimum effort from students. The professor had the impression that students only participated in order to get points (which were considered significant in the context of a medicine course) and was disappointed with what was considered to be poor results. The students interviewed found the online experience positive but in their answers they focused mostly on other aspects of the online experience rather than on electronic conferencing. It was noted that although participation was mandatory the use of conferences had a positive impact on the process.

Discourse analysis

The study was done upon 49 messages of 7 problem-solving working group online conferences, open to those assigned groups. Participation was not mandatory but students got participation points. Messages with arguments were almost non-existent: most messages did not have any arguments (Figure 8).

| Messages | # | % |
|-------------------|----|----|
| With arguments | 3 | 6 |
| Without arguments | 46 | 94 |

Figure 8 - Presence of arguments

Co-construction of arguments was also almost non-existent but some construction could be seen in messages without arguments, mostly because of the use of the reply function to answer a question (Figure 9). The professor participated in 26.5% of the conference (13 messages written) and was responsible for 84.6% of messages with construction (9 messages). Most messages had no arguments and construction: just information publication (“listing the objectives”).

| Messages | # | % |
|--|----|----|
| With arguments and construction | 2 | 4 |
| With arguments and without construction | 1 | 2 |
| Without arguments and construction | 9 | 18 |
| Without arguments and without construction | 37 | 76 |

Figure 9 - Arguments and construction

In terms of values, most messages had a negative or neutral content. Most students did not even use to say “Hello” (Figure 10).

| Values 1 | # | % |
|-------------|----|----|
| Positives + | 15 | 31 |
| Negatives - | 24 | 49 |
| Neutral +- | 10 | 20 |

Figure 10 – Intensity of values

As stated above, most negative and neutral messages were those that just presented crude information (the objectives) with any kind of attempt to interact. Many positive messages, though, were those that presented arguments (Figure 11).

| Values 1 (%) | Positives + | Negatives - | Neutral +- |
|--|-------------|-------------|------------|
| With arguments and construction | 2 | 0 | 2 |
| With arguments and without construction | 0 | 0 | 2 |
| Without arguments and construction | 12 | 4 | 2 |
| Without arguments and without construction | 16 | 45 | 15 |

Figure 11 – Intensity of values according to messages with or without arguments, with or without construction

As expected, most messages had a neutral information value (Figure 12). A significant number had also an affective value and few messages a moral value (all of them written by the professor exercising authority in a way or another).

| Values 2 | # | % |
|-------------------------|----|----|
| Affective | 21 | 43 |
| Moral | 3 | 6 |
| Informational (neutral) | 25 | 51 |

Figure 12 – Type of value

Concerning how the types of value were distributed, the figure below (13) just highlights what has already been suggested above.

| Values 2 (%) | Affective | Moral | Neutral |
|--|-----------|-------|---------|
| With arguments and construction | 4 | 0 | 0 |
| With arguments and without construction | 2 | 0 | 0 |
| Without arguments and construction | 12 | 4 | 2 |
| Without arguments and without construction | 25 | 2 | 49 |

Figure 13 - Type of values according to messages with or without arguments, with or without construction

When we cross the values, we further confirm the trends of these conferences. Negativity was related to neutral (informational) statements because most students just published objectives disregarding any usual polite words used in written communication such as e-mail (Figure 14).

| Crossing values (%) | Affective | Moral | Neutral |
|---------------------|-----------|-------|---------|
| Positives + | 31 | 0 | 0 |
| Negatives - | 0 | 4 | 45 |
| Neutral +- | 12 | 2 | 6 |

Figure 14 - Crossing intensity and type of values

Hereunder we show one of the few examples of knowledge construction emerging from the conferences in which two students and the professor discussed a problem to be solved:

Message p (Informational / Affective value – with argument – no construction)

(Student A'')

Premise 1 – Hi Dr.... In the self-assessment quiz of the problem-solving working group 6, question 8, response about hypocalcaemia is related to the augmenting of phosphor-calcium product and vitamin D...

Premise 2 – I thought I had understood from my readings that the phosphor-calcium product was a kind of constant, THEN how could it augment?

Conclusion – (IF the previous THEN) I understand that as the augmentation of the phosphate triggering a diminution of calcium to guarantee that the phosphor-calcium product does not change... (Signed)

Message p' (Informational / Affective value – with argument – with construction upon the previous argument)

(Student B'')

Premise 1 – Hi there, I am not sure whether I have the good answer or not but if PO₄ augments, it produces the diminution of Ca²⁺ because it will precipitate both the PO₄ and the Ca... Conclusion – (IF this THEN it will lead the phosphor-calcium product at a constant level (after having diminished the Ca²⁺).

Message p'' (Positive / Affective value – no argument – with construction upon the previous message)

(Professor)

Rhetorical procedure – You have the good answer! (Signed)

Conclusion

Our research suggests that, although the quality of online interaction cannot be strictly attributed to a given teaching strategy, the nature of the discipline, planning of the course and management of the online conferences shape the level of participation. The use of online conferencing can hardly be considered a success in these courses but our goal here was not one of evaluating them in terms of a dichotomy success/ failure. In fact, the conferences served those who asked questions and had them answered, served as a communication tool

about administration information the professors were willing to broadcast, and served for those unhappy voices that used the conferences either for legitimate or non legitimate reasons. Argument co-construction was reasonable in the Chemistry course and poor in the Medicine course indicating a low to medium level of online learning emerging from the written interactions. However, nothing could be said about effective student learning in those courses because they were not limited to the virtual and also had a face-to-face component.

These experiences, however, show the potential of the use of online conferencing. They certainly should be re-thought in the context of the sciences, and the strategies employed adjusted with a goal of extracting a more consistent engagement and participation. This adjustment should be one of reconsidering the rules employed in order to avoid negativity in the exchange of values, critical for promoting co-argument building and knowledge construction.

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The Effects of Personality on Collaborative Online Learning: Communication Type, Task Engagement, and Communication Duration

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Abstract

This study investigated the potential influence of students' personalities on online discussion, group interaction, task engagement, and communication duration. The results of this study indicate that personality affects communication type, pattern and duration; productive group structures result in sustained discussion. The results also showed that students' feelings, attitudes and opinions about their online discussion experiences are positive. To optimize effective online communication, grouping strategies should combine personality profiles when designing online collaborative learning activities.

Introduction

The value of collaborative learning experiences has been well established (Campbell & Smith, 1997; Johnson, & Johnson, 1989; Johnson, Johnson, & Smith, 1997, 1999). Online collaborative learning has typically been studied within the context of learning communities (Sherry, 1996; Sharon & Edward, 1999; Solloway & Harris, 1999). Though communities are composed of groups of people with common interests (The American Heritage Dictionary, 1997), individuals within communities bring unique personalities. People vary consistently in terms of personality, which is likely to have a consistent influence on group interactions. Personality influences attitudes, beliefs and behaviors (Saucier & Goldberg, 2003); therefore, an individual's personality will likely influence interactions with members of a community. Despite the importance of personality in learning communities, little is known about the potential influence of personalities on online discussion.

Collaborative learning requires communication in some form. Human communication involves both cultural and social processes. The cultural process reflects learning and using language conventions that have shared or agreed-upon interpretations. Through the social process, communication becomes the principal way in which human beings experience meaningful interactions. Through such interactions, people learn to play roles, understand social norms, recognize and apply social sanctions and evaluate each other's actions according to systems of shared values and beliefs (DeFleur & Ba-Rokeach, 1982; Spears & Lea, 1994). Online communication lacks these features of typical human communication therefore limiting the potential effectiveness of online learning. Knowing that personality will likely influence interactions among community members, grouping by personality may compensate for these missing features. Effective grouping strategies appear to be the essential parts of the online learning process (Sherry, 1996, 2000; Sherry, Billig, & Tavalin, n.d.). However, the effect of grouping by personality has yet to be investigated.

Purpose of the Study

The purpose of the study is to investigate the following questions:

1. Does personality influence group interaction in terms of communication type, task engagement, and communication duration?
2. Do communication pattern differences exist among groups based on personality profile?
3. Do communication patterns change over time due to personality influences on group interaction?
4. What are students' feelings, attitudes and opinions about their online discussion experiences?

Methodology

Design

A mixed method triangulation design was used to address the questions considered in this study (McMillan, 2004).

Participants

Seventy undergraduate education majors enrolled in three sections of an educational psychology course participated in the study. The majority (80%) of students were white females from the southeastern region of the United States. Most students were traditional undergraduates between ages 18-22 enrolled in one of their first education courses. Minority and non-traditional students were also enrolled in the course and participated in this study.

Instruments

An online personality inventory, the International Personality Item Pool (IPIP) (Buchanan, 2001; Goldberg, 1999b), was used to classify the students' personality profiles. Three personality traits were used in this study: Extraversion, a tendency to seek and engage in social interactions; Agreeableness, reflecting the quality of interaction engagement; and Openness, reflecting an interest in intellectual and imaginative experiences. High IPIP scores relative to the norming population indicated a greater tendencies toward these personality traits (Saucier and Goldberg, 2001; 2002; 2003).

Student attitudes about their online learning experiences were assessed with a paper and pencil survey prepared for this purpose and administered at the end of the semester.

Procedure

Students were assigned to one of the four personality profile groups prior to the start of the online discussions. Students scoring at or above the 67th percentile of the sample group on these three traits were identified as "high," while those scoring at or below the 33rd percentile were identified as "low." All other students were considered "neutral," that is, neither predominantly "high" nor "low" in the relevant traits. Therefore, four personality profile groups, "high profile," "low profile," "high+low profile," and "neutral profile," were formed, including: 16 students assigned to the high group, 9 assigned to the low group, 10 assigned to the high+low group, and 35 assigned to the neutral group, for a total of N=70.

Students participated in three online discussions (approximately one per month) about three case studies reflecting course concepts. The assignment was to discuss the scenarios using relevant course concepts and content, as well as open-ended discussion questions provided to guide the conversations. WebCT (an online course management system) was used as the forum for online discussions. Discussions had specific opening and closing dates. Although students were required to post a minimum of three messages per discussion, some failed to do so. Therefore, the sample sizes varied across the three discussions due to variations in the participation rates.

After the third discussion, students completed an inclass survey regarding their feelings, attitudes, and opinions about using online discussion and collaborative teamwork to complete the assignments.

Data and Analyses

The content of each message was analyzed for communication type (one-way vs. two-way), task engagement (fully engaged; somewhat engaged; disengaged), and communication duration (Rice & Love, 1987). One-way communication (scored 1) involved messages expressing questions, comments, statements or opinions, but neither inviting, encouraging, nor soliciting reactions from group members. Two-way communication (scored 2) involved inquiry and/or responding messages engaging other members through questioning, commentary, statements or opinions explicitly responding to previous messages or directly inviting, encouraging or soliciting replies. Task engagement was interpreted as the degree to which messages related the case studies and course concepts. Being "Fully engaged" (scored 3) involved content that specifically and consistently focused on instructional or assignment issues. "Somewhat engaged" (scored 2) was used to code content that clearly but inconsistently reflected instructional or assignment issues, and "Disengaged" (scored 1) reflected content that was either marginally related or unrelated to instructional or assignment issues.

The interrater reliability for communication was .94 and for task engagement was .91. Communication duration was assessed through descriptive analyses of word count per message. Student attitude was measured using a 6-point Likert scale. Two one-way ANOVAs were conducted to examine the effects of personality on communication type and task engagement. Descriptive statistics were used to examine communication patterns and duration, and student survey.

Results and Discussion

Tables 1 and 2 present the results related to communication type. Table 1 shows descriptive statistics for all groups averaged across three messages for each discussion and across all three discussions.

Table 1: *Description of group communication type across three discussions*

| Group | | Discussion 1 | Discussion 2 | Discussion 3 | Discussion overall |
|----------|------|--------------|--------------|--------------|--------------------|
| High | n | 13 | 14 | 14 | 10 |
| | Mean | 1.62 | 1.57 | 1.62 | 1.63 |
| | SD | .36 | .30 | .34 | .20 |
| Low | n | 8 | 8 | 8 | 7 |
| | Mean | 1.50 | 1.08 | 1.38 | 1.30 |
| | SD | .47 | .15 | .33 | .21 |
| High+Low | n | 8 | 8 | 10 | 7 |
| | Mean | 1.38 | 1.71 | 1.70 | 1.59 |
| | SD | .28 | .21 | .189 | .106 |
| Neutral | n | 25 | 29 | 32 | 21 |
| | Mean | 1.47 | 1.52 | 1.28 | 1.41 |
| | SD | .236 | .374 | .282 | .234 |
| Total | N | 54 | 59 | 64 | 45 |
| | Mean | 1.49 | 1.50 | 1.43 | 1.47 |
| | SD | .316 | .358 | .33 | .23 |

Table 2 shows the ANOVA results for communication type. ANOVA results for communication type yielded significant differences for discussions 2, 3 ($F(3, 55)=5.94, p<.001$; $F(3, 60)=7.72, p<.001$) and overall, $F(3, 41)= 4.96, p<.01$. LSD post hoc analyses indicate that the high-profile group consistently engaged in more 2-way communication than both the low- and neutral-profile groups. Also, the high+low group outperformed both the low- and neutral-profile groups, suggesting the potential personality influence of the high-profile members. The high-profile group consistently engaged in two-way communication whereas the low-profile group consistently used one-way communication. The high+low group resembled the high-profile group. A gradual change in communication type from one-way to two-way was also evident for this group, perhaps due to the influence of high-profile members. The neutral-profile group showed a distinct pattern of near average performance.

Table 2: *ANOVA results on communication type across three discussions*

| Discussion | Source | SS | df | MS | F | Sig. |
|--------------|----------------|------|----|-----|------|------|
| Discussion 1 | Between Groups | .32 | 3 | .11 | 1.09 | .362 |
| | Within Groups | 4.95 | 50 | .10 | | |
| | Total | 5.28 | 53 | | | |
| Discussion 2 | Between Groups | 1.82 | 3 | .61 | 5.94 | .001 |
| | Within Groups | 5.6 | 55 | .10 | | |
| | Total | 7.42 | 58 | | | |
| Discussion 3 | Between Groups | 1.96 | 3 | .65 | 7.72 | .000 |

| | | | | | | |
|--------------------|----------------|------|----|-----|------|------|
| | Within Groups | 5.08 | 60 | .09 | | |
| | Total | 7.04 | 63 | | | |
| Discussion overall | Between Groups | .644 | 3 | .22 | 4.96 | .005 |
| | Within Groups | 1.78 | 41 | .04 | | |
| | Total | 2.42 | 44 | | | |

Tables 3 and 4 present results related to task engagement. Table 3 shows the descriptive statistics for all four groups averaged across three messages for each discussion and across all three discussions.

Table 3: *Description of task engagement across three discussions*

| Group | | Discussion 1 | Discussion 2 | Discussion 3 | Discussion overall |
|----------|------|--------------|--------------|--------------|--------------------|
| High | n | 13 | 14 | 14 | 10 |
| | Mean | 2.41 | 2.57 | 2.43 | 2.46 |
| | SD | .43 | .33 | .48 | .28 |
| Low | n | 8 | 8 | 8 | 7 |
| | Mean | 2.54 | 1.79 | 2.63 | 2.37 |
| | SD | .59 | .59 | .45 | .39 |
| High+Low | n | 8 | 8 | 10 | 7 |
| | Mean | 2.71 | 3.0 | 2.83 | 2.86 |
| | SD | .38 | .00 | .18 | .12 |
| Neutral | n | 25 | 29 | 32 | 21 |
| | Mean | 2.53 | 2.78 | 2.59 | 2.61 |
| | SD | .51 | .37 | .43 | .32 |
| Total | N | 54 | 59 | 64 | 45 |
| | Mean | 2.53 | 2.63 | 2.60 | 2.58 |
| | SD | .48 | .51 | .42 | .33 |

Table 4 reports the ANOVA results for task engagement, which indicated significant differences for discussion 2, $F(3, 55)=17.7$, $p<.001$ and overall, $F(3, 41)= 3.82$, $p<.05$. LSD post hoc analyses revealed significant differences at the .05 level for discussion 2 (high>low; high+low>high and low; neutral>low), discussion 3 (high+low>high) and overall discussion (high+low>high and low). These results indicated that the high+low group appears to be more consistently fully engaged than the other three groups.

Table 4: *ANOVA result on task engagement across three discussions*

| Discussion | Source | SS | df | MS | F | Sig. |
|--------------|----------------|-------|----|------|-------|------|
| Discussion 1 | Between Groups | .44 | 3 | .15 | .62 | .606 |
| | Within Groups | 11.9 | 50 | .24 | | |
| | Total | 4 | 53 | | | |
| Discussion 2 | Between Groups | 7.42 | 3 | 2.48 | 17.70 | .000 |
| | Within Groups | 7.7 | 55 | .14 | | |
| | Total | 15.13 | 58 | | | |
| Discussion 3 | Between Groups | .96 | 3 | .32 | 1.85 | .148 |
| | Within Groups | 10.41 | 60 | .174 | | |

| | | | | | | |
|--------------------|----------------|--------|----|-----|------|------|
| | Total | 11.373 | 63 | | | |
| Discussion overall | Between Groups | 1.04 | 3 | .35 | 3.82 | .017 |
| | Within Groups | 3.71 | 41 | .09 | | |
| | Total | 4.76 | 44 | | | |

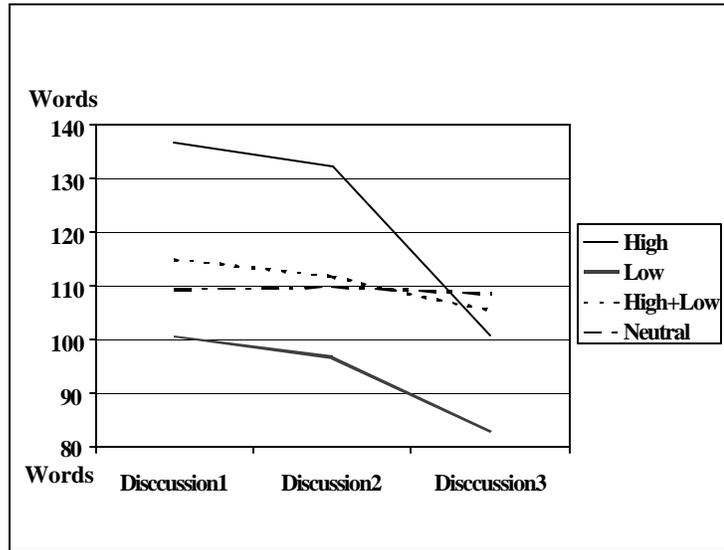
The comparison of communication duration averages across three discussions indicated that high-, high+low-, and neutral-profile groups exceed the message length of the low-profile group, but the high-profile group consistently surpassed all other groups until discussion 3. Table 5 shows the descriptive statistics for communication durations averaged across three messages for each discussion, and across all discussions. In general, high-profile students wrote longer messages. In overall discussion, the high-profile group exceeded the average message length of all other groups. Additional support comes from the high+low group, which shows an average message length exceeded the low- and neutral-profile groups.

Table 5: *Mean message length across three discussions*

| Group | | Discussion 1 | Discussion 2 | Discussion 3 | Discussion overall |
|----------|------|--------------|--------------|--------------|--------------------|
| High | n | 13 | 14 | 14 | 10 |
| | Mean | 136.72 | 132.38 | 100.76 | 137.29 |
| | SD | 73.38 | 128.88 | 42.06 | 72.13 |
| Low | n | 8 | 8 | 8 | 7 |
| | Mean | 100.63 | 96.75 | 82.79 | 92.59 |
| | SD | 39.04 | 32.93 | 22.92 | 28.85 |
| High+Low | n | 8 | 8 | 10 | 7 |
| | Mean | 114.92 | 111.79 | 105.3 | 105.35 |
| | SD | 29.23 | 17.81 | 34.41 | 19.44 |
| Neutral | n | 25 | 29 | 32 | 21 |
| | Mean | 109.45 | 110 | 108.6 | 109.99 |
| | SD | 56.08 | 49.11 | 47.2 | 46.26 |
| Total | N | 54 | 59 | 64 | 45 |
| | Mean | 115.52 | 113.76 | 103.15 | 112.63 |
| | SD | 55.84 | 72.02 | 41.94 | 49.15 |

Figure 1 compares the means of communication duration across three discussions for all groups. High-, high+low-, and neutral-profile groups all far exceed the message length of the low-profile group, but the high-profile group consistently surpassed all other groups until discussion 3.

Figure 1: Patterns of communication duration



Group mean comparisons of communication type revealed communication patterns that distinguish these personality groups (Figure 2). The high-profile group consistently engaged in two-way communication (78% of the messages >1.5), whereas, the low-profile group consistently used one-way communication (78% of the messages \leq 1.5). The high+low group resembled the high-profile group (67% of the messages >1.5). A gradual change in communication type from one-way to two-way was also evident for this group, perhaps due to the influence of high-profile members. The neutral-profile group showed a distinct pattern of near average performance (67% of the messages were between 1.4 and 1.6).

Figure 2: Patterns of communication type for four groups

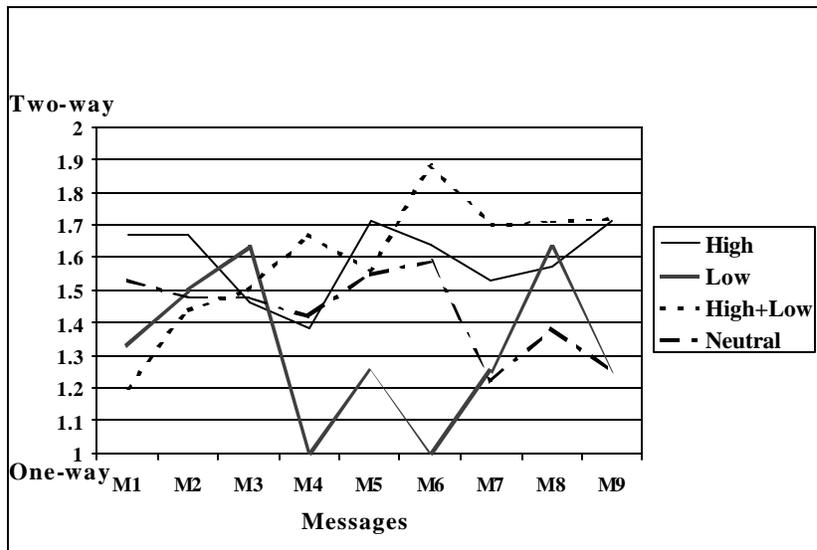


Table 6 reports students' feelings, attitudes, and opinions about their online learning experiences, grouped into five categories. The data indicated that regardless of personality profile, students were consistently positive and receptive with respect to their online discussion experiences.

Table 6: Results of students' feelings, attitudes, and opinions about online learning experience

| Category | High (n=16) | Low (n=9) | High+Low (n=10) | Neutral (n=32) | Total (N=67) |
|--|----------------|----------------|--------------------|-------------------|-----------------|
| | <u>M</u> (SD) | <u>M</u> (SD) | <u>M</u> (SD) | <u>M</u> (SD) | <u>M</u> (SD) |
| Feeling about the quality of online discussion tasks & content | 4.97 (.78) | 4.94 (.92) | 4.95 (.88) | 4.75 (.93) | 4.86 (.89) |
| Feelings about the quality of online collaborative learning | 4.83 (.96) | 4.89 (.80) | 4.8 (.89) | 4.4 (1.13) | 4.62 (1.04) |
| Attitudes about group structure & membership | 3.31 (1.49) | 3.78 (1.26) | 3.75 (1.21) | 3.63 (1.35) | 3.59 (1.35) |
| Opinions about assigning a group leader in the discussion form | 3.88 (1.63) | 3.56 (1.59) | 3.8 (1.62) | 3.5 (1.27) | 3.64 (1.43) |
| Opinions about the value of online discussion & professional development | 4.78 (1.01) | 5.00 (.59) | 4.65 (.88) | 4.52 (1.13) | 4.66 (1.01) |
| Attitudes toward future participation in forums of other online courses | 4.50 (1.59) | 4.67 (.71) | 4.2 (.92) | 4.16 (1.42) | 4.31 (1.32) |

Consistent differences in communication type and duration were identified in terms of personality profile. Students that tend to be more socially outgoing and engaging, more inclined to agreeableness and seeking of intellectual and/or imaginative experiences seem to be better able to meet the goals of collaborative learning, sharing and seeking ideas, comments, questions and concerns, as well as engaging in longer and more sustained conversations. The change of communication type from one-way to two-way for the high+low group indicated a possible personality influence of the high-profile peer learners in the same group. The unexpected effects of personality group on task engagement may well have been influenced more by the constraints and structure of the online assignment, which was somewhat general and non-directive with respect to content but highly structured in terms of frequency of postings.

Educational Implications and Future Research

The results of this study indicate that personality affects communication type, pattern and duration; productive group structures result in sustained discussion. To encourage effective online communication, grouping strategies should combine personality profiles to engage rather than isolate low-profile students. Knowledge of personality will help instructors to better structure the collaborative groups and to develop more dynamic and effective online learning communities.

Future research may engage in a longitudinal study to find out the long-term effects of grouping by personality, peer influence, and stability of communication patterns. Future studies examining the extent of conceptual and relational structure of messages will illuminate the extent to which personality influences messages content. It is also suggested to include problem- or inquiry-based tasks in the learning and discussion in future studies. Students also have to be instructed with collaboration strategies in order to work effectively with group members.

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The Effects of Design Strategies for Promoting Students' Self-regulated Learning Skills on Students' Self-Regulation and Achievements in Online Learning Environments

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Abstract

The purpose of this study was to investigate the effects of design strategies for promoting students' self-regulated learning skills on students' self-regulation and achievements. Seven strategies for promoting students' SRL are identified through the literature review and applied into the experimental group: goal setting, self-evaluation, self-monitoring, cognitive strategies, resource management, self-efficacy and volition. Students were assigned into the control and experimental group. Independent samples T-test and semi-structured interview were conducted to analyze the effects of the design strategies. Implications to promote SRL in online learning environment were discussed.

Recently, self-regulated learning (SRL) has emerged as an important issue in educational circles (Boekaerts, 1999; Schunk, 2000; Schunk & Zimmerman, 1998). Self-regulated learning is students' active learning processes in meta-cognition, motivation, and behavior (Zimmerman & Martinez-Pons, 1986). Self-regulated learning skills are critical for students to succeed in learning not only in traditional learning environments, but also in web-based learning environments. This is particularly true in online learning environments, where students basically learn by themselves without face-to-face instruction and immediate help from teachers. In addition, from the perspective of lifelong learning, the needs for E-learning have been increasing. This relatively unfamiliar learning environment can be challenging to students. Therefore, promoting students' SRL skills is something that instructional designers should consider when they design online learning courses.

Zimmerman, Bonner, and Kovach (1996) argued that students' self-regulation can be taught and improved through the students' own efforts. However, promoting students' self-regulation is not an easy task because it requires them to spend a lot of time and energy. In addition, promoting self-regulation is only possible when students experience the benefits of self-regulation (Zimmerman, Bonner & Kovach, 1996).

Many researchers argued that the effective way to improve students' SRL skill is to embed SRL strategies into the context. This is because students do not apply the learned SRL skills into their learning context after they learned self-regulated learning skills. Also, it is important to have students experience (Zimmerman, Bonner & Kovach, 1996) and use the designed SRL skills into their learning. It is true that many students even don't click a designed content or button and ignore many important learning events designed for them (Lim, 2002). Many researchers (Ley & Young, 2001; Zimmerman, Bonner & Kovach, 1996) suggested the following four design principles to promote students' self-regulated learning skills: (1) The SRL activities need to be explicitly delivered to students. (2) Students should have opportunities to utilize learned SRL strategies in real learning situations. (3) Intervention to promote students' SRL skills should be mandatory or strongly structured. (4) Having students successfully experience SRL skills is needed for regular application of SRL skills in their actual learning.

What self-regulated learning skills are critical?

Self-regulated learning strategies consist of cognitive and meta-cognitive activities, resource management activities, and affective activities (Zimmerman and Martinez, 1986; Pintrich, 1999). Corno and Mandinach (1983) viewed self-regulated learning as a deliberate planning and monitoring process and emphasized the importance of cognitive and meta-cognitive activities for self-regulated learning. Cognitive activities refer to rehearsal, elaboration, and organization (Hofer, Yu, and Printrich, 1998; Yang, 2000). According to Printrich (1999), rehearsal strategies are recitation of items to be learned, saying the word aloud when students read, and highlighting or underlining the text, elaboration strategies are paraphrasing or summarizing the material, and organizational strategies are selecting the main ideas and outlining the text. Cognitive activities vary depending on the learning domain.

With cognitive activities, meta-cognitive activities are critical for self-regulated learning. If cognitive

activities are specific strategies to accomplish goals, meta-cognitive strategies are monitor and reflection to accomplish goals. Meta-cognitive activities are goal setting, self-monitoring, and self-evaluation. Goal setting refers to deciding on specific learning outcomes (Zimmerman, 1999). Schunk (2000) mentioned two roles of goal setting: a motivator to exert persistent effort over time and the criteria to monitor learning progress. A self-monitoring activity involves comparing goals and current accomplishments with the use of cognitive activities. There are a lot of self-monitoring methods depending on learning context, e.g., narrating behavior in the context, recording frequency counts, measuring duration, time-sampling (dividing observation periods into smaller time periods), and tracing times of behavior occurring (Mace, Belfiore, and Hutchinson, 2001). For an effective self-monitoring, it should regularly, proximately, (Schunk, 2000) and accurately (Mace, Belfiore, and Hutchinson, 2001) occurred. Self-evaluation is a learners' judgment on their performance. Self-monitoring plays a great role in self-evaluation. Based on the results of comparing performance to standards or goals, self-regulated learners decide to whether they will change cognitive strategies, keep going the efforts, or give more efforts. Self-evaluation and self-monitoring occur almost at the same time.

Resource management activities are time and effort management, seeking help from others, seeking information and structuring environment for learning (Pintrich, 1999). Resource management activities can occur differently depending on what prior knowledge about subjects students have and what resources they can use in their context. The activities for resource management are not directly related to cognitive and meta-cognitive activities (Pintrich, 1999) but they are important for academic success (Hofer, Yu, and Pintrich, 1998). Zimmerman and Martinez's research (1986) also indicated that high self-regulated learners did resource management activities more frequently than low self-regulated learners did.

In addition to cognitive, meta-cognitive and resource management activities, students' affective activities play a significant role for their self-regulated learning (Pintrich, 1999; Schunk and Zimmerman, 1998; Shin, 1998). Self-efficacy is students' confidence about their ability to perform a task. Scott (1996) found that high self-efficacy students tend to be confident and motivate themselves to acquire learning while low self-efficacy students tend to less motivate themselves to learn and think that acquiring goals are difficulty. Parajes (2002) found that high self-efficacy students tend to exert more effort than low self-efficacy students do when they meet obstacles in learning. With self-efficacy, volition is also important for self-regulated learning (Garcia, McCann, Turner, and Roska, 1998; Kehr, Bles, and Rosenstiel, 1999; Kuhl, 2000). Volition is students' will power to accomplish certain goals. Garcia, McCann, Turner, and Roska found that volition is strongly related to students' use of cognitive and resource management activities. They argued that volition leads students to goal-directed learning and teaching volitional skills to students will be helpful for them to self-regulated learners.

How self-regulated learning strategies are designed in online learning environment?

Seven self-regulated learning strategies are embedded in the context for learning the Test of Written English (TWE). Learners are required to practice every designed SRL skill in each chapter. When practicing cognitive, meta-cognitive, resource management and affective activities, students are asked to submit the results of the each activity to the instructor.

Meta-cognitive activities: regarding goal setting students were asked to hierarchically set the goals for the course at the beginning of the class. Students set the goals by answering the questions: how this course contributes to getting a job in the future, what goals you have after one year with regards to this course and what goals you have after one month with regards to this course. In addition, they are asked to write down what distracts their learning and devise a plan to overcome the problems. With the regard of self-monitoring, students were asked to self-monitor by checking learning processes box. The questions in the box to check are asking about their goal achievement and using cognitive and resource management strategies. Last, in order to promote students' self-evaluation, writing journal was required of the students.

Cognitive activities: rehearsal, elaboration, organization strategies are suggested as learning clues on the screen with the feedback format whenever it is necessary. Students were asked to practice suggested cognitive strategies and submit the results to the instructor.

Resource management activities: Before starting learning, structuring learning environment questions are given to students with the checkbox format. The questions are about whether they organized a learning environment for the learning. They were also asked to submit their time schedule for this course, e.g., how they schedule this course in their daily lives and how much time they will spend on the course. Last, for effective help, a help desk was operated through the discussion board.

Affective activities: Feedback was given on every student's assignment. When giving feedback,

attribution feedback is given with compliment, e.g., “Your writing is good. If you keep this pace, your writing will be greatly improved”. In addition to attribution feedback, volition encouragement was given with the learning strategy clues on the screen. With structuring learning environment checkbox, questions asking volition were given to remind them of the importance of their volition in learning. The SRL design strategies are summarized in Table 1.

Table 1. *Design strategies to promote self-regulated learning*

| SRL strategies | Design strategies |
|--------------------------------|---|
| Meta-cognitive activities | Goal setting: students set goals after reading each chapter overview Self-monitoring: students check their learning process at the end of each chapter Self-evaluation: students write a journal about their learning |
| Cognitive activities | Rehearsal, elaboration, organization: Necessary rehearsal, elaboration, organization are suggested to students as a feedback form depending on content. |
| Resource management activities | Time management: students are asked to plan their time for learning Help seeking: Online help seeking corner is constructed and encourage students to use it any problem related to learning Structuring learning environment: Feedback is given to students before starting each chapter |
| Affective activities | Self-efficacy: Progression and attribution feedback are given to encourage them to learn and keep going their learning Volition: students check their volition before they learn each chapter and feedback encouraging volition is given |

Course Development

The course consisted of 12 lessons, and the experiment was conducted for a month. Two online learning sites for the control group and the experimental group were respectively developed to verify the effectiveness of design strategies for promoting self-regulation with the use of the book, “*To Be A Master In TWE*” (Min, 2002). The online TWE (Test of Written English) program used in the control group was developed according to the Gagné’s nine events. Another website for the experimental group was developed according to the devised SRL strategies. Both groups’ students commonly should submit their assignments three times per week. In addition to turning in the assignments, the students in the experimental group should obligatorily practice Self-regulated Learning activities and post the results on the online bulletin boards for each class. SRL strategies are visualized in figure 1.

In the figure, the upper menu involves a learning preparation, learning overview, learning goals, learning content, learning evaluation, and learning arrangement. The bottom of the program menu involves a syllabus, room for submitting assignments, notice, and learning aids consisting of button explanations, asking questions, total dictionary, summary of important terminologies, and online English learning sites. In addition, five buttons for SRL, used for setting course goals, planning learning resources, establishing learning goals, following learning strategies, and writing a reflective diary are incorporated on the right side of the screen.

Data gathering

Thirty students in a Korean university volunteered for this research for a month. Most of the students were freshmen. The students are randomly assigned into the experimental group or the control group using random numbers. This is a pre and post test. Students’ self-regulated learning skills and essay levels were measured before and after the treatment.

The Self-Regulated Learning Strategies Questionnaire developed by Yang (2000) was used to measure students’ SRL level. The SRL questionnaire consists of cognitive, meta-cognitive, motivational and behavior strategies. The number of item is 84. It uses a self-reported five-Likert scale.

An essay topic randomly chosen from the ETS TWE topics is used to measure students’ prior knowledge and achievements. These were measured by providing students a topic and letting them write an essay about the topic. The criteria used in ETS were also used in rating students’ prior knowledge and achievements. ETS uses 0 – 6 scale points to evaluate students’ essay where 6 is the best score.

Research Questions

Students studying in learning environments, which are designed to forcefully encourage the practice of SRL skills, will show a higher self-regulation than others studying in normal learning environments, which don't support SRL activities.

Students studying in learning environments, which are designed to forcefully encourage the practice of SRL skills, will show a higher achievement than others studying in normal learning environments, which don't support SRL activities.

Results

Independent samples T test for group comparison and semi-structured interviews were used to analyze the data. Pre-test results showed that there is no significant difference in SRL between two groups. Also, there was no significant difference in TWE level between two groups. The mean scores of each group was the same with each other, $M = 1.067$.

SRL Post-test indicated that there was no significant difference between groups. Also, there was no significant different in SRL strategies between groups. Experimental group's sum of SRL scores (276.85) were slightly higher than those of control group (274.07). However, it was not significantly different. This means that the treatment having students practice SRL skill was not effective.

Table 2. *SRL level comparison between experimental and control group.*

| | Control group | | Experimental group | |
|----------------|---------------|-------|--------------------|-------|
| | M | SD | M | SD |
| Cognitive | 58.73 | 6.11 | 59.47 | 6.19 |
| Meta-cognitive | 36.20 | 4.92 | 35.27 | 4.83 |
| Motivational | 87.47 | 14.41 | 86.27 | 10.43 |
| Behavioral | 91.67 | 12.93 | 95.87 | 7.97 |
| SRL | 274.07 | 30.44 | 276.87 | 20.62 |

Regarding the students' TWE levels, there was slight difference between the two groups. The mean score of the experimental group ($M = 3.07$) was slightly higher than mean of control group ($M = 2.97$). However, the difference was not significant. The one important thing is that TWE scores were significantly improved during the one month in both groups, $t(29) = -20.761$, $p = .00$ (two-tailed). This means that the online course was effective to improve students' performance.

In order to identify the reasons why the treatment was not effective, semi-structured interviews with the experimental group students were conducted. The interview data revealed that students didn't know how to effectively practice the intended SRL skills and they didn't know the necessity of practicing SRL skills. Many students in the experimental group felt that practicing SRL skills was another assignment which made them annoying. Many students reported that the designed SRL practices were demanding. In the experimental group, students were required to submit every result of SRL practices three times a week. This fact made them less motivated in learning TWE. Last, they felt that individualized SRL practice were necessary. Some of them were already good at cognitive activities or time planning. They did not want to follow practices, which were different from their own ways. The interview data gave clues why the treatment was not effective to promote their SRL skills.

Discussion

The purpose of this research was to investigate the design strategies for promoting SRL skills on students' SRL skills and performance. The research results imply three things to consider when designing SRL practice and training SRL skills in online learning environments.

First, college level students' self-regulated learning skills are not something to be improved in short time periods just by forcefully having them practice activities. Interview results showed that students felt a lot of burden because of the mandatory participation in every designed self-regulated learning activity. This led some students' motivation going down and being hesitant to use self-regulated learning activities.

Second, exposing students to practice self-regulated learning skills is not enough to promote their self-

regulated learning. They need continuous interactions with peers or with instructors about their progress. Interview results showed that many students was not able to fully understand the purpose of self-regulated learning and why they were doing the activities. The interactions with others will remind them to think continuously about their activities and progresses. This will lead them to self-regulated learner and to apply the acquired skills to other contexts.

Third, autonomy and responsibility should be given to students to self-regulate their own learning while they practice designed practices. The online program was intended to give as many opportunities for students to practice self-regulated learning skills and feel the benefits of them. That's why it demanded students' mandatory participation in the SRL. However, it did not consider how students' self-regulated learning skills are different. For example, some students are good at resource managements while they are not good at cognitive activities. Some students are good at meta-cognitive activities while they are not good at resource managements. By allowing some extend autonomy and responsibilities they will focus on their weakness of self-regulated learning skills.

Figure 1. Self-regulated learning design strategies in the online learning environment



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How Culturally Responsive Are Public School District Websites to The Needs Of The Latino Community?

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Introduction

The research team identified and tested six criteria that operationalize cultural responsiveness as a factor for evaluating school district Websites: cultural utility, representation of diverse cultures of target populations in graphics, percentage of website topics translated into Spanish, the content of topics translated, the level on which translation takes place, and the level on which website navigation elements are translated into Spanish. Fifty school district Websites were evaluated. Findings indicate lack of cultural responsiveness on websites and that cultural responsiveness should be added to website evaluation instruments.

Problem

School districts serve not just their students, but also the communities where students live. In addition to being educational institutions, they are cultural, political, and economic institutions. Therefore, school districts need to address cultural responsiveness on their websites (Huang & Tilley, 2001; Badre & Barber, 1998). On websites, “metaphors, mental models, navigation, interaction, or appearance confuse, or even offend and alienate, a user” (Marsus & Gould, 2000). The need for Texan school district Websites to address language and worldview differences for the Latino community provides a basis for asking, “How culturally responsive are public school district Websites to the needs of the Spanish speaking community?”

Ninety-five percent of the families of the 630,000 students that have been placed in Limited English Proficient programs in Texas indicated that they speak Spanish in the home. In addition, many more families have indicated that Spanish is spoken in the home but have not placed their children in the Limited English Proficiency program (Seidner, Director of the Bilingual Education for the Texas Education Agency, personal communication, July 27, 2003). Although federal law assures equitable access to educational resources, Spanish speakers in Texas have limited access to general information that is provided on school district Websites.

Website evaluation typically focuses on the dimensions of design, credibility, usability, and accessibility (Alexander & Tate, 1999; Lynch & Horton, 2001; Nielsen, 1993). Design relates to the overall aesthetics of a website. Credibility involves the quality of the information on a website (Fogg, et al, 2001). Usability refers to the ease with which users find information on a website and their level of satisfaction with the experience. Accessibility is the use of the Internet by people with disabilities through assistive technologies such as web-readers for the blind or pointing sticks for the physically handicapped.

Cultural responsiveness in website design impacts each of these dimensions and is particularly important for equitable access to educational environments. The emergence of Latinos as a force in online shopping and political polls has triggered acknowledgment by the business and political worlds of the importance of tailoring websites to reach Spanish speaking populations (Swartz, 2003). However, our literature review reveals that educational institutions are not yet addressing cultural responsiveness on Websites and that cultural responsiveness is not included as a Website evaluation criterion on existing instruments.

Objectives

Three intents of this exploratory study were to (1) develop criteria for evaluating the effectiveness of school district websites at meeting the needs of the Spanish speaking community, (2) field test these criteria using 50 district websites in Texas, and (3) specify directions for future efforts aimed at website evaluation to address cultural responsiveness.

Participants

Six criteria for evaluating websites' cultural responsiveness were tested on websites for the 50 largest school districts in Texas (a purposive sample) using both descriptive statistics and naturalistic inquiry methods (Lincoln &

Guba, 1985). These included districts in Houston, Dallas, Fort Worth, San Antonio, Austin, El Paso, Brownsville, and Laredo. They represent 50% of the total student population in the state of Texas and 75% of the limited-English-proficient student population. The six criteria tested were: Percentage of topics translated to Spanish, the content of topics translated to Spanish, level on which translation first takes place, level on which navigation devices (menus and navigation bars that enable movement through several topics on the Web site) are translated to Spanish, cultural utility, and inclusiveness of graphics.

Methods

Criteria for evaluating websites' cultural responsiveness were tested on Texan school districts using both descriptive statistics and naturalistic inquiry methods (Lincoln & Guba, 1985). The field test evaluated the websites of the 50 largest school districts in Texas. These included districts in Houston, Dallas, Fort Worth, San Antonio, Austin, El Paso, Brownsville, and Laredo which represent 50% of the total student population in the state of Texas and 75% of the limited-English-proficient student population.

Evaluation Matrices were designed to describe each Website in terms of six cultural responsiveness criteria:

- ◆ *Cultural utility* was estimated by establishing topics of interest to parents in the Latino community and determining which of those was addressed and how many of the topics were translated. Community interests were identified through interviews with individuals and focus groups with Latino parents and students. These included a representative from the Mexican American Legal Defense and Educational Fund, a representative from the Mexican American Latino Research Center at a research university, and six focus groups of parents and teachers from different school districts in Central Texas and from the Rio Grande Valley. Each reacted to a variety of websites revealing their interests and reactions, both positive and negative. The interview process was conducted by two of the researchers and contents were recorded and transcribed for evaluation by all researchers who identified emergent themes by color coding text and marking in margins. We achieved consensus regarding topics of interest to Spanish speaking users and conclusions that could be drawn regarding culturally responsive design issues.
- ◆ *Percentage of topics translated to Spanish*: The researchers counted the topics listed on levels one and two of each site, counted the topics translated on those two levels, and calculated the percentage translated. If a topic that appeared on the first level appeared again on the second level, it was not counted twice. If translation was indicated on the second level, then the researchers pursued those topics to their full extent. Therefore, most topics that were translated on subsequent levels were identified.
- ◆ *The content of topics translated to Spanish*: These will be identified during the exploratory process described for criteria one and will include translated topics found on any level of the site.
- ◆ *Level on which translation first takes place*.
- ◆ *Level on which navigation devices are translated to Spanish* (menus and navigation bars that enable movement through several topics on the Web site).
- ◆ *Inclusiveness of graphics* was determined by six evaluators. The evaluators all had college degrees in education, business, computer science, or biology. They ranged in age from 21 to 50 and included 4 females and 2 males. All six evaluators were white. They listed graphics on each district's home page and labeled each listed graphic as cross-cultural, neutral, or specific. If evaluators labeled a graphic as "specific," they specified the culture represented by that graphic. They provided a rationale for the decision making regarding culture represented by graphics. After compiling evaluators' categorizations and rationales in a summary matrix, we paid closest attention to the evaluators' rationales. Throughout the data analyses we inserted our own judgment and understanding to summarize and draw conclusions keeping in mind that the ambiguous nature of the data made it subject to our interpretation. Therefore, we do not claim that our interpretation is the sole interpretation of these data.

Results

Preliminary results of the exploratory study follow. In testing the six criteria on Texas ISD Web sites, we found that they informed us regarding dimensions of cultural responsiveness.

Focus groups and interviews of the Latino community members revealed that cultural utility, or topics of interest, included information about registration, bussing, curriculum and programs of study, quality of program, class sizes, immunization information, how to contact the Board of Trustees, how to make course

changes, extra curricular activities, wages of teachers, and credentials of teachers.

For 31 ISD Websites, the percentage of topics translated to Spanish was .02% of the topics posted on school district Websites. They ranged from 0 translation to .15% of topics translated. However one site was an outlier with 23% of the 610 topics translated. This site was not included in the averaging process.

The content of topics translated to Spanish Translated content was idiosyncratic in that it varied widely from district to district including topics ranging from bacterial meningitis warnings to parental permission forms. Generally content fell under the following categories: Calendar, newsletters, menu, PTA information, school handbook, health information, bond information, enrichment information, and curriculum Curricular information included information about migrant education, bilingual programs, pre-kindergarten, kindergarten, recommended high school programs, magnet schools, grading periods, exam schedules, and gifted and talented programs. Only two of the 31 sites had translated information about gifted and talented programs.

Again for just 31 sites, the level on which translation first took place were identified. Translations were typically found on the third or fourth level of the Websites making them inaccessible to users who only spoke Spanish. One site had no translation; 6 sites began their translations on level 3, and 14 sites began their translations on level 2. Ten sites had an "En Espanol" on the first level of the site.

For those same 31 sites, navigation devices were translated to Spanish starting with different levels. One site had no translation for navigation; 7 sites began their translations on level 3, and 13 sites began their translations on level 2. Ten sites had the "En Espanol" link on the first level of the site.

Website developers appear to be somewhat responsive in their selection of images that revealed the cultural diversity of the district. On the 50 Websites, one hundred and eleven graphics were polycentric, 707 were culturally neutral in their imagery, and 51 were ethnically specific or ethnocentric. Data analysis reveals that the criteria developed for website evaluation facilitates identification of cultural responsiveness or unresponsiveness on websites.

Conclusions

When evaluating web sites, cultural responsiveness should be considered as an aspect of each of the four conventional criteria: design, credibility, usability, and accessibility. Continued research needs to aim at further identifying clear operational elements of culturally responsive website design. A next step is to quantify our developed and tested criteria. Once our criteria have been quantified, a cultural responsiveness score and portrait of any district website will be able to be drawn. Based upon each score and portrait, specific recommendations for improving cultural responsiveness in website design can be specified for any given Web site.

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Culture and Motivation in Online Learning Environments

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Online learning has been hailed as a huge step forward for education. Academia is increasingly offering Internet-based distance courses because they allow “anywhere, anytime” learning and access to a wider pool of students. Firms and organizations like it for training employees because it permits consistency and repeatability in training delivery. K-12 educators endorse it because it teaches children important technology skills that they will need in their advanced education process and in their careers.

Online learning has been implicitly considered the lingua franca of education in terms of its functioning and graphic content (Gunawardena & McIsaac, 2004, p.363). For the most part, instructional design of online learning has largely ignored culture in the creation of online learning environments (Thomas, 2002).

By not taking learners’ culture into consideration, it is possible that online learning environments have been designed in such a way as to negatively impact learners’ motivation and persistence levels. For example, Merryfield (2001) found unexpected challenges in transferring a course on diversity in education to the Internet. She observed that many of the behavioral aspects that differentiated students were broken along cultural lines, and noted that this may have implications for equity of access.

In the European Union, where issues of cultural diversity loom even larger than they do in American classrooms, there have already been some efforts to find an acceptable middle ground in educational software and to make it more portable across political and ethnic borders (Collis & Remmers, 1997). Suggestions offered by the Commission of the European Communities are pragmatic and aim at making educational software equally usable by all, but they do not address issues of learner motivation except by inference.

The fact that online learning and distance education can impose its authors’ goals, perspectives, and standards on a receiving culture (Gunawardena & McIsaac, 2004, p. 388) is very rarely cited in the literature. Understanding whether and how learners’ cultural characteristics may interact with a major delivery method such as online learning makes possible the exploration and creation of alternative means of supporting learners in the construction of knowledge. Not doing so may well condemn groups other than the course implementer’s or author’s to decreased motivation and thus higher attrition, reducing some learners’ chances of benefiting equally from a digital learning environment.

Is Online Learning Different?

Why is it necessary to explore and evaluate the issues of culture and motivation in online learning environments, as distinguished from other specific environments? After all, there already exists persuasive evidence that culture does matter, whether in the classroom, in textbook construction, or in testing. So it is worthwhile to ask the question: Why should online learning need to be investigated separately?

Although research does not generally indicate that learning *outcomes* are different in online learning as compared to other learning delivery methods (Saba, 2000), Winn and Snyder (1996) noted that traditional theories of distance education evolved while behaviorist models were prevalent; thus cognitive psychology and cognitive science have been incompletely integrated in distance education theory and models.

There is evidence to support the contention that online learning environments impose different types of *cognitive loads* on the learner. This was first proposed by Kozma, who argued that there must be recognition of the cognitively relevant characteristics of media. Kozma differentiated between the learner’s *internal* and the *external* environments, specifying that the learner must use his or her internal cognitive resources to extract information from the external environment during the process of constructing new knowledge (Ullmer, 1992).

This position was strengthened by recent research comparing brain activity in virtual and real environments (Micropoulos, 2001). In this exploratory study, participants’ EEG readings were recorded while executing a simple task in a virtual environment and the same task in a real environment, and the two readings were compared. Significant differences were found in the readings, indicating that different cognitive processes were being used when in the virtual environments.

Related to this is Prensky's (2001) contention that "digital natives" actually think differently from those who are not accustomed to using digital accessories and games. He argued that the very use of the digital tools has modified the cognitive processes of those who have grown up with them. Other research on such phenomena as split-attention effects (Mayer & Moreno, 1998) has tended to support similar conclusions.

If it is true that the cognitive load imposed by online learning differs qualitatively from that of other learning environments, then perceptions and reactions that are intertwined with cognition are also likely to vary. A review of how culture and cognition interact will illustrate how this may be true.

The Relationship Between Culture And Cognition

A sociocultural view of cognitive ability first appeared in the early 1900s (Sticht, 1994), although at that point it was almost the opposite of what it is today. A century ago scholars believed that "primitive" people had primitive cognition patterns such that the cognition patterns and the cultures reinforced each other (Cole, Gay, Glick & Sharp, 1971), making members of those cultures unable to think in complex or "advanced" ways. With behaviorism, however, came the belief that cognition is essentially the same across cultures, regardless of cultural norms and practices; anthropologists especially held that position, believing that people varied only on cultural practices.

However, behaviorism fails to explain why different cultures develop such radically different practices if their cognitive patterns are essentially the same. The concept of "World View" prevalent in the 1970s and 1980s attempted to deal with this issue by analyzing the "culturally specific cognition of a people" and representing it "in terms of a set of logically interrelated and structurally consistent propositions and corollary statements that are assumed to model native perception and thinking" (Kearney, 1984, p. 36). Kearney defined a culture's worldview as a model of how that culture looks at reality, consisting of "...basic assumptions and images that provide a more or less coherent, though not necessarily accurate, way of thinking about the world." (p. 41) Kearney further noted that different worldviews developed because of both external (i.e., environmental) and internal (i.e., cognitive) reasons; however, this stance incompletely addresses the question of interaction between culture and cognition.

The sociocultural understanding of cognition has regained currency recently, as social constructivism and contextualism has emerged, according to Sticht (1994); Sticht noted that this approach attempts to explain the cognitive development of humans in general and social groups (cultures) as well as individual development.

Contributing to and fueling this re-emergence was a growing interest in diversity, and thus in how one culture behaved as compared to another (e.g., Dick & Robinson, 1997). Such comparisons often took the form of a litany of differences that were largely anecdotal and without theoretical basis, but they did attempt to categorize and rationalize cultural differences. Unfortunately, they also had the tendency to reduce cultures to stereotypical lists of characteristics.

As knowledge regarding different aspects of cognition was expanded, there began to be cultural analyses that emphasized those aspects. For example, Griggs and Dunn (1996) considered learning styles of Hispanics, mentioning their "other-directedness" which conflicts with the US mainstream individualism and noting that Hispanics' emphasis on cooperation can result in discomfort with the competitiveness of the classroom. A similar study was produced by Chen and Stevenson (1995) who looked at motivation and mathematics achievement in Asian-American, Caucasian-American, and East Asian high school students.

Cognition, Learning Theories, and Social Contexts

During the 60's and 70s, the influence of Piaget caused learning and intelligence to be seen as a progressive process involving feedback and stages of cognitive development. The individual and the characteristics of the individual's mental organization was at the center of Piagetian theory, and social issues were at best secondary, being indicators of progress rather than contributing factors (Light & Perret-Clermont, 1989).

In contrast, Vygotsky treated cognitive development and higher mental functions as primarily a social-cultural product, with cultural knowledge and values providing the basis of reasoning, inferencing, and interpreting meanings. Vygotsky also linked culture with language development, and language with learning, providing an additional link or anchor into cultural meaning making (Trueba, 1993).

An offshoot of Vygotskian thought, activity theory was advanced by Luria, Leont'ev, and Zinchenko. It takes as its main focus the sociocultural nature of intellectual development, according to Gauvain (2001). Activity theory is based on three main assumptions: (1) behavior is goal-directed and practical, (2) cognitive development is a product of social and cultural history, and (3) cognition is a socially mediated process.

Gauvain commented that, because activities and their settings are created by the participants in that setting, they reflect the group's assumptions, resources, and goals. "This notion transcends the boundary between the individual and the social. In so doing, it connects the interpsychological plane, that is, *between* individuals, and the intrapsychological plane, that is, *within* an individual, of human functioning and development." (p. 48) Thus cognitive development is the means by which the individual shapes his/her biological capabilities to conform to the social environment in which the individual is active. But Gauvain cautioned that activity theory is limited because it does not specify which social processes shape intellectual growth or connect specific features of social interaction to specific facets of cognitive growth.

An early example of the application of the sociocultural theory of cognition is found in the study published by Cole et al (1971). It is an exhaustively detailed ethnography of the Kpelle in Liberia that sought an explanation of why Kpelle children have so much trouble with Western-style mathematics, and in doing so it demonstrated how culture and thought processes are intertwined. The researchers found significant differences between the Kpelle and Americans in uses of taxonomies, class distinctions/heuristics, memory skills, etc. Their primary conclusion was

...that cultural differences in cognition reside more in the situations to which particular cognitive processes are applied than in the existence of a process in one cultural group and its absence in another. Assuming that our goal is to provide an effective education for everyone..., our task must be to determine the conditions under which various processes are manifested and to develop techniques for seeing that these conditions occur in the appropriate educational setting. (p. 233)

Bandura continued to focus on social constructs, in particular expanding the notion of self-efficacy to include the concept of "collective agency" (Pajares, 2002). This is defined as "a group's shared belief in its capability to attain goals and accomplish desired tasks" (Pajares, 2002, Self-efficacy Beliefs, paragraph 7).

Clearly, current learning theory has progressively emphasized the role of the culture in the development of cognition and learning. But how is this accomplished? What is the nature of the interaction between the culture and the developing intellect that would make this so?

On The Social Context Of Cognition

At the organic level, it is assumed that all "normal" brains function roughly in the same way within a broad range in terms of perceiving and conveying data (Carter, 1998). That data is then processed into information and stored; this "information processing approach" (Anderson, 2000) is assumed to be common to all "normal" human cognition. But an important corollary of these concepts is that the brain perceives and processes information by using pathways and schemata laid down by previous experience; consequently, each successive cognitive experience is progressively more affected by what the individual has perceived and experienced previously. So over time, perceptions of experiences and knowledge provided by the environment (including the cultural context) will literally change the flow of the same mental processes from which they emerged (Valsiner, 1996; Anderson, 2000; Carter, 1998; Sticht, 1994).

Not only perception, but also reasoning is strongly influenced by culture. Reasoning depends on schemata, many of which are supplied by the cultural context (Hutchins, 1980, cited by D'Andrade, 1989). D'Andrade concludes that when differences in problem solving are found between groups of people, it is much more likely that this is the result of a difference in shared cognitive structures, or culture, between the groups than the result of a genetic difference in some kind of general reasoning ability.

These perspectives are further buttressed by the theory of ecological psychology, which argued that the mind and the environment must be treated as a unity rather than separate and independent entities (Costall, 1989; Rosche, 1996). Similarly, the theory of situated learning (Sticht, 1994; Stein, 1998) asserted that learning results from a social process involving a variety of thought, perception, problem-solving, and interaction; thus learning is not separate from the physical, dynamic world, but connected to it through complex social environments. Downes (2004) transferred that concept to online environments, commenting on the importance of social interactions in learning; he especially noted its importance in computer supported collaborative learning and touched briefly on the cultural aspect of social interactions.

If, indeed, social context is intimately involved with the development of cognition, what are the means by which it leaves its mark, and on what aspects of cognition? Culture has traditionally been defined as a stable set of norms, beliefs, and behaviors; however, during the past two decades, culture has been seen as consisting of knowledge and conceptual structures (Valsiner, 1996). If so, how do those structures and knowledge impinge upon and affect the developing mind such that they leave a lasting imprint?

Gauvain (2001, 1995) examined in minute detail the research that points to the social foundation of developmental cognition. She considered the sociocultural context of development to provide the core activities

through which children are exposed to, and learn about, thinking; she believed that the vast majority of the cognitive functions that children develop in the early to middle years of childhood are connected to social experience in ways that are both intricate and interrelated.

She identified three subsystems (Gauvain, 1995) that serve as a sociocultural structure within which cognition develops:

- Cultural activity goals and values
- Tools and materials provided by the culture to meet the goals and values
- High-level cultural structures (e.g., scripts, routines, and rituals) that help the culture implement the goals and values in socially organized and cohesive ways

These subsystems both assist and constrain the cognitive development of the culture's members, and channel human thinking in ways appropriate to and supportive of the culture.

It may seem intuitively obvious that children are taught by adults in a culture, but what is less obvious is that those adults quickly and completely pass on their own cultural values and goals to the children (Rogoff, 1989). Thus, children are, in effect, apprentices to their culture, and learn concepts, e.g., amount, number, area, volume, weight, etc., that exist in their culture because they are useful in that environment (Light & Perret-Clermont, 1989). Gauvain (2001) referred to this process as *cognitive socialization*, and noted that it emphasizes the cultural and goal-directed nature of these interactions as well as requiring the learner to play an active role in the process. By linking the larger sociocultural context of cognition with the individual context of cognitive growth, the learner's mind is organized and shaped "in ways that are suited to the needs and aspirations of the community in which growth occurs." (p 34).

Higher mental functions identified by Gauvain and indicated by research also to be socially co-constructed processes include:

- **Problem solving skills:** Transfer of cultural knowledge is involved in terms of what features of a problem space to encode, strategies to use, and knowledge base development. Values are also transmitted about the problem domain and the categories of thinking that problems represent.
- **Memory:** both content and process are socially co-constructed processes. In the process of developing memory, individuals absorb values represented as memories as well as specific strategies for remembering.
- **Planning:** Social context is involved in learning how to plan actions in order to reach goals and how to coordinate plans with those of others.

Gauvain did not deny that the individual brings intrinsic capabilities to social interactions and therefore to the developmental process. But she focused on the research that supports the view that much of cognitive development is a shared domain between the individual and society. If her view is correct, there should be persuasive evidence that adults in different cultures actually have differing thought patterns.

Such research has recently been published by Nisbett (2003). Basing his conclusions on a series of experiments conducted by himself and others and supporting them with an analysis of cultural history, he contended that East Asians and Westerners differ in terms of whether they perceive the world holistically or as collections of objects, their conception and use of logic and categorization, their valuation of individualism versus group harmony, their use and understanding of causal attribution, their inclination to apply rules to situations, their development of relationship skills, and much more. His research tends to bear out Gauvain's assertions about cognitive development, and shows us the degree to which the typical adult's cognitive profile can differ from culture to culture.

Culturally Defined Value Systems

Gauvain, Nisbett, and others have indicated the degree to which the sociocultural context affects cognition and how social goals and values underlie many cognitive processes. But that begs the question: to what extent do value systems (and therefore goals) reflect cultural identity? This is an important question in the current inquiry, because a distinct correlation between value clusters and culture is required in order to search for the effect of a given culture in an online learning environment, or to differentiate between two or more cultures.

Recent analyses of culture and attitudes in teaching indicate that values do, indeed, matter. For example, Boufoy-Bastick (2001) noted that strategies for improving computer-related attitudes and beliefs of young Latino students are needed as many do not see computers as being relevant in either their careers or their personal lives. Ziegahn (2001) remarked on the potential variance between adult education teachers' values and those of their students.

The term “values” can vary somewhat in definition from scholar to scholar, but it consistently carries with it the concept of normative orientations, of preferred or even obligatory conduct and of desirable and undesirable conditions (Williams, 1979). It is recognized that societies (as well as institutions) have specific value priorities or hierarchies (Rokeach, 1979; Williams, 1979).

Rokeach (1979), whose quantitative research some three decades ago clearly established the fact that values were differently prioritized by various institutions and societies, contended that values were organized into value systems by organizations and societies, and that a main determinant of values is one’s culture. Using a list of 18 terminal values (i.e., ideal end-states of existence) and 18 instrumental values (i.e., ideal modes of behavior) Rokeach evaluated the value systems of many different groups, concluding that the actual number of terminal and instrumental values that an individual or an organization has is fairly small.

But it was Hofstede’s astonishingly wide data-gathering work that led to a more comprehensive value structure across countries. In a work first published in 1980 and augmented in a second edition (2001), Hofstede detailed the results of a series of surveys of cultural values conducted between 1966 and 1978, then added to in 1985-1995. The surveys included some 116,000 questionnaires in 72 countries, using 20 languages; respondents were members of the IBM workforce. Later, even more data from non-IBM respondents was added.

Using the data produced, Hofstede and his associates constructed a database suitable for statistical analysis. Extensive statistical analysis and data reduction techniques revealed a structure of five axial data values (or clusters of values) on which the national cultures surveyed differed from one another. Significantly, countries seemed to group together on each of the structural axes in ways that suggested a degree of cultural consistency (e.g., Hispanic countries tend to group near each other on most of the axes).

Hofstede’s five cultural dimensions are:

- **Power distance:** the degree to which the less powerful members of the society accept and agree that power is distributed unequally; the acceptance of power inequality in the society.
- **Uncertainty avoidance:** a measure of how comfortable or uncomfortable members of a culture are in unstructured situations; how much the society accepts the novel/surprising/unknown versus how much it tries to control it. This concept is not analogous to risk avoidance; rather it is a tolerance for ambiguity or uncertainty.
- **Individualism/collectivism:** the balance in the society between the requirement that individuals take care of themselves versus integrating into groups; the degree to which social referencing is encouraged; whether the individual identifies strongly with a group and is indivisible from it, or whether the individual primarily sees him/herself in self-defined terms, separate from group identity.
- **Masculinity/femininity:** the width of the divide between gender-based roles; the degree to which biological differences are expected to be reflected in social and emotional roles.
- **Long-term/short-term orientation:** the degree to which members of a society are expected to be able to accept delayed gratification of material, social, and emotional needs; persistence and thrift are aspects of this continuum.

Hofstede offered the first comprehensive, data-derived model of cultural values. He defined the model and its components in ways that are usable and coherent, consistent with previous research in the field, and statistically defensible.

Motivation And Persistence

It is clear from the foregoing discussion that values are culturally anchored, and deeply intertwined with cognition and therefore with learning. But what is the connection of values, cognition, motivation, and persistence?

Thought and theory regarding motivation in general has undergone much development in the last century, especially since McClelland (1961) and Atkinson (1964) respectively introduced their works on achievement and expectancy theories. Atkinson examined such factors as anxiety regarding failure, expectancy of success, and need for achievement, but considered these to be individual characteristics only. McClelland, however, saw an effect of culture, at least obliquely, by considering social practices such as methods of childrearing that he felt contributed to the individual’s need for achievement.

A few years later, Raynor (1967) addressed what was essentially a weakness of expectancy theory—that it was concerned only with the expectations of success and failure in the activity being observed. In his model of motivation, Raynor integrated the importance of long-term goals and expectancies, noting that anticipated future consequences of present behavior differentially affects individuals, depending on the strength of their achievement-related motives.

Maehr (1974) did early studies specifically pointed at cultural aspects of motivation, examining logically various constructs that might represent the interaction among culture, personality, and motivation. He observed the effect that social roles may have on certain types of behavior and recommended that more should be done to analyze the influence of social norms on motivational behavior. Maehr noted that culturally derived beliefs about ends (terminal values) and means (instrumental values) typically played little or no role in then-current achievement motivation, but felt that they should.

Keller's (1983; 1987) ARCS model brought together the above themes in motivational thought plus many more, including those of such theorists as Weiner, de Charms, Rotter and Bandura. ARCS, which stands for Attention, Relevance, Confidence, and Satisfaction, provides a systematic approach to incorporating motivational tactics into instruction. The learners' goal orientations are implicit in the Relevance aspect of the model, and their perceived success in having met those goals is included in the Satisfaction phase.

Motivational Systems Theory

Still, motivation as a field did not have a single, unifying theory until Ford's (1992) work. Anchored within a comprehensive theory of human functioning called the Living Systems Framework, Ford's Motivational Systems Theory (MST) provides a complete formulation of the basic characteristics and interactions of motivation and competence development.

Ford defines motivational processes as having three primary characteristics:

- They are qualities of the person rather than properties of the context.
- They are future-oriented rather than being focused on the past or present.
- They are evaluative rather than instrumental in character.

So motivation can be facilitated or constrained, but not imposed on a learner under Ford's theory, as it is entirely internal to the individual.

Within MST, motivation is defined as "the organized patterning of an individual's personal goals, emotions, and personal agency beliefs." (p. 78) Thus the concept can be restated:

Motivation = Goals x Emotions x Personal Agency Beliefs

Ford assigned goals a leadership role in motivation, specifying that both cognitive and emotional evaluations underlie the formation of new goals. He contended that a large portion of one's feelings of satisfaction and frustration can be traced to the organizing aspect of one's goals, and that the most motivating activities in life will be those that involve the simultaneous pursuit and attainment of multiple personal goals. Goals include both content (representing the consequences to be achieved or avoided) and process (directing the other components and capabilities of the person to try to produce those consequences).

Thus Ford's theory fits neatly into the space provided by Rokeach and Hofstede on one hand, and Gauvain and Nisbett on the other. As discussed earlier, Rokeach and Hofstede made clear that goals and the values that support them are heavily influenced by one's national culture, and Gauvain and Nisbett showed in exhaustive detail the extent to which culture is seen to affect the individual's cognitive processes. This interlinking of values, goals, cognition, and culture is at the heart of the theoretical connections being proposed by this paper. A schematic view of these linkages is shown in Figure 1.

In fact, Gauvain (2001) nibbled around the edges of this when she remarked that children's learning and involvement with their community show "patterns reflecting both short- and long-term goals and values of the communities. These variations would be expected to lead to differences in what children learn to think about and how they learn to think." (p. 40)

The other two components of MST also show unmistakable connections with the individual's culture. Personal Agency Beliefs are evaluative thoughts (and therefore anchored in cognition) that compare desired and anticipated consequences; but they have no meaning or functional significance if the goal they support is without value to the individual. They are seen as being more fundamental than the actual skills and circumstances they represent, because they can encourage people to open opportunities and acquire capabilities that they do not yet possess; thus they serve as a potentiating force. Ford notes that they play "a particularly crucial role in situations that are of the greatest developmental significance—those involving challenging but attainable goals." (p. 124). Note that Bandura's notion of "collective agency" (described above) is an expanded version of this concept that illustrates the cultural connections even more clearly.

Likewise, emotions (in older children and adults) are generally "activated by cognitive evaluations pertaining to current or potential concerns in real or imagined circumstances" (p. 143) according to MST. Regardless of whether the emotions are conscious or not, they may involve habitual patterns. Both in terms of

their cognitive component and in terms of their connection with ingrained patterns, emotions clearly have connections with culture.

Emotions have long been considered to have a clear interaction with online learning as well. Malone and Lepper (1987; also Lepper and Malone, 1987) wrote extensively on the importance of using “motivational embellishments” to create a sense of fun, challenge, curiosity, and fantasy in online learning in order to engage learners and enhance their intrinsic motivation.

Finally, it should be noted that MST defines competence as “the attainment of relevant goals in specified environments, using appropriate means and resulting in positive developmental outcomes” (p. 67). Accordingly, the concept of competence is also intimately connected with cultural issues as regards both goals and context.

Thus every aspect of Ford’s theory, when juxtaposed with other relevant models and theories, is permeated by the effects of the individual’s cultural background and the effects that background unavoidably imposes. When these interactions are mediated by an online environment, the motivational outcome may be different than that in other environments. And because we have seen both theoretical and research-based evidence that online environments differ from other learning environments in terms of their cognitive load and effects on the learner, it is reasonable to suggest that the role of culture on motivational outcomes in online environments is worth studying.

Conclusion

Cognition, cultural goals, and values, motivation... the pieces are all there for online learning and instructional design experts to find. The problem is that they are scattered across disparate disciplines: anthropology, psychology, sociology, and education. Given the current state of relevant knowledge and theory, it would be illogical that there might not be an effect—or a range of effects—on learner motivation and persistence, rooted in the interplay between the online learning environment and learner culture. It only remains to find what those effects might be so that we can allow and plan for them, and in so doing, provide added means by which all learners can advance equally on the path offered by online learning.

Unfortunately, so far research in this area is very sparse. (Collis & Remmers, 1997; Collis, 1999; Thomas, 2002). As learning becomes increasingly globalized and as academic and other organizations move forward with plans to encourage learners from other cultures to join them, it would be a shame if our own ethnocentrism prevented us from understanding that other cultures may react differently than we do to the virtual learning environments we have implemented. Only by testing and engaging in continued research can we evaluate whether the learning structures we have designed will provide equal access and opportunities for success to all learners.

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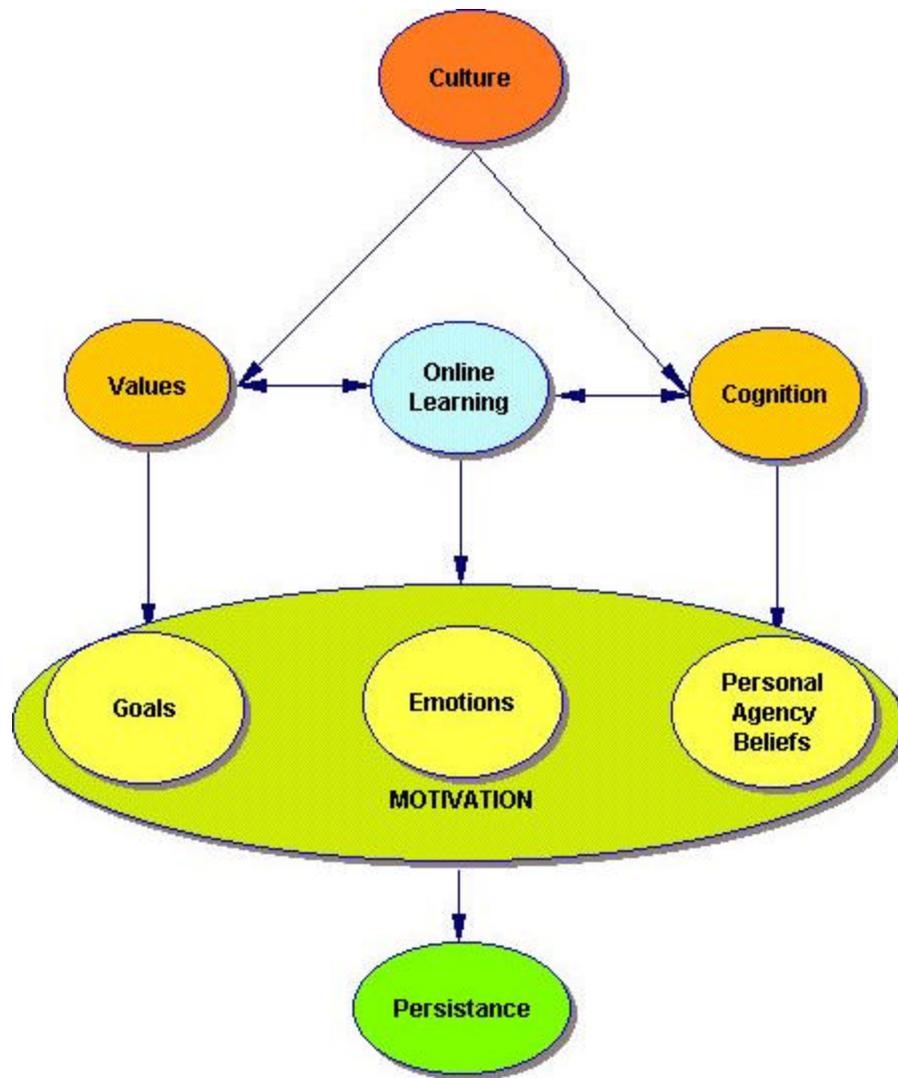


Figure 1

Pre-service Teachers and Search Engines: Prior Knowledge and Instructional Implications

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Abstract

There is a wealth of information available on the World Wide Web that can assist pre-service teachers in their course studies. Yet observation of students in a technology integration class indicated that students were not able to find resources efficiently or reliably. The purpose of this study was to establish a baseline of what undergraduate, pre-service teachers know about search engines and searching the Web prior to beginning a course on integrating technology into the classroom. A total of 355 undergraduate, pre-service teachers over three semesters participated in the study. The results indicate low declarative, syntactic and semantic knowledge. Implications for course and program revisions based on the results are addressed.

Academic programs are continuously under evaluation and revision. Whether through a formal process from an outside agency, or the individual reflections of an instructor, these reviews seek to determine the effectiveness and value of a specific course or program in terms of the validity of objectives, relevancy and sequence of content, relation between assumed prior knowledge and current course content, and achievement of specific goals. In an internal review of a technology integration course at a southeastern university, the researchers found that faculty in the college of education assumed students at the university knew how to use the Internet as a source of information to support their academic studies. Yet the researchers observed many students had difficulty locating information relevant to their courses and assignments. The researchers also observed students spent a great deal of time on unsuccessful searches; few students were able to locate relevant resources quickly. The purpose of this study was to establish a baseline of what undergraduate, pre-service teachers know about search engines and search strategies. The results would then be used to determine if any changes in the curriculum were warranted.

Literature Review

Many people turn to the World Wide Web as a source of information. Whether searching for information on travel, health, entertainment, or academic resources, the Web has many attractive qualities: it is easy to access, it is "open" 24 hours a day, seven days a week, there is no need to venture out in the cold or rain, and there is privacy as people search for the information they need. Yet research among the general public has shown searchers looking for information on the World Wide Web have a difficult time developing search queries and using a search engine (Chen, Houston, Sewell & Schatz, 1998; Lazonder, Biemans & Wopereis, 2000). Searches tend to be simple (Spink, Bateman & Jansen, 1999) and Boolean operators are used infrequently and incorrectly (Jansen, Spink & Saracevic, 2000). Although time spent searching the Web is high (Sullivan reports 31% of Internet users utilize a search engine two to three times per week [Sullivan, 2001]), frustration levels are also high with 71% of respondents reporting they get frustrated when searching for information on the Internet (Sullivan, 2002). Frustration and poor search skills rarely lead to positive results. It is possible, though, that college students may have more experience with computers, and thus may be more successful at web searching than the general population.

A 2001 survey among U.S. college students who use the Internet for school-related assignments found 70% of respondents reported they were successful in finding what they seek most of the time (OCLC, 2002). These students have confidence in their ability to locate information for their assignments and they find the Web easy to use. The study, however, only polled those already using the Internet. Another survey conducted in 2001, found 91 percent of students rated themselves competent in accessing information on the Internet (Osika

and Sharp, 2002). Do all college students report such success? If so, is this self-reported data true in practice? Specific to the review of this course, are pre-service teachers adept at the skills that will help them find information on the Internet?

The purpose of this study was to establish a baseline of what undergraduate, pre-service teachers know about search engines and searching the Web prior to beginning a course on integrating technology into the classroom. The following research questions were addressed:

- What factual knowledge do these students have about search engines?
- When given questions, how do these students structure a search string?
- Can these students describe how a search engine operates?
- Does knowledge of search engines vary with the amount of time a person spends on the Web?
- Does knowledge of search engines vary with the age of the student?

The study examined three types of knowledge associated with web searching: declarative knowledge, syntactic knowledge, and semantic knowledge (Colaric, 2002). Declarative knowledge (Anderson, 1982) refers to understanding facts; in this case, facts about search engines. Syntactic knowledge refers to knowledge of the language units and rules when working with a computer system (Mayer, 1992); in this case, how to structure a search query using terminology the search engine can interpret correctly. Semantic knowledge refers to the user's understanding of the major locations, objects, and actions inside a computer system (Bayman & Mayer, 1988; Mayer, 1989).

Method

Participants

Potential participants were undergraduate pre-service teachers at a research university in North Carolina. All students enrolled in a pre-service teaching course on integrating technology in the classroom during three semesters (spring 2002, fall 2003, and spring 2004) were invited to participate. The technology integration course is required for College of Education students and is usually taken during the students' junior year. Completion of the surveys was voluntary and no incentive was provided for completion.

Instrument

The survey instrument was developed previously by one of the researchers (Colaric, 2002). Eighteen questions were used to gather information in four areas: personal information, declarative knowledge of search engines, syntactic knowledge of search engines, and semantic knowledge of search engines. The questions included short answer and multiple choice. Eight questions related to participants' personal information: age, gender, number of semesters completed at the university, major field of study, minor field of study, whether he/she owns a computer, approximate number of hours per day searching the Web, and approximate number of hours per day sending/receiving email. Five questions related to declarative knowledge of search engines. Participants were asked to answer questions about whether or not all search engines work the same way, whether search engines look at all web sites on the WWW, the difference in the amount of results obtained by using AND and OR, the name of the program used by search engines to gather web sites, and whether the search term used needs to match the engine's index in order for a site to be returned. All questions included an option of "I don't know". Three questions asked participants to write down what he/she would normally type into a search engine when looking for information on a given topic (syntactic knowledge). An example is: "Suppose you want to find web sites that describe the naval battles that took place during the Napoleonic War. What would you type into a search engine?" Two questions asked the participants to describe what a search engine would do when given a particular search query. Both queries contained information grouped in parentheses, as well as use of the Boolean operators AND and OR. These two questions assessed the participants' semantic knowledge of a search engine by asking them to describe what goes on inside the system when a command is executed.

Data Collection and Analysis

The materials were administered in the pre-service teaching course on integrating technology during its normal time and day in the first or second week of classes. Surveys were coded by the researchers and results

were analyzed using SPSS (Statistical Package for the Social Sciences). Demographic data was entered as the participants recorded; groupings were also established for age (traditional undergraduate age of 19 to 22 and age 23+) and use of the Internet (both Web searching and email; "low" group of less than one hour, "medium" group of 1 to 2.5 hours, and "medium-high" group of 3 to 4.5 hours, and "high" group of 5+ hours).

Questions for the declarative knowledge section were multiple choice with answers coded and entered into SPSS. For the syntactic knowledge section, a numeric score for each answer was recorded based on three categories: accuracy of concepts identified, inclusion of variable concepts, and accuracy of Boolean expression. For the semantic knowledge section, a numeric score for each answer was recorded based on six categories: understanding of OR as a join, understanding of AND as an intersect, inclusion of all terms from the query, understanding that the search engine is querying a database set, understanding of searching for a literal string of characters, and understanding that all search engines operate in a unique manner (Colaric, 2002).

Results

Demographic Results

A total of 355 students completed the survey over the three semesters. Participants ranged in age from 19 to 57 with a mean age of 23 (median age was 21). Eighty-three percent of the participants were female; seventeen percent were male. Semesters completed ranged from one to sixteen; the mean number of semesters completed was 8.5. Ninety percent of participants own their own computers. Fifty percent of the participants were Elementary Education majors; all participants were studying in some area of teacher education. Participants reported spending an average of 1.5 hours per day searching the Web (range of 0 to 10) and 1 hour per day on email (range of 0 to 8).

Comparisons between the different semesters were tested to determine if any variations existed; the groups were found to be similar in all areas. Cross tabulations were run to determine if students of traditional college age (19-22; $n = 270$) spent more time on email or searching the Web than students of non-traditional age (23+; $n = 84$). No significant differences were found.

Declarative Knowledge

The participants in the study appeared to have some prior factual knowledge of search engines. Most ($n = 355$; 64%) understood search engines operate differently from each other. Of concern are the 14% ($n = 49$) of participants who thought search engines were all the same and 22% ($n = 80$) participants who did not know if search engines were all the same.

A fairly high number of participants believe search engines peruse all sites on the Web ($n = 143$; 40%) while a number of participants ($n = 73$; 21%) are not sure about this idea. Forty-seven percent of participants ($n = 168$) understood that terms typed into a search engine need to match the indexed sites of the engine in order to be returned. Thirty-three percent did not know ($n = 115$) and 20% thought this was false ($n = 71$). Less than half of participants ($n = 162$; 46%) understood the Boolean operator OR retrieves more results than the operator AND. Twenty-five percent ($n = 89$) thought OR retrieved less results; 23% did not know ($n = 81$) and 6% thought OR retrieved the same amount as AND ($n = 23$).

There were no statistically significant differences between the age groups (19-22; $n = 270$ and 23+; $n = 84$) in relation to declarative knowledge. Nor were there statistically significant differences in the amount of time spent searching the Web or the amount of time spent on email in relation to declarative knowledge.

Syntactic Knowledge

When asked to construct a search string given a particular topic, participants tended to construct very simple queries with a mean of 2.9 terms per query. Scores for syntactic knowledge could range from 0 to 18; the mean score was 5.36. Twenty-five percent of participants used AND correctly in their search string; 1% used AND incorrectly. One percent of participants used OR in any of the three search strings. Twenty-seven percent of participants included stop words in their queries (common words which are ignored by some search engines or result in a high number of listings for other engines). Three percent of respondents included words not directly used in the search question; in all cases the words used were appropriate synonyms for the terms in the search question. Six percent of participants used phrasing with 1% of those using it incorrectly. Truncation, NOT, and search modifiers were not used by any participants.

There were no statistically significant differences between the age groups (19-22; $n = 270$ and 23+; $n = 84$) in relation to syntactic knowledge. Nor were there statistically significant differences in the amount of time

spent searching the Web or the amount of time spent on email in relation to syntactic knowledge.

Semantic Knowledge

Participants were generally not successful in describing their semantic knowledge, scoring a group mean of .47 points out of a possible 12 (standard deviation = 0.96; range = 1, 5). Two hundred and seventy-two participants (77%) received no points for this section. Participants who did respond were slightly more likely to include a description of AND as an intersect (15%) than include OR as a join (10%). Most participants (81%) did not include all of the terms included in the question, choosing instead to describe what the engine would do with just one or two terms.

There were no statistically significant differences between the age groups (19-22; \bar{n} = 270 and 23+; \bar{n} = 84) in relation to semantic knowledge. Nor were there statistically significant differences in the amount of time spent searching the Web or the amount of time spent on email in relation to semantic knowledge.

Discussion

Evaluation and revision are necessary in all successful academic programs; however, the success of programs that integrate technology goals and objectives hinge on the evolution of new technological innovations as well as student's technical skill subsets. As program, accreditation and state standards are revised to correlate with the demands of the 'technology age' it is imperative that the courses that support technology integration for educators rise to meet and exceed the needs of the populations that they serve. The purpose of this study was to establish a baseline of what undergraduate, pre-service teachers know about search engines and searching the Web in an effort to evaluate the course curriculum in place and determine if changes are necessary to effectively meet the goals and objectives of the course. A current review of the literature as well as an informal review of the course indicated that students may not have the prerequisite skills needed to engage effectively in the Web searching skills necessary for the planned course content.

Confirming instructor suspicions, a significant proportion of students, 36%, surveyed indicated that they did not have the declarative knowledge necessary to effectively use search engines. These students believed that search engines did not differ in function or were not aware of their function. The results from the survey further showed that most students had misconceptions regarding Boolean operators, the construction of search strings, and were generally not successful in describing their semantic knowledge of search engines. These results corresponded with the suspicions of the course instructors noted in informal reviews and evaluations of the course but contrasted with generally held assumptions of student knowledge of web searching held by faculty in the College of Education at large. Student time on the web and demographic variations did not demonstrate a significantly statistical difference in semantic, systemic or declarative knowledge which defeats the notion that time on task correlates with efficient searching. Instead, time on the Web perpetuates poor searching. These results support the need for course revisions in curriculum programs that integrate Web technology, particularly the Educational Technology course where the survey was conducted, by establishing a baseline of student knowledge. Without an understanding of students' prior knowledge, integration of new knowledge is bound to be less successful. In addition, course revisions will focus on a curriculum alignment that works with a triangulated approach to search engines and Web searching. Units of curriculum will focus on evaluating student's prior knowledge as well as incorporating declarative, semantic and systemic approaches to instruction of search techniques as a development of baseline skills necessary to achieve the goals and objectives necessary for program, accreditation and state standards.

Sound design principles require that course developers as well as instructors evaluate the effectiveness of course materials, curriculum and objectives. In a technology based pre-service teacher course, evaluations and curriculum revisions must reflect the innovations presented in technology as well as in schools. The results from this survey suggest that curriculum revisions include professional development with in the College of Education, development of CAI tutorials for student instructional supplement, implementation of modules within the course content focusing on the online research and methods.

The use of technology in a College of Education can not be narrowed down to one specific course. Effective instruction requires that students are given the opportunity to view various methods of integration, modeling and repetition in order for retention and meaningful learning to take place. In order to facilitate and model appropriate schemas of technology integration, staff development for all College of Education Faculty will be developed and made available. The development module will contain training on Internet research techniques, Boolean operations, and technology integration methods for University faculty that correlate with ISTE's NET-S standards. These development modules will offer faculty the opportunity, time and information necessary for implementation within their course curriculums.

Development of CAI tutorials as well as the implementation of curriculum modules within the technology service course have also been recommended based on the survey results. CAI tutorials will be developed and used as course supplements for College of Education faculty as well as faculty teaching the pre-service technology course. These tutorials in conjunction with the addition of a curriculum module of web research techniques will serve as the curriculum revisions necessary to meet the needs of both the students and faculty within the pre-service technology course. Faculty will continue to re-evaluate course curriculum and student needs by developing a focused evaluation instrument designed to measure the effectiveness of instruction based on the three areas of knowledge, Declarative, Syntactic and Semantic, and their effective outcomes on meaningful learning.

A triangulated approach to further research is recommended by the researchers to determine the global impact of the relationship between the declarative, syntactic and semantic knowledge relationships effect on instruction and learning. In order to develop CAI training and curriculum modules that are instructionally effective investigation will focus on the relationships between meaningful learning and the three knowledge domains. Further research will include the development of a pre-test/post-test instrument designed to evaluate the revision changes that will be implemented in the technology course to gauge knowledge acquisition changes. These results will assist in evaluating if student needs and course objectives are being met through the implementations made through the suggestions of this research. Lateral entry teachers as well as teachers in the k-12 field will also be included in continued research efforts to determine the effects of experience and effective implementation of web searching techniques and prior knowledge.

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Computer-Supported Communities for Novice Teachers : Needs Assessment and Design

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Abstract

Retention of novice teachers is a problem for school districts. Teacher induction programs are beneficial in increasing retention, but these programs take time, a commodity in short supply among novice teachers. Computer-based support has been suggested as an alternative resource. This paper reports the findings of a survey among novice teachers in the rural south-eastern United States as part of a needs assessment for developing support tools and programs for this population.

Introduction

Teacher turnover is an unfortunate problem in school systems across the United States. After five years, between 40 and 50 percent of all beginning teachers leave the profession (Ingersoll, 2003). High turnover rates create complex problems for schools including less stable learning environments for students (DePaul, 1998), diverted financial resources as time and money are spent in recruiting, hiring, and training replacements (Berry, Hopkins, Thompson and Hoke, 2002; DePaul, 1998), and limiting districts abilities to carry out long-term planning, curriculum revision and reform (Halford, 1999). Darling-Hammond (2003), in examining the issue of teacher retention, found four factors influencing teacher turnover: salaries, working conditions, preparation, and mentoring support in the early years. Mentoring support, in particular, has been shown to reduce attrition rates by more than two-thirds (NCTAF, 2003).

One method of mentoring that has proven beneficial is teacher induction programs. Such programs present a structured process of teacher learning in the first few years the teacher is in the classroom (Berry, Hopkins, Thompson and Hoke, 2002). The goal is to assist novice teachers in developing a wider repertoire of teaching strategies (Schafer, Stringfield, and Wolffe, 1992), stronger classroom management skills (Educational Resources Information Center, 1986), and strategies for dealing with behavior and discipline problems more effectively (Moir and Bloom, 2003). Components of successful induction programs include: professional development (Feiman-Nemser, 2003; Hinds, 2002; Johnson and Kardos, 2002; Wong, 2002); interaction with other teachers (Berry, Hopkins, Thompson and Hoke 2002; Brewster & Railsback, 2001; Wong, 2002); principal/administrator support (Brewster & Railsback, 2001; Johnston and Kardos, 2002; Wong, 2002); new teacher assessment (Berry, Hopkins, Thompson and Hoke 2002; Huling-Austin, 1992); reduced responsibilities (Berry, Hopkins, Thompson and Hoke 2002; Renard, 2003; Voke, 2002); trained mentor support (Berry, Hopkins, Thompson and Hoke 2002; Brewster & Railsback, 2001; Darling-Hammond, 2003); and school/university collaboration (Berry, Hopkins, Thompson and Hoke 2002; Brewster & Railsback, 2001; Hinds, 2003). In addition to improving retention, induction programs have been shown to influence teaching practices, increase teacher satisfaction, and promote strong professional development and collegial relationships (Voke, 2002).

Novice teachers have constant questions and concerns. They may participate in scheduled formal professional development sessions as part of their induction program; however, the content of the workshops may not be of immediate use to the teachers and may not answer the questions that plague new teachers everyday. Getting answers to the many questions they have is also impeded by the novice teachers' concern of how their colleagues will perceive them and their ability to teach after asking the questions (Stapleton, 2002). Once they decide to ask someone, novice teachers often find that they lack free time needed to ask their question, or the time they have does not coincide with the time that knowledgeable teachers are available to assist them (Stapleton, 2002).

Computer-supported interaction may be an appropriate method for novice teachers to obtain the support and information they need on a daily basis. Listservs and email (Ersinnan and Thornton, 1999) as well as video conferencing (Thomson and Hawk, 1996) have been used to provide feedback to teachers. Case libraries have also been developed to assist in learning about classroom practice (Jonassen, Wang, Strobel, and Cernusca, 2003). But these represent isolated tools. The integration of a number of tools that could serve as a

virtual community for novice teachers may be beneficial in providing support when it is needed. This timely, multifaceted support may help to increase the retention rate.

In 2002, the Golden LEAF Foundation awarded East Carolina University's College of Education funds to develop a model of teacher recruitment and retention for eastern North Carolina. One product of the funding was the formation of the Golden LEAF Educational Consortium (GLEC). GLEC is a partnership between East Carolina University, University of North Carolina at Pembroke, Elizabeth City State University, Edgecombe Community College, and eight county school districts: Bertie, Edgecombe, Greene, Jones, Halifax, Perquimans, Robeson, and Washington. All of these counties represent rural districts. GLEC was charged by the Golden LEAF Foundation to develop, implement, and evaluate a model of teacher recruitment and retention and to create a toolbox of strategies that school systems could use to recruit and retain teachers. One strategy proposed by GLEC was the development of a virtual community for novice teachers. Prior to development, a needs assessment was implemented to determine if novice teachers in rural areas have acceptable access to the technology needed, and to determine the concerns that were most evident to teachers during the first years of teaching. This study reports the findings of a survey among novice teachers in rural north-eastern North Carolina as part of a needs assessment for developing support tools and programs for this population.

Method

Participants

Participants included novice teachers in rural north-eastern North Carolina who were included in the Golden LEAF Educational Consortium (GLEC). For the purposes of this study, novice teachers were defined as teachers in their first three years of teaching; however, there were a small number of participants who were in their first year of teaching in the county but not their first three years of teaching. The eight participating counties included: Bertie County Public Schools, Edgecombe County Public Schools, Greene County Public Schools, Jones County Public Schools, Halifax County Public Schools, Perquimans County Public Schools, Washington County Public Schools, and the Public Schools of Robeson County.

Instrument

The survey instrument contained 43 questions. The first 11 questions were demographic questions dealing with age, gender, ethnicity, teaching and educational experience, type of teaching license and amount and type of orientation received. The next 12 questions asked about the support the new teachers received from their principals, mentor teachers, and New Teacher Coordinators (ILT Coordinators), the biggest challenges they had, the types of professional development they received, how much of their own money was spent, how much time they spent, and if they were planning on returning to teach the next year. The next five questions asked about strategies implemented by GLEC and classroom management challenges. Ten questions were asked to ascertain novice teacher access to and use of computer and computer related resources. The last three questions asked new teachers to give suggestions for improving GLEC strategies, mentor teachers support and new teacher induction.

While the survey questions dealt with a number of issues, only those questions pertinent to the technology needs assessment are addressed here. Specifically, this article focuses on novice teachers' answers to classroom challenges, the preparedness of the teachers to handle those challenges, their sources for information and advice, their satisfaction with the answers they received, and their access to technology at home and in the school.

Data Collection and Analysis

In spring 2003, surveys were sent to the new teacher coordinators (ILT Coordinators) in the eight participating counties. The ILT Coordinators distributed the surveys to the novice teachers during a support meeting. The completed surveys were then returned to the GLEC Principal Investigator by the ILT Coordinator. Of the 370 surveys distributed to novice teachers, 225 returned the surveys for a response rate of 61%. Surveys were received from all eight counties participating in the program. Surveys were coded and results were analyzed using SPSS (Statistical Package for the Social Sciences).

Results

Demographic Results

Forty-three percent of the respondents were age 21-25; 19% were 26-30; 23% were 30-39; and 15% were 40 or older. Seventy-four percent of respondents were female; 26% were male. Fifty-six percent reported their ethnicity to be Caucasian; 30% African-American; 9% Native Americans; 4% Hispanic; 1% did not respond. Ninety-five percent of the respondents had between one and three years of teaching experience. Fifty-three percent of those surveyed entered the teaching profession through an alternative licensure program. The respondents were divided between elementary (45%), middle (31%), and secondary (24%) schools.

Classroom management and discipline problems rank at the top of the novice teachers concerns at 47.5%. (see Table 1). Specific examples of problems included talking during class instruction, keeping the class on task, teaching and disciplining students within the short instructional time, following through on discipline, dealing with disrespect and student attitudes, and lacking principal support on discipline decisions. Planning and teaching to the state standards (15.5%), meeting the needs of students (13.6%), and school policies and procedures (12.3%) were a distant second, third and fourth. Other challenges listed by new teachers included lack of support/assistance, time, working with parents/staff, paperwork, amount of requirements/responsibilities, lack of resources, obtaining certification/licensure, and planning and teaching for state assessments.

Table 1 *Greatest challenge as a new teacher*

| | Percentage |
|---|-------------------|
| Classroom management/discipline | 47.7 |
| Planning and teaching to the state standards | 15.5 |
| Meeting needs of students | 13.6 |
| School policy procedures | 12.3 |
| Lack of support/assistance | 9.5 |
| Time | 8.6 |
| Working with parents/staff | 8.6 |
| Paperwork | 8.2 |
| Amount of requirements/responsibilities | 5.0 |
| Lack of resources | 5.0 |
| Obtaining certification/license | 4.1 |
| Planning and teaching for the state assessments | 4.1 |

The follow-up question, "Did you feel prepared to handle these challenges?" was also asked of the new teachers. Fifty-three percent of the novice teachers answered yes, 20.9% answered no and 15.2% answered "somewhat"/"sometimes". Other responses to this question indicated that after receiving support from their mentor and/or principal, they did feel prepared. Others mentioned the difficulty they had at the beginning and their improvement as the year progressed. One new teacher mentioned the difficulty in applying his/her knowledge and theory into a classroom setting while still remaining positive. At least one new teacher alluded to the fact that he/she thought he/she was prepared "until I realized I was not."

When asked where the new teachers went to get answers to their questions, the respondents most often turned to experienced teachers (91%) (including their assigned mentor teacher [87%]) and administrators (72%) for answers to their concerns but they also used print resources (43%), teachers at other schools (39%), family members (32%), fellow novice teachers (30%), friends (29%), online resources (27%), and former classmates (20%) and professors from college (17%). (see Table 2).

Table 2 *Resources for answers for the new teacher*

| | Percentage |
|----------------------------------|-------------------|
| Experienced teacher at my school | 91.4 |
| Assigned mentor teacher | 87.3 |
| School administrator | 72.4 |
| Print resource (book, manual) | 42.5 |
| Teacher at another school | 38.9 |

| | |
|---|------|
| A family member | 32.1 |
| A new teacher at my school | 29.9 |
| A friend | 29.4 |
| Online resource | 26.7 |
| Someone I went to college/university with | 19.5 |
| A professor from my college/university | 16.7 |

Ninety-one percent of respondents were satisfied with the answer they received when consulting those resources.

Ninety-two percent of respondents indicated that they had daily access to a computer and 82.5% indicated they had computers in their home. Ninety-two percent have Internet access on a daily basis; 77.4% have Internet access in their home although 73.1% of respondents indicated that access from home was with a dial-up modem connection.

In response to the question, "If you had access to an online database of cases with solutions based on common classroom problems, how frequently would you access it?", 37.9% indicated they would access it weekly (see Table 3).

Table 3 *Likelihood of accessing an online database of cases*

| | Percentage |
|--------------|------------|
| Weekly | 37.9 |
| Occasionally | 28.0 |
| Monthly | 15.9 |
| Daily | 13.1 |
| Never | 5.1 |

Discussion

The high percentage of novice teachers who listed classroom management as their biggest concern in an open-ended question indicates how heavily it affects novice teachers. Classroom management concerns and practices should be integrated more into pre-service education to better prepare beginning teachers to deal with this concern. Notifying principals and administrators of this concern may assist them in providing guidance and advice for novice teachers. Additionally, mentor teachers need training so they are aware of the challenges faced by novice teachers and have strategies to help these novice teachers through these challenges. It is encouraging that many of the overwhelmed novice teachers finally found they were able to handle their challenges after receiving support from their mentor teacher and/or their principal.

It is also interesting that when reporting resources novice teachers used to answer their questions, they listed experienced teachers (91.4%) in their school over their mentor teachers (87.3%). Possible reasons for this difference include availability of the experienced teachers, the lack of concern of evaluation by the experienced teacher, and/or new teachers seeking out the experienced teachers they feel could best answer their questions.

It is encouraging that 91% of respondents were satisfied with the answers they received from the various sources that they consulted. These teachers are primarily turning to resources within their schools (teachers and administrators) but they are also not restricting their search to that venue. Both personal and written resources play a role in assisting these teachers as they become proficient at their profession.

Computer access appears adequate although detailed information on the age and software on the computer was not gathered due to constraints on the number of questions that could be asked on the survey. The dependence on dial-up modems for Internet access indicates that high-bandwidth media such as video and audio may need to be kept to a minimum. The possibility of accessing an online database of cases dealing with common classroom problems was welcome by the group with only 5.1% stating that they would never access such a system.

Conclusion

Given the high rate of turnover among novice teachers all avenues for increasing retention should be explored. This study indicates that beginning teachers have many questions, particularly about classroom

management, but that they are finding the answers they need through a variety of sources. Novice teachers most frequently turn to experienced teachers to answer their questions. For this reason, it may be helpful to use experienced teachers to build an online database of cases dealing with common classroom problems. In this database, experienced teachers could talk new teachers through certain situations and model for them the thought processes they used in deciding how to react to the situation. Placing this information online would extend the opportunity for finding answers beyond the time spent in the school building. Novice teachers could find the answers to their questions when it is convenient for them, not when they can have access to the experienced teacher. The online database would also give new teachers the opportunity to get advice from several teachers, not just the teacher that they could find at that moment. Building a prototype system and testing it with the population would be the next step in the process.

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Learning from Experience, for Experienced Staff

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Abstract

Business needs in multinational corporations call for courses that involve problem solving and creating and sharing new knowledge based on workplace situations. The courses also need to be engaging for the participants. Blended learning at Shell International Exploration and Production involves these kinds of outcomes in courses designed around a workplace-learning model. Employees use a Web-based system to make contributions based on their own work experiences in preparation for a face-to-face session. These contributions then feed into classroom sessions that involve collaborative learning where the workplace problems and experiences of the participants are the focus. In this presentation one course is highlighted that demonstrates a number of game-type activities based on the participants' own workplace experiences. Implications for other courses outside of the Shell context are discussed.

Introduction and Problem Statement

In the workplaces of professionals in multinational corporations problems and challenges continually arise that involve creating new solutions and constructing new knowledge, and indirectly involve improving communication and understanding among colleagues who come from and work in different parts of the world. Key strategies involve capturing and sharing both the explicit and tacit knowledge of the experienced staff. Such learning can be either formal such as via participation in structured courses, or informal such as via mentoring and coaching in the workplace, experiential learning (Brookfield, 1995) and participation in "learning communities" (Wenger, 1998).

Both formal and informal approaches have their limitations as well as strengths. Among the strengths of structured learning are guided opportunities to learn while interacting with a new set of peers, broadening the learner's contacts beyond his or her workplace colleagues. Among the strengths of informal learning in the workplace is the anchoring of learning in problems and situations that are real and relevant to the learner and the business (Billett, 2001; Collis & Margaryan, 2003). Collaborative learning within courses that emphasize authentic work-based activities can integrate both these sets of strengths (Lim, Tan, & Klimas, 2001). Collaborative learning can also be structured to involve team-based games and competitions, as methods for engaging and motivating the learners. In this paper we describe a form of blended course emphasizing collaborative learning and learner engagement applied to work-based activities and illustrate it via the detail of one particular course for technical professionals in the oil industry.

The questions addressed in this paper are:

- Why is learning involving engaging work-based activities an appropriate response to key needs in a multinational organization?
- What does such a course look like in practice?
- What are the participants' reactions to such a course and the implications for the instructor?

Learning for Experienced Professionals in a Multinational Corporation

This section focuses on the importance for corporate learning of being directly relevant to business and workplace needs and at the same time being engaging and motivating to the participants.

Learning related to business needs Organizations often do not see a direct relationship between business results and their investments in formal corporate learning because much traditional formal learning is limited in its transfer to the daily workplace (Smith, 2002). Partly this is because formal courses too often focus

on content delivery rather than on building upon the experiences of the participants for peer learning and problem solving (Billett, 2001). In contrast to content delivery, corporate learning should be characterized by knowledge sharing, capturing experiences from the participants, reusing them, creating new knowledge, and recognizing and solving workplace problems, in a process-oriented, collaborative manner (for a review, see Collis & Margaryan, 2003). These call for learning processes that are better fostered in collaborative learning situations focusing on work-based situations rather than in courses characterized by content delivery (Seufert & Seufert, 1999).

When supported by network technology, courses based on collaborative learning centered around real workplace problems and opportunities can begin or even be carried out in entirety when the participants are still in their workplaces. Participants can be directed to find out about the experiences of others in their workplaces and share them with others in the course via a course Web environment. These submissions can then be used as the basis for further collaborative activities if the participants come together in a classroom setting. Collaboration occurs in a variety of ways: among the course participants individually, within teams of participants with similar specialized experiences, or between teams with generically similar problems but from different backgrounds. Within the workplace, collaboration can also involve the participant's peers and supervisor and relevant others in the corporation. All these need to be integrated by the course instructor so that sharing and learning occurs. This approach to collaborative learning involves the use of Web-based course environments that include groupware tools such as shared archives, and tools for structuring, monitoring, and motivating overall course processes.

Learning as engaging

Although professional learners acknowledge the importance of applying learning to improve their own workplace performance and also to eventually have a business impact, it is still important that learners feel personally engaged and motivated for individual learning activities. This is particularly an issue when part or all of a course takes place with the participants staying in their own workplaces; the dynamics of a well-designed classroom session, with peer interaction and the stimulus of being together in the same place, are harder to achieve when participants are fitting their learning activities around work pressures. Thus it is valuable that learning activities focused on the workplace occasionally involve elements of competition or team spirit or even moments of fun. Harris (1991) identifies a number of ideas for motivating learners including: (a) focus on teams and teamwork; (b) provide rewards, have "winners" and near-winners; (c) have learners participate, be actively involved, and make meaningful personal contributions that are valued by others; (d) stimulate learners to find and defend their own solutions perhaps within a timed competition among teams; (e) make learning visual and tactile, have things to look at and to handle; (f) stimulate tangible thinking as well as creativity; and (h) maintain a sense of energy and dynamism.

In the literature, there are a number of references related to bringing motivational elements into classroom sessions for adult professionals through game-type, motivating activities and also other discussions about how to design online learning to be motivating. Smith and Drakeley (2004) for example assume that Web-supported learning means an individual learning via interacting with a computer, and thus call for program designs within the software that involve elements such as game-type assessments, animations, and real-life stories. Sometimes motivation is brought in through the way a course is publicized in the workplace. Bailey (2003) describes a health-care setting in which employees were motivated to succeed in a mandatory online course through promotional strategies in the workplace such as posters and displays in public areas such as cafeterias, break rooms, meeting rooms, corridors and hallways; and by providing buttons to all successful participants and making the wearing of the buttons a focus of in-house communication campaigns. However, bringing a motivating environment into work-based courses that partially take place while participants are still in their own workplaces is not yet much discussed. In particular, designing a course so that Harris' ideas for motivating learners are combined with the need to deal with serious problems in a professional workplace is a challenge.

To integrate these ideas of making learning business relevant and making learning engaging, new course-design principles are needed. On one hand, these need to represent good design for any professional learning. Thus fundamental principles of good learning for adult professionals should apply. Merrill (2002) has identified five "first principles of instruction", which fit well with workplace-learning situations. He argues that "Learning is promoted when:

1. Learners are engaged in solving real-world problems.
2. Existing knowledge is activated as a foundation for new knowledge.
3. New knowledge is demonstrated to the learner.

4. New knowledge is applied by the learner.
5. New knowledge is integrated into the learner's world." (Merrill, 2002, pp. 44-45)

Merrill's principles aim clearly at business relevance. On the other hand, in order to add the engagement dimension, work-based activities related to real workplace problems should also be designed to involve aspects such as those identified by Harris (1991): team competitions with rewards, winners and near-winners; learner participation, active involvement, and building on personal contributions from the participants. Participants should find and defend their own solutions perhaps within a timed competition among teams. Tangible thinking as well as creativity should be stimulated and a sense of energy and dynamism should be maintained, both for portions of the course carried out within the workplace but also within a classroom component. An example of how this is being done in practice is described next.

Work-based Courses at Shell International Exploration and Production

Professionals in multinational organizations gain important practical experience and insights over time that can be used as the basis of engaging and business-relevant learning activities. In a large organization such as Shell International Exploration and Production (Shell EP), employees with the same general job title, such as *Production Technologist*, can vary considerably in their practical experience, depending on the part of the world in which they work. After five to ten years of experience in the company, these professionals often turn to the Shell EP Learning & Leadership Organization (LLD) for a course that will give them technical re-energizing and updating. An important issue for Shell EP LLD is how to make these courses meet the particular needs of the individual participants including their need for engaging learning while at the same time address strategic business goals such as knowledge sharing and building on experience. Shell EP has been developing and using different models of blended learning that have these issues as focuses. More than 50 courses have been redesigned and more than 80 distinct course events have run within Shell EP that demonstrate different ways that this model operates in practice (Collis, Margaryan, & Cooke, 2004; Collis & Margaryan, 2003).

Approximately half of the redesigned course events involving work-based learning supported by technology use a blend that combines a component in the workplace with a classroom component; the other half use only the workplace component. The workplace component is not "e-learning" but rather a series of work-based activities involving collaboration with others in the workplace or course and regular submissions into the course Web environments. The submissions, which can be graded if appropriate but always receive at least written feedback directly into the Web site, can be used as discussion points and resources by the other participants. Technology is thus important to facilitate this approach. A Web-based course-management system such as those commonly used in universities is a key tool (Collis, 2002). This system combines the benefits of a learning-content management system for reuse of participant submissions with tools for collaboration, sharing, and communication, all integrated in practice under the leadership of an instructor who him/herself has many years of experience as a technical professional in the company.

The Applied Production Technology course

The course "Applied Production Technology" is a course for Production Technologists in the oil industry with five to ten years' experience in the company. They will have developed different types of expertise depending on the situations in which they have worked, although all involve skills related to the technologies that are used to bring oil from where it is found to production. Production Technologists deal with problems involving well engineering, the planning of production volumes and capacities, the design of well/reservoir interfaces, sand control, artificial lift methods, and production-system optimization, among others. The following sections describe the general design of the course and give examples of the engaging aspects of the work-based learning activities that link the workplace to the classroom and build on the experience of the participants.

Course design

The course begins with a three-week period of interaction and submissions via the Web-based course environment while participants are still in the workplace, through a variety of activities in which participants identify their own workplace needs as well as their own experiences that will be relevant to others in the course. This is followed by a two-week classroom session in which frequent team-based activities occur based on the submissions that were made by the participants when they were still in the workplace. These activities are engaging in each of the ways that Harris (1991) describes. The Web-based system continues to support the interaction and reuse of submissions. During the classroom session, differences in experience among the participants are capitalized upon in game-type activities.

When participants begin the course, they receive the URL of the course Web environment in which a large number of course resources are available and in which each participant has access to his or her own personal biography page. All course resources and activities, as well as submissions and feedback messages from the instructor, are integrated into a “Roster” (see Figure 1).

| Row | Section | Materials | Assignments | After the session |
|-----|---------|---|--|-------------------|
| 1 | 1.0 | Course Welcome-Read this First! | Biography-All participants | |
| 2 | 1.1 | Course Work - Read This | Learning Agreement | |
| 3 | 1.2 | | Request Course CD | |
| 4 | 1.3 | Classroom Agenda | | |
| 5 | 1.4 | PT Quiz Bowl Questions | | |
| 6 | 1.5 | PT Competencies | Specialist Areas | |
| 8 | 1.6 | P264 Access | | |
| 9 | 2.0 | Completion Type Selection | CTS Challenge | |
| 10 | 3.0 | PSO and PL | PSO Challenge | |
| 11 | 3.5 | Production Links | Prod Link Problem | |

Figure 1. Portion of the roster of the Web environment supporting the production technology course

In Figure 1, the icons to the right of matrix cells with activity instructions indicate links to all the submissions of the participants as well as the feedback given to those submissions by the instructor. The instructor can determine if the participants can see each others' submissions or not.

Via a “News” page and a “Course Info” page as well as the “Roster” the participants can read information about the course and a general welcome from the instructor. An excerpt:

“Think of the course as a way for you not only to learn but to demonstrate that you are a real production technologist. The contributions that you make in the course will help others (perhaps through the magic of technology, for years to come). For this new version of the course, I want to get away from having me and the other instructors lecture to you for hours on end. At this point in your career as a production technologist I think you deserve something more fun. So, I am going to try to keep you very busy and working hard. I will also give you some additional incentives.. Your “carrot” is that at the end of the course, I will reward those people that have done well on the course with a certificate that will say something nice about their accomplishments, their team abilities and their attitudes in the course. Your “stick” is that the course will have several competitive team events. You don’t want to embarrass your team, do you? No, I didn’t think so... Thus here is your checklist of pre-classroom activities to complete before you arrive...”

In addition to five-ten hours' worth of reading materials and one activity involving an orientation to the Web-based environment, 14 work-based activities are then described, each requiring a submission from the participant into the Web environment.

Work-based learning activities

Within the first week of being introduced to the course Web site, each participant is shown a list of the five main specialist areas involved in the Applied Production Technology course, and asked to indicate to the instructor the area or areas in which he or she has somewhat specialized knowledge or is otherwise quite experienced and knowledgeable, but also the area in which he or she most needs new or more knowledge. The instructor uses this to group the participants into different sets of “specialists” that are called upon

throughout the course. The “specialists” will be providing questions to be answered by experts, short stories about their own experiences, and will contribute data for class problems. The specialist roles come up in many of the different learning activities of the course. Several different types of these activities are described next. Each has two parts: a portion done while still in the workplace, and a portion done in a team environment during the classroom component of the course.

Completion-type selection challenge: In production technology, completion design involves the steps and decisions needed to minimize the unit technical costs of a well. It involves many aspects of well design. Some course participants will have had more experience than others at completing the design of a well. These “specialists” for this activity and submit via the course Web site a problem related to completion design that they have been involved with, as well as their solution. A Word template is provided to ensure that the necessary information is provided, such as characteristics of the rock formation, fluids, and reservoirs involved. Then in the classroom session, one of the submitted stories is chosen and the “specialist” sits with the instructor to describe the situation to the other participants. The other participants break into teams and have a certain amount of time to construct and present a solution. The specialist and the instructor score the results and give feedback. This is repeated for each of two additional specialist submissions selected by the instructor. The team with the highest score at the end of the three rounds is the winner.

Guidelines for the activity include: Allow questions for clarification at the start and during the team work but brief the “specialist” not to describe his solution in any way. The “specialist” who contributed the challenge may have some difficulty deciding which team has the best reply as their solutions will vary considerably so the instructor has to take the lead in the scoring. Score each presentation relative to the previous ones so that a sense of excitement builds. Therefore do not score the first one too highly. Allow discussions and comments among the teams as each challenge is presented. Some of the best ideas come from this.

Production Technologist Quiz Bowl: Via the course Web environments, participants read the following: “How much PT knowledge do you have? These questions are an example of those that I will quiz you with during the PT Quiz Bowl sessions during the classroom component of our course. They are derived from materials in P264 (a course the participants had already taken) and this course. You will see many of them again when I ask your team these questions during our classroom sessions. Test yourself now and see how many you can answer. Use this also to determine your weak areas so that you know which parts of the course to concentrate on most”. Attached to this is a spreadsheet with about 60% of the potential questions. The questions are general-knowledge sorts of questions with well-defined answers (“Name five different types of sand control”). In the classroom sessions, the instructor creates a feeling of a television quiz show, building up a sense of excitement about the Quiz Bowl. Beamed on the wall is a large title (see Figure 2). The instructor sits on a stool to the right of the title screen and acts as the quiz-show presenter. Each of the teams has its own session, as the team “in the hot seat” for the Quiz Bowl.

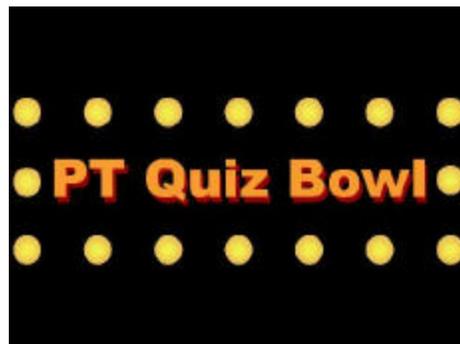


Figure 2. Creating the atmosphere for the Quiz Bowl sessions

In a rapid-fire manner, the instructor/quizmaster gives a question to each member of the team. If that person can answer within a timed count-down, then the team gets two points. If the person called upon cannot answer but someone else on the team can, then the team scores one point. The scores are tallied after each question, to build up the excitement. There are 20 questions in all, so a total possible score of 40 per team. After each team has had its session (about an hour each), the winning team is rewarded. The purpose is to encourage

a general-knowledge review in a fun atmosphere in which those with specialist knowledge about a question can help their team to earn at least one point. During each session, someone has the job of keeping a “parking lot” of issues needing explanation after the Quiz Bowl session is finished.

Peer assist and peer review challenges: This activity is based on the premise that each experienced person wants to have a chance to share what he or she knows. Previous techniques requiring a presentation from each participant took too much time (there are approximately 25-30 participants per course cycle) and there was little chance for discussion. Prior to the classroom sessions, each participant submits a problem that is challenging him or her in the workplace. The instructor gives the following instructions via the course Web site: *“The problem you bring must not be trivial and should not be beyond the scope of your role in the business to solve. You must understand the problem very well as you will need to explain it well. At least three weeks before the classroom session, submit your Peer Assist problem in the Web environment, with enough of an explanation that I can understand the problem You may provide as much detail as you like (as an attachment if you prefer). All participants will be able to see everyone else’s Peer Assist problem.”* During the classroom sessions, the teams meet together, with each team member explaining his or her problem and the others giving challenges and support. Brainstorming techniques are emphasized: The instructions as given in the Web site are: *“Each person takes five minutes to write down any brainstorm ideas for solving the problem on sticky notes. Then an open session starts with all contributing their suggestions and working on the solutions. Keep things moving. Be respectful. No ideas are bad ones. Maintain an environment of friendly challenge and useful support.”* If multiple viable suggestions are found, they can be compared by placing them on a matrix grid (see Figure 3).

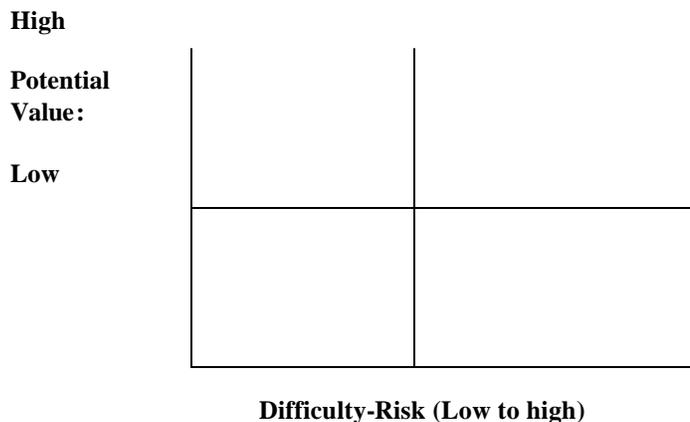


Figure 3. Matrix for comparing peer-assist suggestions

Each team posts its findings in the Web environment so that they can be referred to later in the actual workplaces of the participants. Each participant submits a reflection to the course Web environment that discusses *“(a) a summary of the help you received from your peer assist, (b) your new thoughts on the way forward, and (c) any points for improving the process for your next peer assist.”* During the peer assists, approximately one in three students comes up with a fresh idea or an actual solution. The participants also practice key principles of peer assists and reviews: the value of proper brainstorming techniques, of giving and accepting peer help, and the value of external perspective. The participants are very pleased with this activity.

PT Live! : The instructor set a goal of removing all the lectures from the classroom sessions because in his opinion, *“lectures are not very interactive; for experienced staff there is very little certainty that the content is at the right level; the participants are not at all responsible for success; when given by a variety of guest lecturers the quality of the lectures varies considerably; and the instructor had very little ability to influence the guest lectures”*. Thus, instead of giving an intensive lecture, each guest lecturer makes his notes available ahead of time via the course Web environment. The instructor invites the participants who are serving as “specialists” for the topic to submit questions to the guest lecturer ahead of time, again via the course Web environment. *“In order to call yourself knowledgeable about a topic, you are supposed to be able to carry on a conversation with an expert in the field. Have you ever seen one of those interview shows on television? Well that’s what you are*

going to do yourself. You are going to interview Mr. X when he comes to one of our classroom sessions. Prepare a set of questions for the interview. These need to be really good, interesting questions. They need to be 'open' questions, meaning the answer is not a one-word answer. [some examples are given]. You will need about 10-15 good questions for the topic. Submit these via the course Web environment at least three weeks before the classroom session. We are going to provide these questions to the interviewee." The classroom session is run like a television talk show, where the instructor serves as the host. The guest is given the opportunity to start with a 10-20 minute overview of the topic, with no questions during this time. Then the host controls the entire flow of the session just as a talk-show host would: basing the interview on the questions submitted in advance by the "specialists", working these into a logical flow and balance. There are short "commercial breaks" in which music is played and the instructor/host can decide whether to continue with a question or wrap up the question to move to other questions. "Call-in questions" from the audience can also be possible. The objective is to have the participants and the guest experts think about the topics ahead of time, get out of the experts what the participants want to know via the opportunity for much deeper questions than would occur during a traditional lecture, keep the lecturing short, and potentially create re-usable content.

Creating workplace assignments for an introductory course: Production technologists in Shell EP first take a previous course (called P264) before they can enrol in the Applied Production Technology course. The purpose of the Creating Assignments activity is to re-study the topics and processes in P264 course, and in particular the new set of workplace activities that have been created and are available in the P264 Web environment, and then do the following: "*Have a look at these workplace assignments for P264. Do they look familiar? I hope they do as you should have done several things like this in your career so far. And these relate directly to the competence profiles of production technologists. There are the assignments we have made for the new P264 course. Now then. Let's help out the PT 'newbies' in P264. Pick one of the assignments and write: (a) the three worst mistakes people make doing this type of task, (b) the three best tips you can think of to help them do the assignment, and (c) at least one additional thing you want to tell them about doing this sort of task. Do your best as I intend to use your advice on the P264 workplace activities as content for that course.*" This activity, while not in a game spirit, involves creativity and engagement through being able to use one's own experience as input that will be studied by others. In addition, the assignments for the P264 are enriched with experienced-based insights, beyond what the instructor may have had time to add to the write-ups of the activities.

These are only some of the work-based activities in the Applied Production Technology course. In all of the activities certain characteristics are present. The activities allow for differentiation in the ways that participants contribute to the course. Repeatedly, their different backgrounds and experience bases are tapped in order to strengthen the process of learning from each other's experience. The activities done before the classroom session are not "self-study e-modules" but instead tools by which participants already go deeply into the course topics and themselves prepare many of the resources that will be built upon during the classroom sessions. The submissions of the participants are not only reused during the classroom sessions but are available via the database underlying the course Web environment for reuse as examples in other course sessions or even in other courses or for informal coaching. Participants come from many different locations worldwide, including Nigeria, Oman, and the UK and USA and thus bring in experiences and problems that vary geographically. All activities focus on real workplace situations. All include engaging aspects that motivate and stimulate learning.

Reactions and Implications

The approach used in the Applied Production Technology course is highly appreciated by the participants. In course evaluations, participants consistently give the course and the instructor high ratings. In an evaluation of the course design, using Merrill's (2001) first principles and the extensions of those principles to bring in strategic goals relating to engaging work-based activities, the course ranks very highly. Particular strengths of the course are in relation to Merrill's first principle, "Learners are engaged in solving real-world problems", and Merrill's fourth principle, "New knowledge is applied by the learner." In terms of Harris' guidelines for engaging learners, the course is a strong example of learner participation, active involvement, and building on personal contributions from the participants. On many occasions a game-type or competitive situation is involved, between teams. Teamwork is stressed, as well as creative answers to tangible problems. In terms of Web-site design, the more-than 100 objects in the course Archive are well organized and the instructor makes good use of the different communication possibilities in the site for comments to the entire course in the News and to individuals via feedback messages. The course environment itself is reused for different cycles of participants, with only minor tailoring when needed.

The basic approaches to work-based activities and engagement are not specific to production technology. They can be applied in any course for experienced professionals, particularly when those professionals will bring with them many different sorts of experiences within a general job category. The approach, however, requires new skills of the instructor. The instructor must focus more on activity design than on content presentation. Also, the instructor must be experienced and broadly based in his or her discipline in order to respond helpfully and critically to the great variety of workplace experiences that will be reported by the participants. The instructor needs to develop a communication tone to use in the Web site that sets the atmosphere for team work as well as individual contributions. And, new for many instructors in the corporate context, the instructor must become proficient at making use of a Web-based course environment system as the interface among all aspects of the course during the portions that occur when participants are in the workplace. The instructor also needs to develop techniques for managing his or her own time, in that the large number of submissions coming into a course Web site require timely feedback but at the same time cannot be allowed to overwhelm the instructor. The instructor will also need to interact more with workplace supervisors of the participants, not only because participants will need time and space to carry out their pre-classroom activities but also because many of these activities may require use of data and experiences from the workplace that will have to be cleared by the supervisor or may require interpretation by others with experience. All of this requires new approaches to course design, such as have been developed at Shell EP (Bianco, Collis, Cooke, & Margaryan, 2002).

Thus learning from experience, by experienced staff involves new approaches to course design, new skills of the instructor, and new kinds of work by the participants. The results, in the opinions of those involved in Shell EP courses such as Applied Production Technology, are well worth the investment.

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Conducting a Qualitative Return on Investment: Determining Whether to Migrate to Blackboard™

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Abstract

In 1998, a state university received grant funding to convert their Special Education Blindness and Visual Impairment graduate degree program to an online format. At that time, commercial web course management systems were not accessible to blind and visually impaired users. As a result, grant designers developed a custom, accessible platform, which led to accessibility standards for online courses and to an award-winning design and interface. In 2002, the university licensed Blackboard™ and encouraged the migration of all online delivered courses to this standardized system. After determining that the newer version met accessibility standards, the instructional design staff conducted a qualitative return on investment analysis to evaluate whether the migration to Blackboard™ would cause losses in instructional and interface quality. This paper explores the process for developing a qualitative return on investment and how the benefits and tradeoffs were analyzed related to maintaining an internally developed system versus migrating to Blackboard™.

Introduction

Traditional methods for analyzing whether a decision is ultimately a good decision have focused on measures that can be quantified and that ultimately contribute to a financial bottom line. However, in environments that may not be driven by financial bottom lines – educational settings, non-profit organizations or grant activities within a higher education institution – such methods for analyzing an important decision fail to capture the real variables in the decision. Furthermore, increasing demand for attention to assessing social impact of decisions (Barbour, 1993; Kaufman, 2000) is driving the need for newer methods that take into consideration a broader array of variables and the ultimate impact of a decision.

The ability of return on investment (ROI) and cost-benefit analysis (CBA) to accurately and fully analyze the impact of a decision is being called into question. Barbour (1993) explains that ROIs, CBAs and risk assessments are limited because they often leave the real benefits or dangers unassessed since those are qualitative aspects of a project that cannot be quantified. Often those unassessed benefits or dangers are impacts upon human lives or the environment. In response, agencies such as the Office of Technology Assessment and the United Nations Development Program have developed mixed-method analysis procedures, such as the “Human Development Index” (Barbour, 1993, p. 53), that analyze both the quantitative and qualitative factors of decisions or policies. In business and industry, Kaufman (2000) has proposed an Organizational Elements Model as a tool companies can use to assess their ultimate benefit to and impact upon society.

While every decision may not be an earth-shaking one requiring analysis of societal good, there are many instances where qualitative aspects of a project must be assessed and analyzed in order to determine the real costs and benefits. The impact of a decision upon employee attitudes, public perception of quality, and even changes it causes in processes or specific design standards are all examples of more qualitative variables that may be involved in a decision. This paper explores a specific instance where a qualitative ‘ROI’ process was developed in order to assess a decision about migrating online courses from one platform to another. While some aspects of the migration issue could be quantified, many could not. Still, analysis and data backing the decision were needed by management. We will describe the context of the project and discuss why a qualitative ROI was appropriate. We will also define ROI, the questions we investigated, the methodology developed to conduct the analysis, and the findings the analysis yielded.

Qualitative ROI Project

When a regional funding organization first awarded a state university’s Blindness and Visual Impairment Program grant funding in 1998 to convert its Master’s degree program to an online format; off-the-shelf, commercial web course management systems were not accessible to blind and visually impaired users. Because 10% of the students enrolled in such a program had visual impairments and one faculty member was

blind, it was imperative that the grant team develop a custom web course management system and identify online synchronous and asynchronous tools that were accessible. Over the length of three years, 15 courses were developed on this custom, internally-developed platform, and a virtual campus web interface was developed to support distance students.

Based upon the success of the program, in 2001 the university was awarded a second federal grant, which significantly increased the scope of the project. It provided the necessary funding to continue the online program in Blindness and Visual Impairment and to convert two other programs, the Deafness and Hard of Hearing and Severe Disabilities Master's degrees to an online format. This federal funding was also used to create a national center related to disability services and education. The online Master's degrees are now a part of the center's expanded teacher training function. Additionally, the center contracts with other universities to support the conversion of their low-incidence disability degree programs to an online format. Clearly, the quality of the online courses and programs – both in terms of instructional design and accessibility – formed a cornerstone of the center's work.

At the same time the center received this federal funding and expanded its efforts, the university in which the center is housed licensed Blackboard™, a commercial web course management system, which is maintained and administered by the university's faculty development center. During the fall of 2001, the center's staff members conducted a research study to determine the practical accessibility of the product. The results showed that the majority of the Blackboard™ interface met accessibility standards (Conn & Ektermanis, 2001).

The federal funding impacted the size and structure of the instructional design team. Three additional instructional designers were hired to support the expanded missions of the center. One challenge was to maximize the impact of the new instructional design team members. Even with an increase in staff members, it was difficult to address the issues of limited faculty control that were an inherent part of the internally-developed system and the increased workload of maintaining courses in the Blind and Visual Impairment program as well as the extensive work needed to convert the Deafness and Hard of Hearing and Severe Disabilities programs.

The new instructional design staff members brought varying degrees of technical expertise thus making it necessary to consider a migration to a commercial web course management system with a graphical user interface. Given the results of the accessibility research study and the changes in size and structure of the instructional design staff, it was determined to be an appropriate time to evaluate the benefits and tradeoffs related to maintaining the internally-developed system versus migrating to Blackboard™. Once the project was determined to be appropriate and necessary, the instructional design staff conducted a review of methods to determine an appropriate process for conducting this analysis.

Literature Review

What is ROI?

ROI is an acronym for return on investment. It is a method for measuring the worth of an investment and has been primarily utilized for businesses purposes. In the 1990s, the use of ROI for calculating the value of training and performance solutions began to be addressed by the human resource development and performance improvement fields (Phillips, 1997). In a human resource development context, "ROI practices are a means of economically connecting the performance goals of efficiency and effectiveness with selected interventions and performance results" (Swanson, 1999). The literature base for these fields advocates using ROI as a means of measuring, documenting, and communicating the value of support interventions to both justify projects as well as to build cases for continued or new funding (Pine & Tingley, 1993; Phillips, 1997; Stolovitch, 2002).

Connecting ROI to Kirkpatrick's Evaluation Model

ROI has been connected to Kirkpatrick's (1998) evaluation model. Kirkpatrick's original model included four levels: 1) Training Reaction, 2) Learning, 3) Behavior, and 4) Business Results. Training Reaction is often gathered through end of training or course evaluations and captures data related to participant satisfaction and comments related to how the training or education may transfer to work situations. Learning evaluation data attempts to capture participant perception of their achievement of objectives related to knowledge, skills, and attitudes. Evaluations of behavior, also referred to as Application, investigate changes in work performance. Business Results evaluates the impact of the interventions on related business variables.

Phillips and Phillips (2003) added two new levels to Kirkpatrick's model placing "ROI" and "Intangible" at the fifth and sixth levels, respectively. As mentioned earlier, ROI is a process for measuring the

costs and benefits of an intervention. Intangible is the documenting and reporting of relevant variables that are not easily converted to a monetary value. Although the levels of Business Results and ROI may appear similar, they differ in that Business Results attempts to measure changes in the business related to the intervention, such as productivity or attitudes of employees or profitability levels. ROI, on the other hand, focuses on comparing these identified benefits (or disadvantages) of the intervention with the costs of implementing the intervention.

Types of ROI Evaluations

There are several different types of ROI evaluations that can be conducted. Phillips, Stone, and Phillips (2001) directly align the ROI evaluation options with Kirkpatrick's original model, which forms a framework for the timing of data collection as well as a consideration of the levels of credibility, accuracy, cost to implement, and difficulty to implement. For example, when conducting an ROI measure related to Kirkpatrick's first level of evaluation, Reaction, data is collected during and/or at the end of the training. Credibility and accuracy of these measures tend to be lower since transfer of training to work settings has not yet occurred, but these evaluation measures are often less expensive and difficult to implement. Collecting evaluation data related to Business Results, Kirkpatrick's fourth level, can be very credible and accurate since the intervention will likely be implemented by this point; however, these types of measures are typically more expensive and difficult to collect.

In addition to aligning ROI evaluations with Kirkpatrick's levels, Phillips, Stone, and Phillips (2001) include one more option --- Forecasted ROI. A Forecasted ROI, also referred to as worth analysis (Stolovitch, 2002) and anticipated ROI (Parkman, 2002), is conducted before an intervention is implemented and is the type of ROI employed in this study. It can help provide justification for a project as well as provide baseline data that can be compared with post-project results. Forecasted ROIs are based on estimations and therefore may be less credible or accurate than ROIs calculated on post-project data. However, they have the benefit of being inexpensive to develop and less difficult to conduct.

Sequence and Criteria for Conducting ROI

Before conducting a ROI, a front-end analysis should be conducted to identify "what the desired business state should be, what the current or actual state is and then [to] characterize the gap between the two states in terms of magnitude, value and urgency" (Stolovitch, 2002). This front-end analysis provides data for determining an appropriate solution and clarifying project goals in terms of business results. The results of the ROI can also be used for developing project evaluations and comparing the benefits of the solutions to the potential costs (Parkman, 2002).

Phillips (1997) describes ten criteria for conducting a traditional ROI. These criteria form a set of guidelines to follow when investigating the ROI of a project, product, or training. These guidelines can be summarized as 1) keep the process simple by employing practical, feasible methodologies; 2) design an economical process that is easy to implement, has the potential of becoming routine, and can be applied to a various types projects as well as to both pre-project and post-project data; 3) choose evaluation techniques or research methodologies that are credible, theoretically sound, and based on accepted practices; and 4) create a process that can utilize all types of data and include the costs of the program.

Qualitative ROI

Financial factors are often not the only variables that need to be considered when gathering data to estimate or judge the value of an intervention. Intangibles are variables that are critical to the overall project or solution but are not easily converted to monetary values. As mentioned earlier, Phillips and Phillips (2003) add 'Intangibles' as a sixth level to Kirkpatrick's original model. Swanson (1999) states "criteria other than ROI are being used to gain support for performance improvement programs. Although there appears a difference of opinion in the literature regarding whether 'Intangibles' are or are not a ROI measure, we chose to adapt procedures to create a qualitative ROI process given the mix of data sources available and the context of our study.

Swanson (1999) describes several qualitative factors that should be considered.

1. Appropriateness of the program to the organizational culture and tradition
2. Availability of the program
3. Perceived quality of the program design

(p. 836)

These are especially important to take into consideration when working with non-profit organizations or educational institutions where economics may not be the key driver and where hard program costs may be

difficult to access or are not directly financed by the project's budget. This was the context for this particular proposed evaluation project.

Purpose of the Qualitative ROI Project

A front-end analysis had been conducted to verify that a course management system was (still) needed to deliver the three low incidence disabilities graduate degree programs and to engage in contract work with other universities. Additionally, the version of Blackboard™ licensed by the university had been thoroughly tested to ensure it was accessible and met Section 508 standards. Given the results of this up front analysis, the question that remained was what would be the benefits and tradeoffs of migrating courses to Blackboard™ versus continuing to use the internally developed web-based course management system. From this key research question, the following secondary questions were developed. Would Blackboard™ (or policies related to Blackboard™):

- 1) Decrease course development time for the instructional design staff, so that more time could be devoted to the other missions?
- 2) Allow the center to continue to deliver high quality courses with cutting edge designs?
- 3) Allow the center to maintain and contribute to quality instruction in the areas of accessibility, increased features, and increased control for instructors?
- 4) Increase the center's return on monthly fees being paid to the university's information technology and faculty development departments?
- 5) Enhance campus relationships between the faculty development department and the center, and add value to the university?
- 6) Support the center's ability to partner with other institutions for delivering courses?

In addition to exploring the questions listed above, the center's instructional design staff also felt the results of this study could prove valuable to other university special education departments with whom the center consulted and who were considering whether to develop a course management system internally or use an off-the-shelf product.

Methodology

Going into the project, the evaluation team realized there would likely be many intangible variables and many other variables that would be difficult to quantify, given the fact that departments within institutions of higher education typically do not charge internal clients for the services they provide and often institutional-wide site licenses are purchased for software. Given this context and the potential variables that would be part of the overall analysis, a methodology that incorporated the ROI criteria and qualitative research techniques was employed. Qualitative inquiry methods are an appropriate approach for descriptive studies and for researching practical problems (Creswell, 1998; Merriam, 1988). Given the descriptive nature of qualitative studies, the findings or results include detailed narratives regarding questions being researched. These descriptions are intended to paint a picture for the reader of the situation or entity studied. This is done through the use of text and images as well as through quotes, examples, or other appropriate artifacts (Wilson, 1979).

Project team

As with many return on investment projects, a team was formed to conduct this study. In qualitative research it is important to inform readers of the biases the researcher or researchers bring to the project. Informing readers of researcher bias allow them to draw their own conclusions regarding the trustworthiness of the findings. The research team for this project consisted of two instructional design center staff members who were also pursuing doctorate degrees in Educational Technology. One of the center's instructional design staff members proposed the project and leaned towards migrating to Blackboard™. The second center instructional design staff member had been with the project since the receipt of the first grant and this staff member's work was central to the creation of the internally developed course management system interface; she was hesitant towards the idea of migrating to Blackboard™. In addition, the project team included five other instructional designers with varying levels of expertise. These consultants had no association with the center.

Data collection

Data collection for qualitative studies often involves multiple sources (Creswell, 1998; Merriam, 1998). These sources can include "documents, archival records, interviews, observation, [or] physical artifacts" (Creswell, 1998, p. 65). Merriam (1998) states, "interviewing is probably the most common form of data collection in qualitative studies in education. In numerous studies it is the only source of data" (p. 70). Using

more than one method for collecting data and verifying emerging themes reinforces the results of qualitative studies. This practice of collecting and analyzing a variety of data sources is called data triangulation (Denzin, 1978).

The data collection for this study involved multiple sources. We interviewed the center's director and conducted two separate interviews with staff members from the faculty development department. We collected documentation including a slide presentation prepared by the center's technology manager, which explored technical implications of using various combinations of servers and courseware for delivering courses online and email correspondence with the Blackboard™ staff member responsible for accessibility issues. We also accessed two websites, the Blackboard™ company website that discusses the accessibility of the tool and the Section 508 website, a federal government site dedicated to the implementation of federal legislation for accessibility of multimedia information. Finally, we utilized the results of the Conn and Ektermanis (2001) study that had been conducted to investigate the practical accessibility of the Blackboard™ interface.

Data analysis

The interview data were analyzed using qualitative coding techniques. A characteristic of qualitative research, as defined by Merriam (1988), is inductive reasoning. Inductive reasoning refers to the emergence of concepts and themes through data analysis. The researcher may begin the data analysis with an outline of possible concepts or themes he or she expects to find, but these initial codes are often revised, eliminated, or added to through the coding process.

The detailed interview notes were transcribed and were read and re-read by the project team. The transcriptions were then analyzed using basic qualitative analysis methods. The basic qualitative analysis method followed by the team included first-level coding, which involves how one differentiates and combines the data the researcher has retrieved and the reflections one makes about the information. These codes are designed to be descriptive labels for identifying chunks of information (Miles & Huberman, 1994). The research questions were used to guide the analysis of the data, and were the basis for the initial list of codes used to analyze the interview transcriptions. A content analysis of the documentation collected was also conducted using a first-level coding method to triangulate the data collected through the interviews.

For first-level coding, the team wrote all the data on large pieces of paper that were then posted on the walls of the room. One member of the team typed these pieces into an electronic format as the group worked. Once all the data was posted on the wall, the group started by simply numbering each piece of data. The first data piece listed received number one. If the next piece was similar to something already numbered, it received that same number. Otherwise, a new number was introduced. In the first round of coding, six categories of data emerged. The person entering it electronically reorganized the pieces into those six categories.

The next step in the analysis process was second-level pattern coding. Second-level pattern coding is a method for grouping first-level codes. Pattern coding is used to identify emergent themes or explanations. The primary purpose of second-level pattern coding is to assist in getting to the next level of analysis – beyond simple description (Miles & Huberman, 1994).

For second-level coding, the team printed out the initial six categories and placed these on the wall. They then discussed what the categories would be called and whether categories should be maintained or whether some overlap still existed between categories. After further analysis, the project team reduced the categories to three core themes: Quality, Time and Cost. Once the first-level coding and second-level pattern coding was complete, the project team analyzed the results and synthesized data into a descriptive report delivered to the center's management team that included quotes, examples, and images to convey the findings and recommendations of the study.

Findings

Based on our analysis, the issues, concerns and solutions collected from all sources were grouped into three key themes: Quality, Time and Cost. Figure 1 visually depicts the relationship that emerged between these three themes. The findings of this study indicate that the main considerations short-term were the issues of the loss of the center's identity and 'sense of place,' and the impact on instructional designers' time. The findings also pointed to concerns related to long-term sustainability of the online courses as well as different roles and time investments for the center's staff. In addition, benefits of the migration to Blackboard™ emerged as well as several specific issues that were documented as Recommendations. Table 1 contains a summary of the findings categorized as 'costs' and 'benefits.'

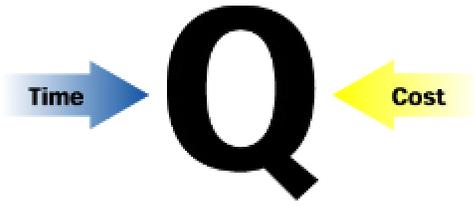


Figure 1. Visual representation of the relationship between the three major themes emerging from

Table 1. Summary of Findings Categorized as Costs and Benefits

| | Variable | Costs | Benefit |
|----------------|-------------------------------------|---|--|
| Quality | <i>Accessibility of Blackboard™</i> | No longer an issue except for minor problems with the interface and the chat room tool | With increased collaboration between the center staff and the faculty development department the center's accessible chat room tool could be made available to the entire university |
| | <i>Interface Design</i> | Would lose 'sense of place' and community designs | |
| | <i>Instructor control</i> | | Instructors would have more direct control over making changes in their courses; a feature that was not available in the internally developed system |
| | <i>Instructional Design Quality</i> | Loss of infrastructure that supported webs of information and data pieces | |
| | <i>Technical Issues</i> | University server less stable, more down time | More portability across programs and universities |
| | <i>Development Support</i> | | Long-term, university funded support for course development and maintenance |
| Time | <i>Course Development</i> | | Decrease course development time for the center's staff since the faculty development department could assist with course development |
| | <i>Collaboration</i> | The center's staff would likely need to spend more time participating in faculty and staff development trainings to address issues of accessibility | This would allow the center to add value to the university community |

| | | | |
|-------------|------------------------------------|--|--|
| | <i>Help Desk Support</i> | Student confusion surrounding the accurate logon and password for a specific course | With the migration to one system for the university, the students would more likely become accustomed to the appropriate logon and password; additionally, the university help desk would be able to assist all students, giving students one central place to contact or for instructors to refer students to |
| Cost | <i>Multimedia Development</i> | | Faculty development department provides (free) audio, video and graphic development services |
| | <i>Information Technology Fees</i> | The center was required to pay \$40 per credit hour to the university's information technology department for support services, but the center was not receiving any value for these fees since all course development and support to students and instructors was provided internally | |
| | <i>Risk Factors</i> | Unknown outcome of annual contract renegotiations between the university and Blackboard™ which could potentially require distribution of Blackboard™ product fees to the department | |

Quality

The migration of courses to the university's web course management system, Blackboard™, raised several concerns related to the quality of current courses, specifically issues of handicapped accessibility and good instructional and visual design. Based on the data analysis, it was determined that these concerns could be addressed through proposed solutions or balanced by gains from the proposed migration.

Accessibility: Earlier accessibility issues related to the Blackboard™ interface had been addressed, and most course components now met federal accessibility guidelines under Section 508 which stipulates that electronic and information technology should be programmed in such a way that individuals with disabilities can access and use the information and data in a way that is comparable to the access and use by individuals without disabilities. Some features of the Blackboard™ interface were still not accessible, though, such as the chat rooms. Interviews conducted for this ROI revealed that university staff were willing to allow the center to link in its own custom, accessible chat rooms and other tools and even make those tools available to users across campus, adding further benefit to the entire campus.

Interface Design: The custom, internally-developed interface featured an identity and 'sense of place' that was designed to be extremely user friendly. The original interface created a sense of community by developing a virtual campus around the online courses and programs, and an infrastructure that allowed students to connect with each other outside of class or with outside experts for informal discussions, much like a physical university center would host social and informal events. Students could also access 'offices' and 'buildings' that they needed to be successful in their studies, such as financial aid, the library and faculty offices. This instructional strategy of community was supported with visuals and identifiers that all created a 'sense of place' where the students felt like they were a part of a program and a university, not just taking online courses. Within classes, a visual interface resembling a classroom had been developed that included pictures of faculty and other features that helped students adapt more quickly to this new innovation of online learning. All this work had been created based on research on learning communities (Wenger, 1998; Palloff & Pratt, 1999) and change facilitation (Rogers, 1995; Hall & Hord, 2000).

A concern that surfaced during this study was that this distinctiveness would likely be lost with the move to Blackboard™. However, benefits to be gained with the migration appeared to offset this concern. For

example, Blackboard™ would allow faculty more control over course changes and updates as well as a wider array of course tools and features. According to the literature base on change, such a form of empowerment would be critical for faculty adoption of the innovation because it fosters buy-in and improves success (Ellsworth, 1995) and allows the stakeholders to participate in the very technology that will impact their work (Ellsworth, 1997; Ely, 1990). A final benefit of offsetting the concern over loss of distinctiveness was that by using the university's official contracted system, long-term support for course development and maintenance was assured, if funding would not be available to support center instructional design staff in the future.

Instructional Design: In addition to accessibility and interface design concerns, were concerns of instructional design quality. Courses had been redesigned for online learning based on cognitive apprenticeship and situated cognition principles (Brown, Collins, & Duguid, 1989; Herrington & Oliver, 2000). Instructional designers had built scavenger hunts using the server technology, created information databases students collaboratively populated as course projects, and even built a set of scaffolded case studies and support tools that all made extensive use of the custom, internally-developed platform. In addition to the concern as to whether these quality learning experiences could be preserved using the Blackboard platform, was the practical consideration that migration of this custom content would not be straightforward, but would require time and expertise to ensure a well-managed process. However, as with the accessibility issues, the qualitative ROI revealed that the center could maintain complex structures on its own server and link to those from within the courses on the Blackboard™ server. Thus, the center could capitalize on the benefits of Blackboard™, but maintain the past work and future flexibility that had contributed to its reputation for quality.

Technical issues: Additional quality concerns centered on technical issues. The university's information technology server was viewed as less stable than the server running the custom, internally-developed course management system. The university's information technology server had been down for two months total out of the year when the center's server was not, one of those downtimes occurring during the critical time when courses started. Furthermore, the listserv functions within Blackboard™ or from information technology were either not as reliable or did not provide the same capabilities as the original server structure. However, the center would be able to institute its own policy and control related to backing up courses.

Portability: One final advantage of migrating the center's online courses to Blackboard™ included cross-institutional portability. By using a common system, other universities' special education departments could partner with the center to develop courses. While a custom solution provided the center a high degree of strength and flexibility, other programs did not have the resources to maintain something similar. Their need to be on a standardized, university-maintained system outweighed the advantage of the internally developed, custom solution.

Time

One of the major issues we investigated was whether switching to Blackboard™ would decrease course development time for the center's staff. Through this process, we discovered that one of the services the faculty development department offers (free of charge) is to do course development for faculty members. To date, most faculty members had opted to develop their own courses, so this service was not being widely used. Other issues that surfaced related to time were the requests by the faculty development department for help with training their staff on development techniques related to accessibility as well as assisting with their faculty development courses on issues related to accessibility.

Based on our analysis, it appeared that in the short-term switching to Blackboard™ might increase work for the center's staff to meet the requests made by the faculty development department. Long-term, the data appeared to support the objective of decreasing course development time for the center's staff. Although these results did not support decreased staff workload in the short-term, the migration would likely enhance campus relationships between the faculty development department and the center, and add value to the university.

The final issue related to time that surfaced was the logon/password confusion encountered by students at the beginning of each semester. This was an issue that the faculty development department, the center, and Special Education instructors currently dealt with each semester regardless of the web course management system. The center's internally developed system required unique course passwords that were reset each time the course was taught. By migrating to Blackboard™, students would be able to use their university logon and password. Additionally, the university help desk would be able to respond to requests for help regarding the logon and password, providing another source of help for students beyond the center's staff members and the course instructor.

Cost

Cost is an inevitable issue when considering the use of new tools and services. Upon analysis, it was found that the data pertaining to cost could be organized into three categories or cost issues for this evaluation project, Free Services, Return on Information Technology Fees, and Risk. The data regarding Free Services revealed the faculty development department's willingness to offer free audio, video and graphic development to supplement the instruction. These services would sustain the center's goal for providing students with authentic and innovative learning environments through the utilization of technologically advanced tools.

The factors fitting under the Return on Information Technology Fees exposed a current lack of return for fees paid by the center to the university's information technology department. The center was required to allot \$40 per credit hour to the university's information technology department for support services. At the time this qualitative return on investment analysis was conducted, the center had not been able to offer the university's information technology department support to students and faculty since the center staff maintained the custom course management system. Migration to Blackboard™ would provide the opportunity for the center to take advantage of the support services offered by the information technology department, thus creating a better return on investment for the fees paid by the center.

Based on the results of the analysis of cost data, the outcome appeared to be in favor of a migration to Blackboard™, with the exception of the Risk factors. Risk factors associated with cost related to the unknown future outcomes of contract renegotiations between Blackboard™ and the university. Renegotiations occurred annually, and terms of a new contract could at some point include a dispersal of cost onto the departments and organizations that use Blackboard™.

Recommendations

Throughout the data analysis process, 'action items' continued to emerge that would need to be addressed should the center decide to migrate to Blackboard™ for online course delivery. The evaluation project team brainstormed solutions that could be implemented to address the 'costs' (e.g., concerns or disadvantages) highlighted in the findings. Presented in Table 2 is a summary of the issues that emerged from the data as well as recommended solutions.

Table 2. *Summary of Issues Related to Migrating to Blackboard™ and Recommended Solutions*

| Issue | Recommended Solution |
|------------------------------|--|
| <i>Loss of identity</i> | <ul style="list-style-type: none"> ▪ Providing a link from the main Blackboard™ page to the center information, stating 'supported by the center' in some fashion – (create a general page for all courses) ▪ Put the center's 'design element' on Blackboard™ page ▪ Support accessibility through training faculty development department staff and instructors |
| <i>No sense of community</i> | <ul style="list-style-type: none"> ▪ With every center course, create a link for all students to access the center's community (create a general page for all courses) ▪ Encourage faculty to develop community through course design ▪ Use orientation for students at beginning of course to inform them of the center's virtual campus |
| <i>Managing the load</i> | <ul style="list-style-type: none"> ▪ Migration Plan <ul style="list-style-type: none"> ⇒ Incorporate change management into the plan ⇒ Limit the number of transitions and course management interfaces for students and instructors |
| <i>Policies</i> | <ul style="list-style-type: none"> ▪ Negotiate policies related to: <ul style="list-style-type: none"> ⇒ Courses being taught for other universities ⇒ Continuing support for online courses and migration to any new system(s) if the university drops the contract with Blackboard™ |
| <i>Relationships</i> | <ul style="list-style-type: none"> ▪ Establish and foster clear, positive communication lines |

| | |
|--|---|
| | <ul style="list-style-type: none"> ▪ Support accessibility through trainings sponsored by the faculty development department and through individual consultation with instructors ▪ Extend accessibility support to library and web manager (for entire campus) |
| <i>Cutting edge design</i> | <ul style="list-style-type: none"> ▪ Not compromised by Blackboard™ if Educational Technology staff mediates between faculty and Blackboard™ |
| <i>Stability of servers/ longevity of Blackboard™ contract</i> | <ul style="list-style-type: none"> ▪ Establish systematic back-up procedure for all courses |

Summary of Findings

Thus the findings showed that the migration to and use of Blackboard™ would not jeopardize quality of online courses and would likely increase quality given the additional features of the system. Over time, use of Blackboard™ would translate into more time for the center’s Educational Technology staff members to devote to broader instructional design efforts rather than course development issues. Under the university model and contract in place at the time, the migration to and use of Blackboard™ would incur no cost to the center and would actually increase return on monies already being paid to the faculty development department. Additionally, if sources of funding for Educational Technology staff were decreased or cut completely, the use of Blackboard™ would ensure longevity of courses beyond any particular grant. Major and minor issues related to Blackboard™ could be addressed through policies, procedures, or products as identified in the Recommendations section. Therefore, it was the recommendation of the project team that the center migrate its courses to the Blackboard™ system and implement the recommended solutions to make such migration as smooth and beneficial as possible.

Conclusion

Overall, the qualitative approach aligned well with the type of data the team was able to collect for this evaluation project. We were able to address the intangible issues related to delivering quality courses. Only a few hard financial costs were gathered as part of the data for this study; however, this qualitative approach could be easily combined with more traditional financial ROI calculations if it was appropriate for the project and the financial data was available to analyze. The final report did provide the center’s management team with detailed analysis of both the benefits and disadvantages, allowing them to make a data-based decision regarding whether or not to migrate to Blackboard™ or remain with the internally developed course management system. The center did choose to migrate to the Blackboard™ server and implemented many of the suggested recommendations for mitigating against lingering costs.

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What's Driving Faculty Participation in Distance Education?

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Abstract

The presentation reviews more than a decade of investigations undertaken to determine what motivates and what discourages faculty participation in distance education. The presenters describe the evidence that faculty extrinsic and intrinsic conditions both influence willingness to participate. The researchers will also compare the findings of this study with three other studies conducted on faculty motivation. The analysis reveals that more recent studies indicate extrinsic motivators are playing an increasingly important role in DE. The presentation will summarize the policy implications for this body of research.

If distance education coursework continues to expand, as predicted (Hannafin, Hannafin, Hooper, Rieber & Kini, 1996; Texas Higher Education Coordinating Board, 2000; Twigg, & Oblinger, 1996; Van Patten, 2000), faculty would be crucial elements in the creation and maintenance of distance education courses. Higher education administration must support their most important asset, faculty, so that faculty maintain both their academic positions and their positions within their communities (Chronicle of Higher Education, 2001a; Chronicle of Higher Education, 2001b; Kezar, 2002). Policies that create motivating conditions for faculty participation and that mitigate or remove inhibitors could sustain and stimulate faculty participation in DE. The purpose of this analysis is to identify what conditions have the greatest influence and which can be manipulated by faculty. A comparison of the top five motivator items in three other university studies using a similar survey, a private eastern university, a public eastern university, and a southeastern university, indicated there were similarities to some of the findings of the southwestern public university study, all reflecting faculty perceptions that the strongest forces influencing their participation were intrinsic, although not always in the same order of priorities. Other findings of this study reveal a growing trend towards extrinsic motivation having a stronger influence on participation in DE.

Background

Studies prior to 2001 reported that intrinsic motivation, a person's willingness to perform acts based on the internal rewards of emotional satisfaction, was a strong influence on participation or nonparticipation in innovation (Betts, 1998; Dillon & Walsh, 1992; Ellis, 1984; Herzberg, 1964; Lepper, Keavney & Drake, 1996; Iyengar & Lepper, 1999; Lewis, 2001; Stephenson, 1997; Vroom, 1964; Wolcott, 1997; Wolcott, 2002a; Wolcott, 2002b; Wolcott & Betts, 1999; Wolcott & Haderlie, 1995). Faculty have reported participating in DE for intrinsic rewards over extrinsic rewards, such as promotion and tenure, grant money, increased salary, additional training, or course releases (Bebko, 1998; Betts, 1998; Brown & Floyd, 1998; Dillon and Walsh, 1992; Johnston, Alexander, Olcott & Wright, 1995; Schifter, 2000; Wolcott, 1999; Wolcott, 1997). However, more recent studies (Arnone, 2002; Bower, 2002; Culp, Riffiee, Starrett, Sarin, & Abrahamsen, 2001; Gannon-Cook, 2003; Twigg, 2000; Weber, 1999) revealed extrinsic rewards were also motivating DE participation.

Faculty teaching DE courses (as of the end of 2002) in the field of education in the United States earn an average salary of \$42,000.00 for a nine-month contract for non-tenure track faculty, and \$45,000.00 for new tenure-track faculty (Chronicle of Higher Education, 2003; Johnston, Alexander, Conrad, & Fieser, 2000; Sloan Center for Asynchronous Learning Environments [SCALE], 1998). Average starting salaries for persons with undergraduate degrees in business are about the same salary range, \$40,000.00-\$42,000.00 (Wall Street Journal, 2002). Teachers with undergraduate degrees and teaching certificates also earn salaries in the same range, \$40,000-42,000 (Chronicle of Higher Education, 2002; Houston Independent School District, 2002). Starting Ph.D. graduates in Computer Science, however, average around \$70,000.00 and in Business, around \$60,000.00 (American Association for Higher Education, 2001; National Center for Education Statistics, 2001; United States Department of Education, National Center for Education Statistics, 1999). This disparity in higher education, with salaries for doctorates in education averaging about \$20,000 per year less than Computer Science and Business, is reflected in many universities throughout the United States (American Association for

Higher Education, 2001; Chronicle of Higher Education, 2003; National Center for Education Statistics, 2001; United States Department of Education, 1997). The lower salaries for faculty in Education could shed light on why lack of compensation incentives could be de-motivating to faculty, and why compensation incentives could make a difference in motivating faculty members to participate in DE.

Methodology

To determine which factors influence faculty participation in distance education, we identified the survey most often used in published studies to measure faculty distance education attitudes. At least eight institutional research studies investigating faculty attitudes toward distance education collected data with parts of the Betts (1998) survey (Bebko, 1998; Berge & Milenburg, 2001; Crawford & Hunt, 1999; Halfhill, 1998; Kambutu, 1998; Montgomery, 1999; Wolcott & Betts, 1999); seven other studies had similar items but did not replicate the survey items (Bonk, 2001; Bower, 2002; Byun, 2000; Ellis, 2000; Groves & Zemel, 1999; Johnston, 2000; Mitchell, 1999). Only four of the studies (Beggs, 2000; Betts, 1998; Gannon-Cook, 2003; Schifter, 2000) published comparable data for the same Likert items to measure faculty motivators and inhibitors for distance education participation; two of the four had the exact same 53 items, with a third study combining several intrinsic and extrinsic motivating factors (Beggs, 2000). The fourth survey (Schifter, 2000) included fifty items and excluded three extrinsic motivator items measuring attitudes toward salary increases, course releases or other workload credit for distance education participation, and royalties associated with course design.

Table one displays the five highest ranked Likert items on each of the four studies (Beggs, 2000; Betts, 1998; Gannon-Cook, 2003; Schifter, 2000). The same five items had the highest means on the two studies conducted in the Southern United States. All four of the studies included three of the same items: personal motivation to use technology; ability to reach new audiences; greater course flexibility for students. These items, while of some interest, reveal little about the underlying factors that support motivation and reflected faculty motivation as a function of their own internal values and were consistent with earlier studies. Only the Gannon-Cook study (2003) validated the survey with a Principal Components Analysis that revealed the underlying motivational factors affecting DE participation. Table two displays the five highest ranked inhibitors or de-motivators. Table three displays the PCA results sustain intrinsic motivators belong to the strongest factor but the next four factors were extrinsic rewards.

In the Principal Components Analysis (PCA), intrinsic motivators comprised the twelve of the first 15 (and uppermost ranking) items in the first factor, entitled "Traditional Staff Service" and representing internal drivers to participate in DE. On the other hand, the second factor and third factor represented conditions in which the university has considerable control, were extrinsic motivators, titled "Monetary Rewards" and "Insufficient Rewards." (Factor two was the presence of rewards and factor three, the lack of rewards). The third factor, Insufficient Rewards, contained eight extrinsic inhibitor items. The fourth factor, Technical and Administrative Support, represented six extrinsic inhibitors, as did the fifth factor, Job Enhancement Requirements, with three extrinsic motivators. The first (intrinsic) factor comprised 19%, the next four (extrinsic) factors comprised 40%, with the remaining four (extrinsic) factors accounting for 10% of the variance, a total of 70% of the variance accounted for by the PCA.

Table Three reveals the items with highest means, items with highest item correlations for each factor, and the five factors explaining the most variance (Gannon-Cook, 2003). The five highest means were: Personal Motivation to Use Technology (Factor one); Ability to reach new audiences (1); Greater Course Flexibility for Students (1); Intellectual Challenge (1); and, Opportunity to develop new ideas (1). The five items with the highest item correlations for each factor were: Opportunity to develop new ideas (Factor one); salary increase (Factor two); lack of salary increase (Factor three); lack of technical support (Factor four); and, required by the department (Factor five). The five factors derived from the 53 items on the survey that explained 70% of the variance were: Traditional staff service (Factor one), explained 18.62% of the variance; monetary rewards (Factor two), explained 15.34% of the variance; insufficient rewards (Factor three), explained 12% of the variance, but note that this factor was the extrinsic inhibitor counterpart to the Factor Two extrinsic motivator, monetary rewards; technical-administrative support (Factor four), explained 7.35% of the variance; and job advancement requirements (Factor five), explained 5.42% of the variance. Factors six (Professional Quality) and seven (Professional and personal prestige) combined accounted for the next 6% of the variance, and Factors eight (Bad Press) and nine (Personal Benefits) accounted for the remaining 5% of the variance. All totaled, intrinsic motivators, Traditional staff Service (1) and Professional Quality (6) combined, accounted for 22% of the variance; extrinsic motivators accounted for the remaining 48%, with Factors two and three accounting for 27% of the variance.

DE Survey Response Patterns

The DE survey patterns indicated that university faculty perceived the strongest forces that would influence their participation were intrinsic (19% of variance) and extrinsic motivators (35%), not inhibitors (15%), yet the responses to the DE survey inhibitor-item questions contained higher means. There were some research findings that indicated inhibiting or negative survey items can receive stronger participant responses (Cuban, 1999; Culp, 2001; Johnston, Alexander, Conrad, & Fieser, 2000; Kaufman, 1992; Lepper & Keavney, 1996; Noble 1996; Postman, 1997; Robinson, 1995). Apparently, faculty may feel strongly about some of the topics, but not have conscious knowledge of those feelings. Faculty also may feel strongly about not being included in important institutional decisions, and because of this, may be inclined to respond negatively, or not at all, to inhibiting questions that ask about what is lacking or not being done at the institution. The inhibiting questions act as double-negatives, demonstrating respondents' assent that the absence of certain items will deter or prevent participation in DE. So, factor items, such as, lack of salary increase, credit and promotion, recognition and awards, release time, and increased faculty workload, could all have more decision-making weight in the minds of the respondents, than indicated by the survey responses. Yet, the inhibitor factor items do rank third, fourth, sixth, and eighth in the nine PCA factor scale, giving some consideration to the items in these factors.

Discussion

Lack of incentives has become an increasing barrier to institutional growth in DE. Studies, such as those conducted at higher educational institutions in Pennsylvania (Broskoske & Harvey, 2000; Distance Education Report, 2001; Pennsylvania State University, 2002), found that issues related to faculty were far more significant for the success of DE than technological issues for the success of DE. Extrinsic motivators, while reported in many studies as non-motivating (Betts, 1998; Lepper, 1998; Schifter, 2000; Wolcott & Betts, 1995; Wolcott & Haderlie, 1995), are hard to ignore when basic physiological needs must be met. For example, hunger, a basic biological need, makes it necessary to earn money to buy food, and then money becomes a specific drive. The other sets of ascending needs relate to achievement and, through achievement, to the experience of psychological growth. For example, rewards for successful academic job performance usually include more money, promotions, or course releases for research (Bonk, 2001), so faculty who teach DE would expect to be rewarded similarly, through salary, promotion/tenure, or adjusted workload. However, to date, this has not been the case in most academic institutions (American Association for Higher Education, 2001; Beggs, 2002; Longmate & Cosco, 2002; National Education Association, 2000; Pennsylvania State University, 2002; Rockwell, Schauer, Fritz, & Marx, 1999). The National Education Association reports that 63% of the faculty who teach DE courses are compensated for a DE course as if it were a traditional, face-to-face course (2000).

Several other studies, such as one conducted by the United States Department of Education (1997), support that incentives do appear to play a major role in faculty decisions regarding participation (American Association of Higher Education, 2001; American Distance Education Consortium, 2001; National Education Association, 2000; Task Force on Development of the Technology Workforce, 2000; Texas Higher Education Coordinating Board, 2000). Wolcott and Betts (1999) examined the concept of equity in relation to the faculty's perceived return on investment. And, when the exchange was not equitable, for time, etc., the DE became a disincentive to participation. Faculty who doubted they would be adequately rewarded cited the following reasons: concern for inadequate financial rewards, workload concerns, concerns relating to research and publication, and distrust of administrators (Wolcott, 1997). Lack of adequate rewards has been shown to be a personal disincentive as well as a barrier to institutional development in DE (United States Department of Education, 1997). To date, faculty participation in DE has not been formally rewarded through advancement in rank, tenure, or merit pay in most academic settings (Beggs, 2002; Betts, 1998; Bonk, 2001; Compensation Project Research in Education, 2000; Culp, 2001; Johnston, Alexander, Conrad & Fieser, 2000; Schifter, 2000b; United States Department of Education, 1997; Wolcott, 1997; Wolcott 2002).

The review of the literature on faculty motivation suggested that potential DE adopters need to have enough time to become more comfortable with the use of technology, that peer mentoring should be offered by the institution, and that both training and follow-up training should be provided, especially during the initial personal concerns stages of adoption (Bandura, 1982; Beggs, 2002; Fullan, 1991; Fullan, 1994; Hall & Hord, 1987; Lick & Kaufman, 2000; Murphy, Walker, & Webb, 2001; National Council for Educational Technology, 1995; Robinson, 1995; Rogers, 1995; Sherry, 1998; Smithers M & Spratt, C, 1999; Stribak & Paul, 1998; Wilson, 1999). While questions about peer mentoring were not posed in this study, the faculty survey responses referenced the need for ongoing training, and for administrative and peer support. If the investment of monies

for the implementation of DE are sufficient, then the investment of time to reinforce faculty adoption of DE would be minimal compared to the emotional security of faculty new to DE.

The DE survey results supported other studies' research recommendations to provide ongoing scaffolding of training for faculty (Bonk, 2001; Fullan, 1991; Johnston, Alexander, Conrad & Fieser, 2000; National Council for Educational Technology, 1995, Robinson, 1995; Wolcott, 2002). Training should be provided more than once, and should be particularly important at the management-concerns stage of adoption, when "how to do it" workshops provide crucial reinforcement to faculty still unsure about their decision to buy into DE participation (Bandura, 1982; Hall & Hord, 1987, Lick & Kaufman, 2000; Robinson, 1996).

In Hall and Hord's (1987) Concerns Based Adoption Model (CBAM), it was recommended that facilitators visit more often with potential adopters on a face-to-face basis to offer assistance and encouragement. In their study, 25% of the respondents ranked personal support and training as most important to adoption of an innovation. In that study, the findings revealed faculty often were not aware of training offered by the institution (1987). It was recommended that more training sessions be held and that more advertising be done to make faculty aware of available training and that the institution supported their efforts. Faculty placed a high priority on technical training and support in this survey too, similar to the Hall and Hord's survey (1987). It appears that DE can be successful and can become integrated into the university culture when implementations, such as enough time to become more comfortable using technology, peer mentoring, follow-up and ongoing training, are offered consistently to faculty and incorporated into university DE plans (Bandura, 1982; Beggs, 2002; Fullan, 1991; Fullan, 1994; Hall & Hord, 1987; Lick & Kaufman, 2000; Murphy, Walker, & Webb, 2001; National Council for Educational Technology, 1995; Robinson, 1995; Rogers, 1995; Schott & GannonCook, 2002; Sherry, 1998; Smithers & Spratt, 1999; Stribak & Paul, 1998; Wilson, 1999).

This Survey's Findings Compared to Three Other University Survey Findings

A comparison of the top five motivator items in the four university studies, the private eastern university survey, the public eastern university, the southern university, and the southwestern university, indicated there were similarities, all reflecting faculty perceptions that the strongest forces influencing their participation were intrinsic, although not always in the same order of priorities. For example, personal motivation ranked first for the eastern public, southeastern and southwestern public universities, but third for the private eastern university. Opportunity to develop new ideas ranked second for the private eastern and public eastern universities, but fifth for the southeastern and southwestern public universities. Ability to reach new audiences ranked first for the private eastern university and second for the southeastern and southwestern public universities, but did not make the top five rankings for the eastern public university. (See Table1).

What these findings reflected was a validation that faculty do care for their students and are personally motivated, intrinsically, to teach. They also care about having opportunities to develop new ideas, to improve their teaching, and to be intellectually challenged. In addition, they care about having the ability to reach new audiences who might, otherwise, not be able to attend college, and having greater course flexibility for students. But these motivations would be present, whether these faculty taught via DE or not, because intrinsic motivators are the key reasons why teachers inherently choose the profession of teaching.

The findings of the southwestern survey differed from the earlier three surveys, however after first intrinsic factor of traditional service (which included those factors shown in Table 2). All of the remaining factors, save Factor 6 (Professional Quality) were extrinsic. Interestingly, the earlier three studies also cited extrinsic factors too, but these were rated lower as influential to faculty motivation (See Table 2). While the extrinsic inhibiting factors' sequence varied among the four studies, there were a number of similarities, such as lack of technical support, which ranked first by the Southeastern private and public universities, and second for the southeastern public university (it ranked ninth for the southwestern university). Concern over faculty workload ranked first for the southeastern university, with the eastern public and private universities ranking it second (it ranked eighth for the southwestern university). Lack of release time ranked third for the eastern public university, but fourth for the eastern private and southeastern universities (it ranked seventh for the southwestern university). The highest inhibiting factor mean in the southwestern public university study was the lack of salary increase; second, lack of merit pay; third, no credit for work or promotion; fourth, lack of monetary support; and, fifth, lack of recognition. Ranked sixth was the desire for royalties, and the seven through ten mean rankings were lack of recognition, lack of release time, concern over faculty workload, and lack of technical support. Despite the findings of the earlier studies indicating the highest means for intrinsic motivators, those studies revealed there were indicators cited in those studies that did cite some of the extrinsic factors in their studies. Those extrinsic factors surfaced again in the later, southwestern public university study, but this time indicating a growing trend by faculty to choose extrinsic over intrinsic factors to motivate their

participation (or nonparticipation) in DE.

Reading in-between the Lines of the Survey Results

Research indicated that early adopters of DE, particularly computer and Internet-based DE, were intrinsically motivated to participate in DE (Betts, 1998; Dillon & Walsh, 1992; Olcott & Wright, 1995; Rogers, 1995; Wolcott, 1995; Wolcott & Haderlie, 1995). Feelings of accomplishment and satisfaction were enough reward for leading the way into innovation for these electronic pioneers. However, the growth of DE and the pace to which it has accelerated so rapidly have put tremendous pressures on universities and the pioneers in DE delivery. Today's DE faculty slump under the burden of too many e-mails and little or no help from teacher assistants or office staff. Surprisingly, many faculty still seem willing to consider taking on such a burden if they perceive their university is interested in supporting their efforts (Beggs, 2001; Bonk, Kirkley, Hara & Dennen, 2001; Bower, 2002; Byun, Hoseung, Paul, Hallett, Karen, & Essex, 2000; Johnston, Alexander, Conrad & Fieser, 2000; Mitchell, 1999; Stevenson, 2001). But these faculty also understand that time is a very precious commodity for them, so time spent on DE will likely take time away from some other priority, such as research. Extrinsic motivation has been claimed to be ineffective as a motivator, but a number of the research studies that reported those results either had small numbers of responses (Herzberg, 1964; Lepper, 1988), or were conducted more than two years ago (Betz, 1998; Lepper, 1988, 1992, 1996, 1997; Maslow, 1970; Schifter, 2000; Wolcott, 1999). The newer research studies indicate a strong trend towards extrinsic motivators as being crucial to faculty decisions to participate (or not) in DE (Bonk, 2001; Bower, 2003; Culp, 2001; Gannon Cook, 2003; Johnston, 2001; O'Quinn, 2001; Wolcott, 2002b).

Implications for Practice and Policy for Institutions of Higher Education

The most important influences remain intrinsic motivators, factors that the university cannot control. On the other hand, university policies can be crafted to enhance the extrinsic motivational factors of monetary rewards, insufficient rewards, technical-administrative support, and mandating participation. Mandating participation is a poor policy choice since job satisfaction and job stress are directly related to faculty control over the job and job tasks, the latter could lead to a corresponding drop in job satisfaction and costly increased faculty turnover.

The southwestern university study provided a better understanding of faculty needs and concerns with respect to distance education; and provided information that can be used for distance education faculty development programs and distance education policy revisions at the university studied in the survey. Universities that are encouraging voluntary participation in DE and are valuing their faculty with extrinsic motivators along with administrative support, are faring better with employee retention and ongoing DE participation.

If faculty see the commitment to DE is there, evidenced by multiple examples of what the administration is willing to do to support their commitment, such as technical assistance, course releases, and salary increases, then faculty members might be more willing to participate in DE. The support of the administration could demonstrate that authentic participation is actually occurring within the university and is not mere rhetoric (Anderson, 1998; Beggs, 2002; Bonk, 2001;). Authentic participation by administrative role-modeling lets the faculty know there is "buy-in"; but, more importantly, it conveys the message that the innovation is beneficial to both the university and to the faculty (Anderson, 1998; Clark & Kaufman, 2000; Herzberg, 1987; Striabiak & Paul, 1998; John-Steiner, Weber, 1999). The university administration must be an integral part of the faculty DE team, leading to success, not just presiding over DE in a top-down mode. Authentic participation by administration creates an environment conducive to team building, nurturing and collaboration that extends throughout the university (Anderson, 1998). "The culture and obligation of the university rewards system must reflect (administrative support), not in rhetoric, but in reality"(Hardi, 2000, available on-line). Faculty need to feel valued.

Value is intrinsic, but society places a value on value by assigning price tags to even the most modest of living accommodations. Therefore, extrinsic motivators, such as stipends, merit pay, and grants could help reinforce the university's acknowledgement of value to faculty who participate in DE.

It would be interesting to follow surveys on DE participation over the next several years to see if this trend continues, but judging from the more recent findings of the last two years (Beggs, 2002; Bonk, 2001; Culp, Riffée, Starrett, Sarin, Abrahamsen, 2001; Distance Education Report, 2001; Hunt & Crawford, 2001; Johnston, Alexander, Conrad & Fieser, 2000; Kirk & Shoemaker, 1999; McKenzie, Mims, Bennett, Waugh, 2000; Rockwell, Schauer, Fritz & Marx, 1999; Schott, 2002; Southeast Missouri State University, 2002; Southern Utah University, 2002; Wilson, 1999; Wolcott, 2002), and it is likely that it will, institutions will need

to accommodate these extrinsic motivation needs or face the risk of faculty attrition and challenges to the delivery DE programs.

The growing need for academe to adapt to electronic delivery is immediate, “not just to avoid extinction, but to actively cultivate opportunity” (Kiernan, 2002, p.54). Studies, such as this one, could help with assessments of which factors could motivate faculty to deliver these e-courses. “Academe must adapt its approaches to governance, too, to react more nimbly to technological changes...consultation and consensus-building are important in shared governance, in part to make sure that decisions are made thoughtfully...It’s important that all members of the (academic) community are involved” (2002, p.54).

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Table 1. *Highest Item Means Motivator-Inhibitors from Urban Universities*

| | Eastern Private (Betts, 1998) | Eastern Public (Schifter, 2000)* | Southeastern Public (Beggs, 2000) | Southwestern Public (SP; Gannon-Cook, 2003) |
|---|---|--|---|--|
| 1 | Ability to reach new audiences (1) | Personal motivation to use technology (1) | Personal motivation to use technology (1) | Personal Motivation to Use Technology (1) |
| 2 | Opportunity to develop new ideas (1) | Opportunity to develop new ideas (1) | Ability to reach new audiences (1) | Ability to reach new audiences (1) |
| 3 | Personal motivation to use technology (1) | Opportunity to improve my teaching (1) | Greater course flexibility for students (1) | Greater Course Flexibility for Students (1) |
| 4 | Intellectual challenge (1) | Opportunity to diversify program offerings (1) | Intellectual challenge (1) | Intellectual Challenge (1) |
| 5 | <i>Overall job satisfaction (1)</i> | Greater course flexibility for students (1) | Opportunity to develop new ideas (1) | Opportunity to develop new ideas (1) |

*Three items excluded: Salary increase, course release, and royalties

Table 2. *Comparison of Four Universities' Top Inhibitors*

| | Private Urban Eastern | Public Urban Eastern | Southeastern Public | Southwestern Public* |
|---|--|--|---------------------------------|-------------------------------------|
| 1 | Lack of tech support by inst. | Lack of tech support by inst | Concern over Faculty workload | Lack of Salary Increase (Factor 3) |
| 2 | Concern about faculty workload | Lack of Release Time | Lack of Tech Support | Lack of merit pay (3) |
| 3 | Lack of release time | Concern about faculty workload | Lack of release time | No credit for work or promotion (3) |
| 4 | Lack of grants for materials/ expenses | Lack of grants for materials/ expenses | Concern over quality of courses | lack of monetary support (3) |
| 5 | Concern over quality of courses | Concern over quality of courses | Lack of DE Training | Lack of recognition (3) |

*Gannon-Cook, 2003, p.193.

Table 3. *Items with highest means, items with highest item correlations for each factor, and five factors explaining the most variance (Gannon-Cook, 2003)*

| Items by highest means of fifty items | Five items with highest item correlations for each (factor) | Five factors derived from 53 items explaining 70% of the variance |
|---|---|---|
| Personal Motivation to Use Technology (1) | Opportunity to develop new ideas (1) | Traditional staff service |
| Ability to reach new audiences (1) | Salary increase (2) | Monetary rewards |
| Greater Course Flexibility for Students (1) | Lack of salary increase (3) | Insufficient rewards |
| Intellectual Challenge (1) | Lack of technical support (4) | Technical-administrative support |

| | | |
|--------------------------------------|----------------------|------------------------------|
| Opportunity to develop new ideas (1) | Required by dept (5) | Job advancement requirements |
|--------------------------------------|----------------------|------------------------------|

Helping Learners Gain Diagnostic Problem Solving Skills: Specific Aspects of the Diagnostic Pathfinder Software Tied to Learning Outcomes

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Introduction

Problem solving is of critical importance in many disciplines. In medicine, the clinician's ability to arrive at the correct diagnosis often means the difference between life and death. Despite its importance and a significant amount of research regarding how to improve problem solving, few unambiguous answers have emerged for promoting problem solving learning.

This paper follows up on recent published findings (Danielson, Bender, Mills, Vermeer, & Lockee, 2003) concerning the Diagnostic Pathfinder (DP), a software learning tool designed to help clinical pathology students improve their ability to solve diagnostic problems. That paper described the functionality of the DP, and showed that using the DP for homework and lecture improved students' grades on a case-based final exam by a full letter grade. Very little was discussed in that paper as to how characteristics of the software supported the gains that were seen. In the two years since that report was written, the DP has been used by 640 more students at five college of veterinary medicine. Quantitative learning gains similar to those reported in 2003 have been observed (as yet unpublished) in two other settings. In this paper we turn our attention to explaining those gains, both theoretically, and in terms of the qualitative data we have been able to collect from learners over the past two years. Our goal is to associate those gains with specific characteristics of the DP by and meaningfully categorizing and characterizing thousands of comments from students who used the DP in a number of different settings, and to use those comments to illustrate, from the students' perspective, how using the DP accomplished what it did. These ideas will be tied to current theory regarding the teaching and learning of problem solving.

Defining Problem Solving

One difficulty in building upon current problem solving research is that researchers in various fields study problem solving for differing purposes and define problem solving in different ways. Even within individual domains, the conceptual waters are muddy. In the domain of cognitive psychology, for example, where problem solving has received considerable attention, the heart of the issue seems to lie in whether to define problem solving in terms of the "gap" between what the problem solver knows and what he/she must figure out to solve a problem (Wenke & Frensch, 2003), or in terms of measurable characteristics of the problem solving task (Quesada, Kintsch, & Gomez, in press). Each class of definitions is both useful and problematic. Defining problem solving purely in terms of addressing the gap between what the learner knows and what he/she needs to know implies that literally any task can constitute problem solving (or not), depending on the interaction between the problem solver and the presented problem. This state of affairs makes it difficult to provide "controlled," yet authentic, instances of problem solving for laboratory study. At the same time, the skill that problem solvers employ when they address gaps in their own knowledge seems a worthy object of study, and it seems short-sighted to ignore this phenomenon simply because it is difficult to control for in a laboratory setting. As reiterated by Ericsson (2003), it has long been recognized that one potential pitfall of experimental science is that simple and convenient forms of inquiry can prove inadequate for studying complex phenomena.

If the definition of problem solving is unclear in the field of psychology, it is more so across many of the disciplines that attempt to teach students how to solve problems. While some researchers in various teaching fields (such as biology (M. U. Smith, 1991a) and chemistry (Bodner, 1991)) have made laudable efforts to put forward unified definitions of problem solving, one disturbingly prevalent practice seems to be to discuss problem solving in terms of whatever experts do in any given field when confronted with a problem that non-

experts can't solve. Researchers who do this face the problems embodied in both of the definitions put forward by cognitive psychologists without reaping any of the benefits of either; problem solving thereby ends up being neither defined by task characteristics nor by problem solver characteristics, and hence literally can mean almost anything to anybody. (This problem can be observed by perusing the chapters of Smith's (Ed.) *Toward a Unified Theory of Problem Solving: Views From the Content Domains* (M. U. Smith, 1991b).)

Researchers in the domain of instructional design generally have committed to a gap-based definition of problem solving (e.g. (Gagné, Briggs, & Wager, 1992; Jonassen, 2000; P. L. Smith & Ragan, 1999)). Task-specific distinctions are considered (perhaps best illustrated in Jonassen's proposed problem-solving typology (Jonassen, 2003)), but the a fundamental characteristic of addressing the unknown in some way remains a key component of problem solving. Smith and Ragan's (1999) definition of problem solving, as "the ability to combine previously learned principles, procedures, declarative knowledge, and cognitive strategies in a unique way within a domain of content to solve previously unencountered problems" (p. 132), is typical. For the purpose of our discussion, we will align ourselves with this definition because it most closely characterizes the phenomenon we wish to discuss. Specifically, for the purposes of this proposal, *problem solving* occurs when a person employs existing knowledge and skills to achieve a goal state that he or she never before had achieved. If successful, the problem solving process results in the learning of new knowledge/skills relevant to solving the problem that was encountered, and enables the problem solver to deal with similar future situations without having to go through the problem solving process again. How, then, is an instructional designer to improve individuals' abilities to do what they don't know how to do? That is the challenge we address here. To provide a framework, we will first discuss diagnostic problem solving from the perspective of medicine.

Medical Diagnostic Problem Solving

Medical problem solving literature lacks consensus regarding the processes and knowledge structures that contribute to diagnostic problem solving. This is partly due to the fact that, as discussed earlier, definitions of the term "problem solving" vary and the term generally tends to be used synonymously with "expert performance."

One perspective on medical problem solving generally can be characterized by Schmidt, Norman, and Boshuizen's (1990) proposed stage theory of clinical problem solving. They suggested that clinicians employ four stages of reasoning, which build upon, but do not replace, each other. Stage 1 involves the development of elaborate causal knowledge networks. Stage 2 involves compiling the elaborate networks into abridged ones. In stage 3, the clinicians develop illness "scripts," and in stage 4, they develop and use "instance scripts." Causal networks in the first two stages are based on underlying knowledge of pathophysiology, although stage 2 networks also are informed by observations of real patients. Stages 3 and 4 also are knowledge networks, but they are built increasingly on list-like structures containing information from real cases in the clinician's memory. The progression from one stage to another occurs as practitioners gain practical experiences that contribute to the cognitive representations of their knowledge. Causal networks of pathophysiology are not lost, nor do they grow as patient scripts slowly increase. The result is that most clinical problem solving ends up being script-based, rather than pathophysiology-based. Clinicians will tend to use the "highest" stage of reasoning available to them, depending on the availability and complexity of knowledge they have in any given domain. A clinician who has experience with a previous patient that fits a current patient will tend to use that experience as an instance script, whereas in an unknown situation the physician will revert to earlier stages until finding one that best accounts for the current problem. This theory explains the behavior of expert clinicians (and seems consistent with some other work done by researchers in the field of medical education (G. J. Groen & Patel, 1985; Guy J. Groen & Patel, 1991; Patel, Groen, & Norman, 1991) and with the generally accepted concept of the automaticity of expertise (Speelman, 1998; Winn & Snyder, 1996)). However, note that scripted behaviors are unlikely to entail problem solving as we have defined it, because those are the behaviors that experts use when addressing problems they are familiar with (or feel they are familiar with), and not when they address previously unencountered problems. Therefore, behaviors in "lower" stages are more likely to be characteristic of problem solving than are behaviors "higher" in the stages.

Research by Bordage and Lemieux (1991) sheds additional light on the model proposed above. They examined the semantic structures of experts and novices as such structures relate to diagnostic thinking. Their study, based on structural semantic theory, provided clinical problems for a variety of experts and novices and examined their solutions in terms of semantic relationships. These semantic relationships were used to reveal connections between the concepts that were relevant to solving the clinical problem. Each relationship identified was referred to as a "semantic axis." It was found that "the more diversified the diagnostician's network of semantic axes, the better was his or her diagnostic accuracy." In other words, the greater the number

of valid abstract relationships the subjects found between bits of information in the problem, the more accurate were their diagnoses. The number of semantic relationships for each case was not necessarily related to the number of words used to describe the analysis. Therefore, while an expert might appear to arrive at a diagnosis quickly and without much thought (i.e., with very few words), a semantic analysis would reveal that the expert has understood and identified a great number of valid relationships between the data without spelling them out as such. Bordage (1994) later examined his and Lemieux's findings in terms of their implications for arriving at accurate diagnoses. In his words, "The most accurate diagnosticians, whether students or specialists, are those who have the most diversified sets of semantic axes (those who have elaborated or compiled structures) and who organize symptoms and signs into coherent systems of relationships of abstract qualities, and thus demonstrate a broader and deeper representation and understanding of the problem (p. 884)." Several related studies (Cholowski & Chan, 1992; Stevens, 1991; Stevens, Ikeda, Casillas, Palacio-Cayetano, & Clyman, 1999) appear to support Bordage's assertion. While we are reluctant to imply a false dichotomy between the perspectives proposed by these researchers, Bordage's statement, in comparison to Schmidt et al.'s (1990) assertion that "expert clinical reasoning is, to a large extent, based on the similarity between the presenting situation and some previous patient available from memory" (p. 617), highlights one of the fundamental tensions that has characterized this body of literature. We feel that the evidence now available, including our own research, tends to support Bordage's implication that to truly become expert, students must become expert at associating relevant information within a case, rather than or in addition to comparing cases. We will see that this approach, as embodied in the DP, is associated by our students with an increase in their ability to solve diagnostic problems.

Cognitive Tools

The term *cognitive tool* has been used in a number of related ways over the past decade and a half (see, for example, Jonassen, 2003; Lajoie, Azevedo, & Fleiszer, 1998; Robinson, 1999; Salomon, 1988). Salomon (1988) presented the cognitive tool as a computer-based tool using or modeling an expert approach to a given process. He referred to the learner's interaction with cognitive tools as "AI in reverse." Whereas the goal of traditional artificial intelligence (AI) is to lead a computer to emulate the cognitive processes of people, Salomon suggested that learners' interactions with specifically designed software tools would lead them to acquire cognitive skills or strategies embodied in the software. Jonassen (2003) expanded the cognitive tool concept as follows:

Cognitive tools are any technologies that engage and facilitate specific cognitive activities. They amplify the learners' thinking by enabling learners to represent what they know using different representational formalisms. As knowledge representation formalisms, cognitive tools are premised on the idea that humans learn more from constructing and justifying their own models of systems than from studying someone else's (p. 372).

In addition to the intuitive benefit of making one's own thinking apparent, Jonassen points out that such a tool should also reduce the significant demand that complex problem solving places on working memory by harnessing the computer's ability to remember and organize. By this definition, the Diagnostic Pathfinder (DP) is a cognitive tool. The DP supports the learning of problem solving by presenting students with problems and requiring them to address those problems within the framework of the software. This paper does not accommodate a detailed description of how the Diagnostic Pathfinder functions. Such a description is provided elsewhere (Danielson et al., 2003). In brief, through a series of interactions, the DP presents a patient case that includes history, signalment, physical exam, and laboratory data, and then requires students to identify all abnormal laboratory data and communicate their diagnostic reasoning by organizing those data into a diagnostic path. The diagnostic path displays the students' diagnostic reasoning in an outline form of propositions that relate changes in laboratory data to the corresponding disease or physiologic processes occurring in the patient. After students commit to a diagnosis, a diagnostic path created by a faculty clinical pathologist is revealed for immediate comparison. This comparison allows both students and faculty to see the rationale used by the other when analyzing a patient's laboratory data.

Methods and results

Subjects

Between the Spring of 2002 and the Fall of 2004, the DP was used to teach eight semesters of Clinical

Pathology at five colleges of veterinary medicine. A total of 640 students participated in these classes, with roughly 70% of those students being female and 30% male. Other than one small pilot course of five students, the smallest class contained 42 students, with the largest containing 126, and the average class size being 80 students. All students participating in these courses were asked to complete a questionnaire regarding their experience with the DP software. Five hundred and forty three students completed the questionnaire. By class, this response rate varied from 46% (the lowest) to 100% (the highest), with the overall response rate being 84%.

Procedures

Students at the participating institutions used the DP to complete case-based homework assignments and prepare for exams. The number of DP cases assigned to each student using the DP varied from institution to institution, with the smallest number being 6, and the greatest number being 93. Curricular approaches at the institutions varied as well, though all but one of the institutions employed what might loosely be described as a traditional medical curriculum in which students received lectures in Clinical Pathology interspersed with laboratories involving the discussion of laboratory data for specific animal cases. The other institution, which only represents five of the students surveyed, uses a curriculum that mixes several approaches, including traditional strategies, collaborative learning, and problem based learning (PBL).

Instruments

The full questionnaire upon which the findings for this study are based is found elsewhere (Danielson et al., 2003). The questionnaire was designed to determine the students' perceptions of the DP's clarity (or usability), feasibility, and impact on learning. Responses to the items dealing with feasibility and clarity have changed systematically over time as the software has been debugged and various changes have been made in navigation, etc. We will not explore those responses in this paper. Rather we will focus specifically on the items designed to reveal the students' perceived impact of the DP on learning. Because the software's core learning interaction has remained largely unchanged, a comprehensive analysis of the students' reaction to the instructional attributes of the software can be performed meaningfully. The questionnaire items having to do specifically with learning outcomes are: 6, 7, 12, 16, and 17, and are found in Table 1. Other items, particularly those intended to measure enjoyment or ease of use, can arguably be hypothesized to indicate learning gains as well, at least indirectly. However, these items are also closely tied to software feasibility factors, such as computer bugs, network problems etc., so we will not discuss them here. In addition to the results of items 6, 7, 12, 16 and 17, we will examine responses to the survey's open-ended questions, many of which clarify the students' general indications of their response to the software's affect on learning. Those questions are as follows:

23. For questions above that you ranked particularly negatively, please indicate why here.
24. What are the things you like most about using the DP?
25. What are the things you like least about using the DP?
26. What would you change about the DP if you could?
27. Any additional comments you'd like to make about the DP:
28. If you used the DP for less than 20% of your cases, why did you choose not to use it?

Data analysis procedures

Descriptive statistics were calculated for responses to survey Likert items across all respondents by institution. Open-ended responses were analyzed initially by one of the primary researchers to reveal broad trends in the data. The responses were then codified according to those trends, and recorded in an access database by a research assistant. The coding was then reviewed and corrected as necessary by one of the primary researchers.

Presentation and Analysis: Likert Items

Table 1 reports student responses to the Likert items by institution and year. Students at all institutions generally indicated that the knowledge or behaviors identified in items 6, 7, 12, 16, and 17 were enhanced by DP use. Item 6 was intended to measure perceived completeness – i.e., how many data abnormalities students accounted for. Item 7 was intended to measure whether or not students felt that DP-use affected the precision of their diagnostic rationale, and, if so, whether the effect was positive or negative. As seen, students generally felt that DP-use made their rationale more precise. Items 12 and 17 were intended to function as general indicators

of the students' appraisal of the DP's overall value to them as a learning tool. As seen by responses to those items, students generally found the learning value to be quite high. Finally, item 16 was intended to get a general sense of the DP's affect on the students' ability to organize the data relevant to solving a particular case. Again, as seen, the students generally indicated that the DP's affect on their ability to organize data was positive.

Table 1 *Mean responses by item number, institution and year:*

| Institution/Yr | Mean | Median | Max | Min | Sample Size |
|---|----------------------|------------|------|-----|-------------|
| 6. Using the DP made me account for more lab data than I otherwise would have accounted for. | | | | | |
| | less | same | more | | |
| | 1 2 3 4 5 6 7 8 9 10 | | | NA | |
| Virginia Tech 2002 | 8.7 | 9 | 10 | 5 | 86 |
| Iowa State 2002 | 8.5 | 9 | 10 | 2 | 96 |
| Iowa State 2003 | 8.4 | 9 | 10 | 5 | 68 |
| Wisconsin 2003 | 8.1 | 8 | 10 | 5 | 42 |
| Wisconsin 2004 | 8.2 | 8 | 10 | 5 | 65 |
| California Davis 2003 | 7.7 | 8 | 10 | 1 | 55 |
| California Davis 2004 | 8.6 | 9 | 10 | 2 | 124 |
| Guelph 2003 | 8.6 | 9 | 9 | 8 | 5 |
| 7. Using the DP made my diagnostic paths more precise than they would have been otherwise. | | | | | |
| | less | same | more | | |
| | 1 2 3 4 5 6 7 8 9 10 | | | NA | |
| Virginia Tech 2002 | 8.7 | 9 | 10 | 4 | 86 |
| Iowa State 2002 | 8.1 | 9 | 10 | 1 | 96 |
| Iowa State 2003 | 8.3 | 9 | 10 | 1 | 68 |
| Wisconsin 2003 | 7.8 | 8 | 10 | 3 | 42 |
| Wisconsin 2004 | 8.3 | 8 | 10 | 3 | 65 |
| California Davis 2003 | 7.2 | 7 | 10 | 3 | 55 |
| California Davis 2004 | 7.8 | 8 | 10 | 2 | 124 |
| Guelph 2003 | 8.0 | 8 | 10 | 6 | 5 |
| 12. The DP makes doing my Clinical Pathology homework more worthwhile than similar paper-based assignments. | | | | | |
| | definitely not | absolutely | | | |
| | 1 2 3 4 5 6 7 8 9 10 | | NA | | |
| Virginia Tech 2002 | 8.6 | 9 | 10 | 1 | 86 |
| Iowa State 2002 | 7.9 | 9 | 10 | 1 | 96 |
| Iowa State 2003 | 8.6 | 9 | 10 | 3 | 68 |
| Wisconsin 2003 | 6.8 | 7 | 10 | 1 | 42 |
| Wisconsin 2004 | 7.4 | 8 | 10 | 2 | 65 |
| California Davis 2003 | 6.1 | 6 | 10 | 1 | 55 |
| California Davis 2004 | 7.3 | 8 | 10 | 1 | 124 |
| Guelph 2003 | 8.8 | 9 | 10 | 7 | 5 |

16. Using the DP helps me to organize my thoughts about a case.

| | definitely not | | | | | | | | | | absolutely | | | |
|-----------------------|----------------|---|---|---|---|---|---|---|---|----|------------|----|---|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | NA | | | |
| Virginia Tech 2002 | 8.4 | | | | | | | | | | 9 | 10 | 2 | 86 |
| Iowa State 2002 | 8 | | | | | | | | | | 9 | 10 | 1 | 96 |
| Iowa State 2003 | 8.6 | | | | | | | | | | 9 | 10 | 4 | 68 |
| Wisconsin 2003 | 8.3 | | | | | | | | | | 9 | 10 | 3 | 42 |
| Wisconsin 2004 | 8.2 | | | | | | | | | | 9 | 10 | 2 | 65 |
| California Davis 2003 | 6.8 | | | | | | | | | | 7 | 10 | 1 | 55 |
| California Davis 2004 | 7.8 | | | | | | | | | | 8 | 10 | 1 | 124 |
| Guelph 2003 | 8.8 | | | | | | | | | | 9 | 10 | 8 | 5 |

17. Using the DP makes understanding clinical pathology....

| | harder | | | | | | | | | | easier | | | |
|-----------------------|--------|---|---|---|---|---|---|---|---|----|--------|----|---|-----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | NA | | | |
| Virginia Tech 2002 | 8.3 | | | | | | | | | | 9 | 10 | 3 | 86 |
| Iowa State 2002 | 8.2 | | | | | | | | | | 9 | 10 | 1 | 96 |
| Iowa State 2003 | 8.9 | | | | | | | | | | 9 | 10 | 6 | 68 |
| Wisconsin 2003 | 8.5 | | | | | | | | | | 9 | 10 | 4 | 42 |
| Wisconsin 2004 | 8.4 | | | | | | | | | | 8.5 | 10 | 5 | 65 |
| California Davis 2003 | 6.9 | | | | | | | | | | 7 | 10 | 3 | 55 |
| California Davis 2004 | 7.9 | | | | | | | | | | 8 | 10 | 1 | 124 |
| Guelph 2003 | 8.3 | | | | | | | | | | 8.5 | 10 | 6 | 5 |

Presentation and Analysis: Open-Ended Responses

We analyzed the responses to open-ended items with the hopes of understanding more specifically, from the learners' perspective, what characteristics of the software produced the results we had measured empirically in earlier studies. Here we will not report all open-ended responses, because of the large amount of information involved. Also, we will not report the results by survey item number, because there isn't always a predictable relationship between the nature of the question that was asked and the actual response. For example, the question, "What are the things you like most about using the DP?" elicited both of the following responses: "It was great in getting concepts stuck in my head. . ." and "I really didn't like it."

The open-ended responses were analyzed as follows. One of the primary researchers read through all the responses several times, identifying broad thematic categories. All the open-ended response data were then reviewed, coded, and categorized by a research assistant, in consultation with one of the primary researchers and with the aid of an Access database. This process resulted in several categories being combined, expanded, or eliminated. The resulting categories, in order of most responses to fewest, were as follows: 1. General Response, 2. Ease/Efficiency of Thinking 3. Ease of Use/Convenience, 4. Requirement that all data abnormalities be typed by hand and spelled correctly. 5. Requirement of completeness 6. Expert feedback, 7. Process of Manipulating Data in the diagnostic path, and 8. Diagnostic path format. Responses in each category were coded as either (a) positive comments, (b) negative comments and/or suggested improvements, or (c) comments that were mixed (both positive and negative) or in some way unclear. We then counted each response-type by category. Recall that all 543 students responded to the questionnaire. Because the Likert responses were largely positive, it would be expected that responses to open-ended questions would be as well. At the same time, because more open-ended questions were designed to elicit critical responses or suggestions for improvement (items 23, 25, 26 & 28) than positive responses (item 24), it seems reasonable to expect a disproportionately high number of critical comments.

1. General Response Category:

This category was used to broadly characterize the overall tenor of individual respondents' appraisal of the DP as a learning tool, considering all the responses to the open-ended questions. This category was considered important because many respondents gave mixed feedback (i.e., some positive comments and some

criticisms or suggestions for improvement). All the comments for each respondent were considered cumulatively to determine if the overall impression of the software was positive or negative. In some cases, it was too difficult to identify one overall sentiment from a respondent's open-ended responses. Such respondents were classified as "unclear_neither_both". Of the 543 total respondents, 242 made comments that were judged to be predominantly positive, 152 made comments that were classified as unclear_neither_both, and 20 made comments that were predominantly negative. Many of the responses that contributed to this broad categorization will be discussed when we discuss the other nine specific response categories.

2. Ease/Efficiency of Thinking

A number of open-ended responses referred to the software's general effect on the way students perceive themselves as thinking about the problems. Of comments in this category, 178 were positive, 2 were mixed, and 5 were negative. The positive comments ranged from fairly vague statements such as, "a great way to get us to think clinically. . ." to more specific statements such as, "helps me be organized about my thoughts, shows me clearly flaws in my logic and ability to reason," and ". . . I could organize my thoughts in a logical manner." The two respondents who gave mixed responses in this category seemed to simultaneously feel that the DP was useful, but that it didn't change the way they would think about clinical pathology, or that it was inconsistent with their way of thinking. One respondent for example, made both of the following statements in response to different questions: "The DP did not make me understand clinical pathology any better. I still needed to use paper at times to organize my thoughts and group findings." and "[The DP is] very repetitive and good for learning how to rank and place abnormalities." Five students made comments suggesting that they felt the DP did little to help their thinking, or that the amount of effort required to use the DP did not justify the benefits that were derived from its use. For example, one respondent said, "I feel like you can breeze through the case without really learning a link between cause and effect." Another said, "I spent much more time using DP or putting this stuff on computer than it took to understand/make my problem list and reasonings on the lab data sheets. Not saying it probably didn't help cement things, but it was more time than necessary for my understanding (I felt)."

3. Ease of Use/Convenience

A number of respondents referred to the convenience or ease of using the DP. One hundred and fifteen respondents made positive comments in this category, 13 made mixed comments, and 21 made primarily negative comments. Some positive comments referred to specific aspects of the software that made study more convenient, such as the ability to work from any computer, the ability to work/save cases on-line, or the ability to save a partially completed case. Such comments included "online and total select" (the latter referring to the ability to select multiple data items in manipulating the data), and "being on the computer." Other positive comments were simple generic statements of convenience, such as "saves time", or "easy." Mixed comments often had to do with student responses to different aspects of the software, for example, one student objected to the fact that the software tied up the phone line, and experienced some trouble installing it, but still indicated that the software "Saves time, its easy." Other students indicated that their perception of the ease of use changed over time. For example, one said, "The first few cases seemed more overwhelming as the process was entirely new; once I was familiar with the program, there were no difficulties stemming from the program." The negative comments were usually tied to factors inherent in working with a computer. Some students did not own an adequate computer, and so completed their assignments on lab computers, which they did not find convenient. Other students expressed a preference for working without computers.

4. Requirement that all data abnormalities be typed by hand and/or spelled correctly

The DP requires that students manually enter names of all data abnormalities spelled correctly. Forty three students only made positive comments about this requirement, 10 students made mixed comments, and 71 students made primarily negative comments. Characteristic of positive comments, one student, when asked what he/she liked best about the DP wrote: "The structure of having to learn vocabulary by retyping. . ." Other students made only positive comments about this requirement, but only mentioned partial aspects of the process. For example, a number of students mentioned that they liked being told the correct spelling of data abnormalities after three tries. Most comments in this category emphasized that the primary benefit of this requirement was learning the vocabulary. One student providing a mixed review listed what he/she liked most about the program as "Learning new vocabulary," and what he/she liked least as "Having to repeat over and over the same vocabulary." Most of the negative comments in this category had to do with the requirement of typing each data abnormality name multiple times. For example, one student wrote, "Typing in lab data gets

repetitive and annoying,” and another wrote, “Sometimes just filling out the names of all the abnormalities was very time consuming.” However, it seemed clear from many of these responses that it was the repetitiveness, and not the basic requirement of generating the names that most objected to. For example, the same student who made the previous comment also suggested, “Perhaps as one becomes more advanced, lab abnormalities can be pre-identified, making it easier/quicker to complete a case,” suggesting that the requirement to type abnormalities is an acceptable entry-level requirement. Other students seemed to object to the requirement of correct spelling at all. For example, one student wrote, “I’d have a glossary for tests and abnormalities just for “pop up” spelling. I get mad having to retype for spelling,” and another wrote that the software would be improved by “giving a break on incorrect spelling by 1 or 2 letters.”

5. Requirement of completeness

Ninety seven students commented on the aspects of the software that require the learner to consider all laboratory data when constructing a diagnostic rationale, or to classify all data as being normal or not. Of those comments, 73 were positive, 9 were mixed, and 15 were primarily negative. Positive comments included, “couldn’t ignore any abnormalities,” “made me account for the data abnormalities,” and “It made me analyze each and every piece of data, something I probably normally would not have done.” One of the students providing a mixed review said, “The *DP* made me get more lab results than I probably would have gotten otherwise, but I sometimes found myself sifting thru them in a rote manner. Not really a *DP* problem-more my problem.” Another wrote that what she/he liked best about the *DP* was that “It makes you account for every abnormality even insignificant ones.”, while what she/he liked least about the *DP* was that, “It makes you account for every abnormality even on cases where the solution is obvious.” One student providing primarily negative comments reported liking least, “Having to account for every extraneous, insignificant detail that[’s] outside the norm.” Another reported that she/he did not like, “Having to account for morphology results that were normal. No way to avoid putting them in the path.”

6. Process of manipulating data in the diagnostic path/format of diagnostic path

Eighty nine students commented on the process of manipulating data in the diagnostic path. Forty six of these students made generally positive comments about this process, 4 made mixed comments, and 39 made primarily negative comments, or suggestions for improvement. Many of the positive comments had to do with the ease of manipulating the data. For example, when asked what they liked best about using the *DP* one student wrote, “I can move things easier than erasing them,” another wrote, “neatness and ability to quickly and easily rearrange *diagnostic paths*,” and a third wrote, “organizing clinical abnormalities and formulating a diagnostic path.” One of the students providing a mixed review observed as a benefit that the *DP*, “helps me to analyze data more efficiently,” while also noting as something she/he didn’t like that it “takes a long time to construct a path.” Many of the negative comments in this category had to do with the difficulty inherent in considering/presenting all the relevant data at once. For example, one student wrote that, “Not being able to see the entire path at once makes it difficult to organize my thought further along the path,” and another observed that “It was difficult to tell what signs/data still needed to be placed into the diagnostic path.” Other students had difficulty with specific aspects of the diagnostic path construction process, such as not being able to easily place mechanisms where they wanted them to appear in the diagnostic path. Finally, some students recommended that concept map-style diagrams be used in portraying the diagnostic path, as opposed to the outline format currently used.

7. Expert feedback

Eighty three students commented on the feedback they receive regarding their rationale in the form of the expert diagnostic path. Sixty eight of these comments were strictly positive; 15 were mixed. The following are illustrative of the positive comments: “I can compare my list to the expert list right away,” “The professional pathways given very quickly,” and “I liked having immediate feedback; I think that is very beneficial to learning something new.” The fifteen students giving mixed comments all found the expert feedback useful, but wanted that feedback altered or expanded in some way. For example, one student wrote, “I wish the expert path had a few more notes explaining certain things instead of just listing them,” and another wrote, “I would like it more interactive at the end when I compare my diagnosis with the clinical pathologist’s.” Several students also indicated wanting access to the expert rationale without having to complete the case first. None of the comments suggested that students did not want expert feedback.

Discussion

The Likert responses provide a valuable perspective for interpreting the open-ended responses. Clearly, based on the Likert response data, most of the negative comments or suggestions for improvement came from students who overall felt the DP was a useful learning tool. This is supported by findings from comments in the first category. Overall, positive comments outnumbered mixed comments by a ratio of 1.6 to 1, and positive comments outnumbered negative ones approximately 12 to 1.

The greatest number of positive comments fell into the second category, which we have called “ease/efficiency of thinking” because these comments tend to make claims regarding the DP’s effect of helping to organize or clarify thoughts, or to make learning/thinking easier. These comments are perhaps the most difficult to interpret because this category contains the most vague positive statements. However, at the risk of stating the obvious, all these comments must refer to one or more things that the DP does, or allows. Also, since the same broad group of respondents produced comments in the other categories we have provided, it seems likely that many of the vague positive impressions, if the students could have been prompted for specifics, would have fallen into one of the broad categories 3 – 7. Similarly, because so many of these comments seem to center on the organization of thinking, it seems fair to say that these indications support the broad claims of cognitive tools enthusiasts that encouraging students to create representations of the knowledge relevant to solving a given problem will enhance their ability to solve that (and similar) problems. Furthermore, the fact that the enforced organization of pathophysiologic concepts is identified by the students as helpful to learning, and that it is associated with greater performance on related problem solving tasks, supports the idea that improved problem solving performance is related to practice producing robust representations of the problem’s sub-elements.

As seen with the third category, one hundred and fifteen students specifically mentioned finding DP-use convenient/easy. The main idea seems to be that many students consider it easier to deal with/manipulate information electronically than it would be in paper form. This is true both in the context of the software itself, where concepts can be identified and manipulated without the necessity of erasing, re-writing, etc., as well as in the administrative aspects of the homework process (receiving assignments, partially completing and saving assignments, submitting assignments, etc.). Clearly, the data manipulation aspects of this preference could be theorized to have a beneficial impact on learning. It certainly seems reasonable to suggest that any relief an instructional approach may pose in administrative cognitive overhead will allow learners to focus more attention on integrating/understanding domain-specific concepts.

The fourth category, the one requiring students to enter all data abnormality names manually and spelled correctly, received by far the greatest proportion of negative comments. In fact, the number of students who felt this policy required a change outnumbered those who made positive comments about it by a ratio of 1.7 to 1. At the same time, among the forty three students who endorsed this feature, as well as among many arguing for change, there was strong agreement that writing data abnormality names manually resulted in learning the vocabulary. This was the intended outcome of this feature. It will be our goal to adjust the current requirements to the point that student learning and annoyance are optimized against each other. We plan to do this by allowing students to “pass out” of the spelling requirement by spelling data abnormality names correctly the first few times they encounter them, and then either having an auto-fill feature or a pull-down list become available for those students.

The fifth category referred to various gating behaviors of the DP that require students to consider all data that technically fall outside of the reference ranges for every test in any given case (even if such data turns out to be clinically insignificant). This feature was viewed as beneficial for learning by many students, with positive comments outnumbering negative comments or suggestions for improvement by a ratio of 4.9 to 1. In essence, many students felt that they considered more information than they would have considered had they not used the DP, and that doing so resulted in superior understanding of the underlying pathology and physiology. While a reasonable fear might be that this aspect of the software would serve as a crutch rather than a scaffold, with students returning to “ignoring” behavior with the DP withdrawn, that does not seem to have been the case, given the students’ improvement on case-based exams that were entirely paper based.

The sixth category involves the process of manipulating data in the diagnostic path. Recall that this is a process of dragging and dropping concepts or clusters of concepts in an outline format, where it is understood that items above and to the left cause items below and to the right, or items below and to the right are supportive of items above and to the left. Students having only positive things to say about this process slightly outnumbered those having primarily criticisms or suggestions for improvement (1.2 to 1). Clearly, this process worked well for many students, but also was difficult for a significant number of others. While some other formalism for representing the learners’ knowledge might be less problematic for more students, there are

reasons to suspect that this process will be difficult regardless of the formalism used. First, the information-synthesis task is very difficult, regardless of the mechanisms used to assist the learner in accomplishing it. In this case, students had to represent causal and/or supportive knowledge involving dozens of discrete concepts in most cases, and more than a hundred discrete concepts for complicated cases. Given the known limitations of human cognition, this process is inevitably difficult regardless of the information-presentation formalism that is employed. Second, current commonly available electronic display technology doesn't permit for the spatially meaningful representation of large numbers of concepts simultaneously. This number can be very low for students with older computers that only display at a resolution of 640X480 or 800X600 pixels. Therefore, some students would not be able to represent as many concepts using the DP as they might be able to do using other traditional mechanisms of data representation, such as a blackboard, or a large piece of paper. In summary, our future research/development will explore providing optional ways of representing the diagnostic rationale, such as concept maps, with the hope of maximizing clarity and spatial efficiency, and accommodating individual learner preferences. At the same time, however, we suspect that the complexity of the task coupled with display limitations will continue to be problematic for learners, regardless of the formalism used to display the data.

The data presented in the seventh category show significant support for the DP's feedback feature whereby students receive feedback regarding their rationale in the form of an "expert rationale" created by an expert clinical pathologist completing the identical case using the DP. All respondents who mentioned this feature felt that this feature was valuable, with some requests that it be expanded in some way. This should come as no surprise to most readers – immediate and meaningful feedback is prescribed by many common instructional approaches, and these data support the general idea that feedback is a good idea. Again, one particular strength of this approach is that the expert and the student both used the same process to construct the diagnostic rationale, making it possible to attribute differences between student and expert rationale to different understandings of the underlying concepts, rather than to differences in the representation of the problem.

Implications for the Design of Software Tools

One of the complexities of attempting to meaningfully synthesize open-ended responses is that structure and order have not been pre-imposed on the resulting data, as commonly occurs with more traditional empirical approaches to research. The results can frequently represent a hodgepodge of ideas. In this case, however, we feel that several strong coherent concepts emerged that can be useful to the designer of software learning tools. These ideas should be evident in the discussion section. Here we briefly review them. 1. Our findings appear to support the general cognitive tool concept – that requiring learners to create detailed representations of the relationships between the concepts required to solve a given problem will promote understanding and problem solving ability in that domain. 2. Meaningful feedback is important. In our context, producing and presenting feedback in the same manner used by students to create their rationale appears to have been beneficial. 3. Students saw benefit in the DP's effect on the organization of their thoughts. This was accomplished in two ways: first, through gating the tasks relevant to solving the problem (data identification first, followed by data synthesis), and second, through use of the outline-based diagnostic path formalism. 4. The ease/convenience of electronically manipulating problem elements, and managing the larger learning process was appreciated by many students, and may have decreased the "data management" cognitive requirements for students.

Limitations and Future Directions

This study is part of a larger research project. These Likert-based and open-ended response data are intended to explore the specific aspects of the DP that produced the learning gains that were seen. While these findings seem compelling, the fact that they are based on the subjective analysis of open-ended response data suggests further studies to explore these principles empirically. For example, a version of the DP could be created that relaxes gating requirements. Second, the problem-solving tasks in which the students engaged constitute complete and authentic diagnostic problem solving tasks from the perspective of clinical pathology. Often, all the data a clinical pathologist has to consider are laboratory data, signalment, and a brief history. However, this process is not representative of the broader clinical problem solving process, which involves additional data and data collection, as well as the handling of therapy. In the future, we must further explore outcomes of DP-use using broader measures of problem solving, and including clinical problem solving performance.

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Training and Transfer of Complex Cognitive Skills: Effects of Worked Examples and Conventional Problem-Solving

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Abstract

Thirty six senior students in chemical engineering were randomly assigned to three treatment groups in an experimental study that examined the impact of different instructional strategies for troubleshooting malfunctions in a computer-based simulation of a chemical processing plant. In two groups, different types of worked examples, process-oriented and product-oriented, were given to participants as instructional strategies for troubleshooting four plant malfunctions. The third group was given a conventional problem solving strategy for the same four problems. The results of participants' performance on solving a set of eight near-transfer problems indicated no significant transfer differences among the treatments. Neither did a far transfer task result in any significant differences. The findings of the current study supported the notion of the "expertise reversal effect" (Kalyuga, Ayres, Chandler, & Sweller, 2003), which argues that presenting new information to learners with pre-existing schemata in a given domain does not improve transfer and may induce extraneous cognitive load. Given the prior knowledge of the participants, these findings were also consistent with Sweller's (2004) thesis on the "central executive function" and his description of the "redundancy effect."

In his analogy between evolution by natural selection and human cognitive architecture, Sweller (2004) lists the assumptions of cognitive load theory. The theory assumes that the purpose of instruction is to build knowledge by making small incremental changes in long-term memory. He argued that, similar to the way a potentially injurious drastic alteration in the human genome is usually prevented by the process of natural selection in species, a sweeping change in an individual's long-term memory is prevented by the severe limitation of working memory when assimilating unfamiliar information. Such assimilation when no schema exists for organizing new information is performed by searching and testing the fit of random combinations of elements in the new material against premises derived from established assumptions retrieved from long-term memory. The demand on working memory is raised exponentially as the number of unfamiliar interacting elements of information is increased. The random search is essential to the human cognitive architecture when learners face completely unfamiliar information and a central executive is absent. However, when facing *familiar* information as opposed to *unfamiliar* information, a highly effective central executive function becomes available. As opposed to the human genome, this function is not a general biological structure, but a specific learned structure retrieved from long-term memory. In other words, cognitive processes conditioned by domain-specific knowledge act as the central executive when sufficient elements of instructional material are familiar. On the other hand, when the learner lacks a central executive because the information is unfamiliar, the use of worked examples in the design of instructional material can provide a surrogate central executive that constrains the problem space and the number of interacting elements to be randomly searched.

Based on Sweller's (2004) argument, when instruction is properly designed, effective changes to long-term memory structures are orderly and occur in small increments. Cognitive load theory provides guidelines for designing instruction. Investigating and expanding upon these guidelines, researchers have identified instructional strategies that can facilitate incremental changes in long-term memory. The use of worked examples is one of those instructional strategies that promotes efficient and effective learning by reducing extraneous cognitive load through the introduction of schemata and by acting as the "instructional central executive" (p. 21) and accommodating the limited capacity of the working memory of novices.

When teaching complex cognitive skills to novices, the instructional strategy of presenting a set of worked examples for learners to study has been repeatedly found more effective than the conventional problem solving strategy in which they are provided problems to solve immediately after presentation of information in the domain (e.g., Cooper & Sweller, 1987; Paas, 1992; Paas & van Merriënboer, 1994a; Sweller & Cooper, 1985; for a review, see Atkinson, Derry, Renkl, & Wortham, 2000). Two types of worked examples, process-

oriented and product-oriented, have been distinguished with regard to the cognitive load those worked example strategies impose on learners and the instructional efficiency of those types (Van Gog, Paas, & Van Merriënboer, 2004). Specifically, Van Gog, et al. proposed that in the initial instruction of novices, the process-oriented worked example strategy, which explains not only *how* to solve a given problem but *why* the operations are employed, would result in greater problem solving performance and transfer. In contrast, the product-oriented worked examples strategy that just describes the procedures involved in solving a problem would be more effective only after a learner has constructed relevant schemata.

Based on Van Gog, et al.'s (2004) contentions, process-oriented worked examples should be more effective when used with novices who have established relevant schemata prior to instruction. They would therefore benefit from the knowledge provided by *why* problem solving principles. To our knowledge, no empirical studies have been conducted to examine both of these strategies at once for their impact on the instructional outcomes. The current study investigated the effects of these two types of worked examples with a control condition that employed conventional problem solving. It reports measured effects on performance of acquired skills in troubleshooting.

Method

Participants

Thirty-six senior engineering students enrolled in a Chemical Engineering Design course offered by the Florida A&M University – Florida State University College of Engineering participated in the study as part of a required class assignment. They engaged in this activity as a required assignment in their final semester of the bachelor's degree program. Twenty-one of the participants were male and 15 were female. All except one were Chemical Engineering majors and had taken courses that introduced concepts of distillation.

Procedure

The participants engaged in instruction about a water-alcohol distillation plant as a simulation specifically designed (De Croock & Betlem, 1999) for experiments in the area of complex cognitive skills (see Figure 1). The initial instruction on how to operate the simulation was the same for each participant. In the following treatment, three instructional strategies were employed: (1) process-oriented worked examples, (2) product-oriented worked examples, and (3) conventional problem solving. Each of the three treatment groups encountered the same four faults in the plant. For even distribution of participants with varying degrees of prior knowledge in distillation, the subjects were divided into two categories of high and low according to their scores in a recent course that taught them distillation. Equal numbers of participants in high and low categories were then randomly assigned to the three treatment groups and were given, process-oriented worked examples (PC), product-oriented worked examples (PD), and conventional problem solving (PB).

Following the instruction, as a near-transfer task, all 36 participants diagnosed eight malfunctions they had not previously encountered, for which they were limited to 12 minutes for each malfunction. Participants were told to "make as few incorrect diagnoses as possible and diagnose the malfunction as quickly as possible." A far transfer task designed in CHEMCAD measured the number of trials for participants to solve a problem conceptually related to the near transfer task. CHEMCAD is a computer simulation program used by chemical engineers.

Performance Measures

Three measures of performance were used to assess learners' performance. Those three measures were (1) the total number of correct diagnoses within the 12 minute limit, (2) the number of incorrect diagnoses participants reported, and (3) the time required to diagnose a malfunction correctly.

Mental Effort

The 9-point Mental Effort Scale (Paas & van Merriënboer, 1994b) measured the subjects' perceived mental effort invested in performing the tasks. At the high end of the scale, 9 was associated with the response "very, very high mental effort" and at the low end of the scale, 1 was associated with the response "very, very low mental effort." The scale was administered immediately following each correct diagnosis and repair to provide a subjective rating of the variable "cognitive load."

Results

With alpha set at .05, an ANOVA revealed no significant differences among the treatment conditions

on any of the dependent measures of performance. Table 1 displays the mean performance scores and standard deviations for treatment groups, summed across the eight problems, along with reports of perceived mental effort. The far transfer performance measured in number of trials to solve the problem are also reported in Table 1.

Table 1 Means and standard deviations of dependent measures summed across eight problems

| | <i>Process-oriented worked examples (PC)</i> | | <i>Product-oriented worked examples (PD)</i> | | <i>Conventional problem solving (PB)</i> | |
|--|--|-----------|--|-----------|--|-----------|
| | <i>M</i> | <i>SD</i> | <i>M</i> | <i>SD</i> | <i>M</i> | <i>SD</i> |
| Correct diagnoses | 6.91 | 1.00 | 6.75 | 0.97 | 7.17 | 0.83 |
| Incorrect diagnoses | 27.3 3 | 13.0 9 | 32.3 3 | 12.3 5 | 25.7 5 | 7.88 |
| Time to correct diagnoses (in seconds) | 108 6 | 402 | 1097 | 320 | 103 4 | 357 |
| Perceived mental effort | 44.3 3 | 11.2 2 | 46.8 3 | 8.86 | 40.4 1 | 6.88 |
| Far transfer performance | 14.0 8 | 5.87 | 15.9 2 | 7.25 | 17.5 8 | 12.8 5 |

Further analysis of the data revealed an unexpected difference between male and female participants on two of the performance measures. Females had a significantly ($p = 0.02$) higher number of incorrect diagnoses ($M = 33.60$, $SD = 11.35$) than males ($M = 24.81$, $SD = 10.12$). They also took less time, calculated in seconds ($M = 870.93$, $SD = 227.52$), than their male counterparts ($M = 1215.62$, $SD = 332.95$) to correctly diagnose the malfunctions ($p = 0.002$).

Discussion

In the context of Sweller's (2004) analogy of human cognitive architecture to evolution by natural selection, worked examples can provide an instructional central executive when none exists in the domain represented by the learning tasks. Worked examples are found to be effective (Cooper & Sweller, 1987; Paas, 1992; Paas & van Merriënboer, 1994a; Sweller & Cooper, 1985) because they cause incremental changes in long-term memory through acquisition of the new information they present, thus building new schemata. However, if a learner's long-term memory contains pre-existing schemata for solving problems in the domain, the instruction would not be effective and could even impose extraneous cognitive load.

In this context, the process-oriented worked examples were expected to contribute to the participants' performance more than the other strategies by providing the elements for building new schemata. We argue that the ineffectiveness of the worked examples demonstrated by the results of this study was due to high level of the participants' prior knowledge and the existence of schemata for solving these types of problems. It seems likely that the participants, who were already familiar with the principles of distillation, gained little from the principled reasoning presented in the worked examples. Indeed, they might have experienced the "expertise-reversal effect" (Kalyuga, Ayers, Chandler, & Sweller, 2003; Kalyuga, Chandler, Tuovinen, & Sweller, 2001), in which instruction designed to facilitate construction of schemata conflicts with learners' existing schemata and thus inhibits their understanding.

According to the data presented in Table 1, all three treatment groups correctly solved an average of seven of the eight problems presented to them. We attribute this rather high performance to the participants' prior knowledge which rendered the strategies practically ineffective for these participants. Further support for

this argument is apparent in the participants' perceived mental effort also presented in Table 1. According to this information, the mean mental effort for the three groups across the eight problems they solved was near the midpoint of the mental effort scale. They reported an average mental effort of 40, 44, and 47 out of a possible score of 72 across the eight tasks. These are relatively low mental effort scores for solving complex problems and indicate that participants had little difficulty. This argument is further substantiated by participants' performance on the far transfer task. All of the participants correctly solved the CHEMCAD problem with an average number of trials ($M = 15.86$) much lower than expected.

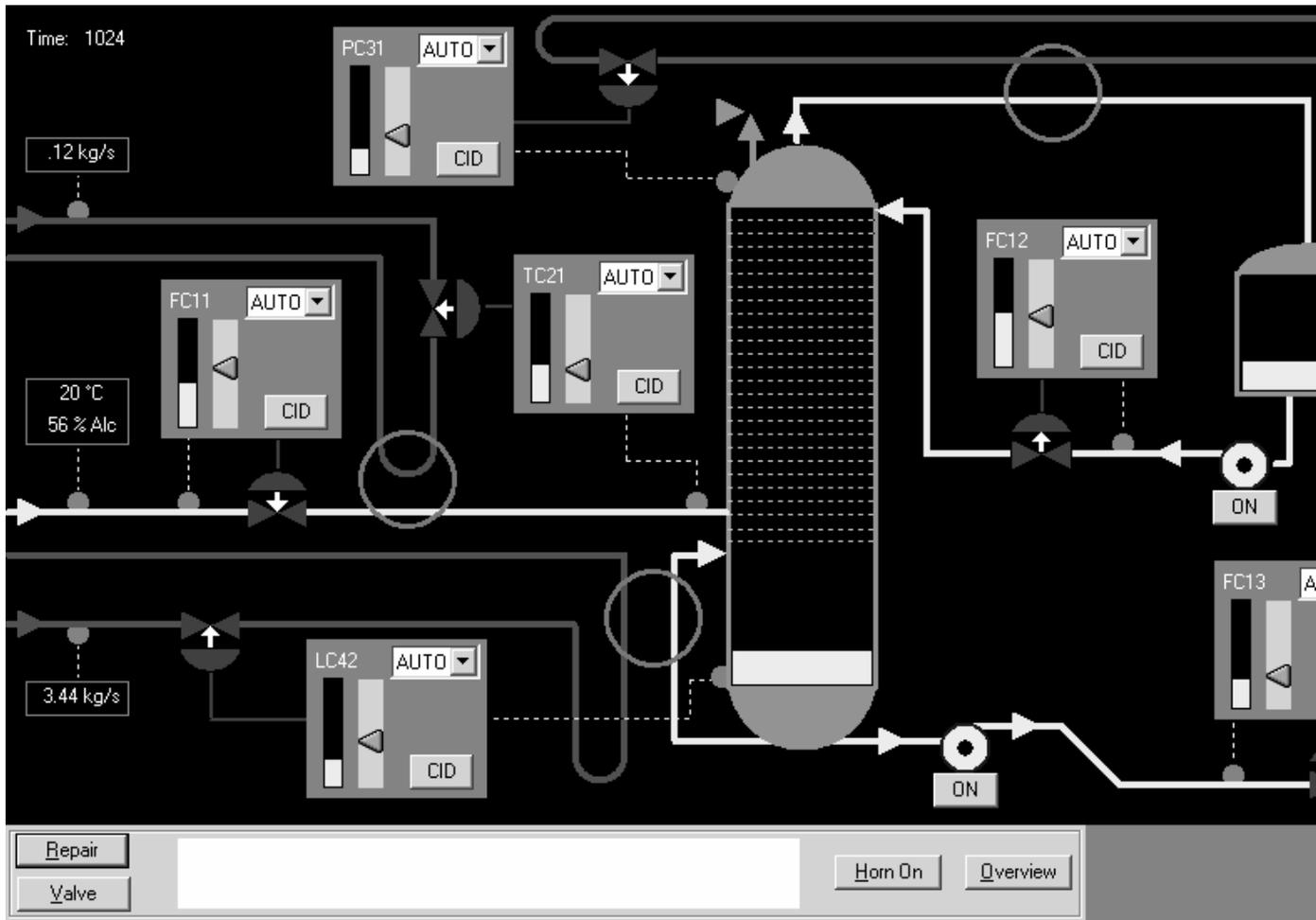
We speculate that novice participants, given the same instructional treatments and experimental conditions, would respond differently to the different types of worked examples. Using process-oriented worked examples, novices would be expected to perform better than those using the other strategies. However, they would be expected to invest much higher mental effort in the problem solving process. In summary, the conventional problem solving exercises were probably more suitable for these participants and the use of worked examples made little difference in their performance. These findings further substantiate our argument that the participants' prior knowledge accounted for the worked examples not being significantly different from the conventional problem solving strategy in their contribution to the participants' performance.

Further analysis of the performance measures revealed two unexpected results among the participants. Females made more incorrect diagnoses than males and took less time to diagnose malfunctions. We attribute this difference to the instruction given at the beginning of the performance phase of the experiment. We told the participants to "diagnose the malfunction as quickly as possible" and "make as few incorrect diagnoses as possible." Apparently males and females responded differently to these instructions. Based on the results of the study, each group favored only one portion of the instructions. An explanation for the reasons for these differences between the diagnostic behaviors of males and females could be the subject of further research.

Future investigation can also focus on the effectiveness of the strategies used in this study by involving novice participants in the same experimental conditions. Worked examples – process-oriented and product-oriented – along with the conventional problem solving strategy may demonstrate a significant difference in novices' performance. The lack of a central executive in novices' long-term memory structures – or schemata – should reveal the different effects of the instructional strategies. We suggest that replicating the experiment with novice learners would provide a set of data by which one can compare the results with those of this study.

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Revisiting the professional status of instructional design and technology and the specializations within

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Abstract

The purpose of this presentation is to continue the dialogue on the professional status of and the specialization within the instructional design and technology (IDT) field. This presentation highlights the similarities and differences among the various classification systems, which are used for ranking occupational fields, and discusses the most appropriate system for categorizing the professional status for IDT. A second purpose is to discuss the delineation of specialization within the IDT field.

Introduction

The IDT literature is replete with information on the field's historical roots and its current state (Dempsey & Van Eck, 2002; Ely, 1998; Reiser, 2002; Saettler, 1990; Torkelson, 1998) since the inception of AECT in 1977. Although it is often discussed as a profession (Bratton, 1981; Davidson, 1985, 1987), the IDT field does not have a clearly defined professional status based on any formal classification system or a comparison of occupations, which are considered full status professions.

Depending on the type of categorization or approach used, any field or occupation varies in its ranking, or status. Hence, determining the professional status of the IDT field has remained elusive due, in part, to no single authoritative classification system appearing to fit well with it. Consequently, the fundamental question remains, is IDT a profession? If so, how is the professional status characterized? In order to determine whether IDT is a profession several considerations must be made. First and foremost is to define the term, profession.

What Do We Mean by Profession?

The term, profession, is often bandied about by practitioners and is used in common language. For instance, the descriptor *professional* can be seen on delivery vehicles, in advertisements, and self-proclaimed in proprietary literature. Often, "profession" is simply used to refer to the work that an individual does for a living. Furthermore, an individual is called a "professional" to convey a level of dignity and prestige. Additionally, the professional craftsman, such as an electrician or plumber is differentiated from the amateur by the term of profession, again, with the expectation that the professional has experience, competence, and is often licensed (Pavalko, 1971).

Even a dictionary derived definition, which states that a profession is "an occupation requiring considerable training and specialized study: *medicine, law, engineering*" (The American Heritage Dictionary, 1996, p. 1446) does not provide a clear conception of what it is to be a profession. Hence, there have been attempts within the sociology of work to define profession, but definitions have remained ambiguous at best (Freidson, 1986; Pavalko, 1971). For instance, Cogan (cited in Vollmer & Mills 1966, p. vii) offers this definition:

"A profession is a vocation whose practice is founded upon an understanding of the theoretical structure of some department of learning or science, and upon the abilities accompanying such understanding. This understanding and these abilities are applied to the vital practical affairs of man. The practices of the profession are modified by knowledge of a generalized nature and by the accumulated wisdom and experience of mankind, which serve to correct the errors of specialism. The profession, serving the vital needs of man, considers its first ethical imperative to be altruistic service to the client."

Cogan's definition focuses on expert knowledge or abilities of an occupation and those individuals associated with it. His definition embodies the concepts of the linkage of theory to practice, how empirical research informs theory and practice, the client-service focus, and the importance of the

service to society. Others would identify specialized knowledge and abilities as part of a profession (Friedson, 1994; Metzger, 1976).

Basing her definitions on a review of literature, Davidson (1985, 1987) distinguishes profession from occupation by stating that a "profession is an acknowledged vocation requiring extensive education in science or liberal arts; a calling" whereas an occupation is "considered to be a means of fillings one's time with regular employment." This definition uses the conceptualization of comparing work along a broad stratum according to Freidson (1994), which is similar to Flexner's system (as cited in Metzger).

More simply put, Abbott (1988, p. 8) defines profession as ". . . exclusive occupational groups applying somewhat abstract knowledge to particular cases" and have jurisdiction over the body of specialized knowledge, skill, and work activity. Abbott's definition again refers to specialized knowledge related to work or occupation along with some governance over that knowledge, but does not necessarily set up a comparison among work or occupations. The key to Abbott's definition is the occupational group's exclusive jurisdiction over the special body of knowledge and work as a result of competition and negotiation with similar groups of challengers.

Furthermore, Abbott's definition provides a more external system orientation toward professions. Another author less concerned with individual traits, Freidson (1994, p.10), refers to a profession as "an occupation that controls its own work, organized by a special set of institutions sustained in part by a particular ideology of expertise and service."

Although there is no definitive statement as to what a profession is, examining the various definitions may facilitate a better understanding of the term and its varying use. One particular use of the definitions has been to classify work or occupations as professional or having professional status. For instance, a definition, found in the Flexner report, is based on a profession having a number of attributes and, according to Metzger (1976), formed a checklist approach to the definition of profession (p. 43). Furthermore, in order for an occupation to qualify as a profession under Flexner's approach, all attributes had to be exhibited by the occupation. In turn, Flexner's definition is considered as one of the classification systems for determining the professional status or professionalization of work or an occupation; there are other systems.

Caplow (cited in Vollmer & Mills, 1966, p. 20-21) contends that there is a definite sequence of professionalization, the process by which an occupation becomes a profession. Deduced from his case studies, each occupation that has achieved professional status has gone through a particular sequence of events. This sequence includes: establishing of a professional organization, changing of the name of the occupation by which a monopoly of work can be secured, developing a code of ethics, and concurrently both lobbying for political power to maintain the new work monopoly and establishing training or education facilities. One could question as to whether we should look at these as milestones to be addressed or merely a report of what has happened in the past, but what may not be a viable course of action in today's political-economic ecology.

What are the Models of Professions?

To understand the application of the term, profession, to any occupation, we may ask ourselves, who is it that ascribes this term?

Economic Skill-based Model

The Department of Labor's skill-based Standard Occupational Classification (SOC) system (2000) is an economic model and provides one method of classification of all occupations. This system examines the nature of the work activity in combination with the skills, formal preparation, and credentials required for that work activity. This classification system is used to facilitate statistical analysis for informational, policy, and program purposes. Eight hundred occupations are included under the 23 major groupings. One major group is titled "Professional and related occupations." Under antecedent, census-based classification schemes this group was known as "professional and semiprofessional workers (1940)" and later "professional, technical, and kindred" occupations (1950). Though the SOC system does not specifically define the term "profession," its earlier manifestations stated that this group "performs advisory, administrative, or research work which is based upon the established principles of a profession or science...and requires...training equivalent to that represented by graduation for a college or university...or extensive practical experience" (p. 116). This major, heterogeneous grouping includes such diverse fields as medicine, law, the clergy, engineering, architecture, computer and math occupations, scientists of all stripes, education and training, the media, and entertainment. We now turn to the sociological literature of the study of professions to gain some understanding of how the term is applied and what constitutes a profession.

Models from Sociology

When considering the various models of professionalism developed over the last century and a half, it is critically important to keep in mind the social, political, and economic history of this period (Larson, 1990). America grew from an agrarian society to an industrial, post-industrial, and informational society. Some occupations were created and others were superseded by technology, the growth of scientific knowledge, and changes in market demand. According to Kerr (1983), there are two broad classification systems alternatively called “trait models” and “power models.”

Trait Models

Metzger (1976) noted that early in the twentieth century, Flexner evaluated the fledgling medical profession and suggested that certain characteristics or traits were required for medicine or any other occupation, to become considered a profession. Metzger suggested that Flexner's model required that an occupation must possess seven traits in order to be a profession and it formed the bases of trait-based models. Metzger further noted that Flexner had a profound effect on social scientists studying the emergence of professionalism in society. As the number of proclaimed professions grew, so did the field of sociology in the study of professions. Consensus was limited and the list of requirements grew or shrank as dictated by the analyst's perspective as new occupations were examined. Several of Flexner's criteria were elaborated or re-articulated adding the requirement for being a life-long, full-time occupation, a calling with a service orientation, with limits to entry, autonomy, employment of discretionary practices, and codes of ethics.

Millerson (1964) conducted a meta-analysis of twenty-one lists of professional traits and concluded that the essential elements of a profession were the six most frequently listed. They are as follows: (a) a profession involves a skill based on theoretical knowledge, (b) the skill requires training and education, (c) the professional must demonstrate competence by passing a test, (d) integrity is maintained by adherence to a code of conduct, (e) the service is for the public good, and (f) the profession is organized (p. 4).

Pavalko's (1971) model of the “occupation-profession continuum” is representative of contemporary trait-based models and has eight dimensions. These dimensions include: (1) theory or intellectual technique, (2) relevance to basic social values, (3) training period, (4) motivation, (5) autonomy, (6) sense of commitment, (7) sense of community, and (8) code of ethics. Pavalko, among others, argues that occupations lie somewhere along a continuum in the professionalization process and that this process is neither unilinear nor static (Parelius & Parelius, 1987). Similarly, Moore (1970), using a “scale” perspective, considers some criteria of a higher order than other. He also recognizes that none of the profession's/quasi-, near-profession's practitioners are homogeneous and their individual position lies on points of the scale perhaps differently than that of the field overall.

Additionally, Pavalko introduces the idea-“marginalization” where some occupations may hold a position toward the professional end of the continuum in several of his model's dimensions, but are on the opposite end in others. For example, Pavalko cites the limited autonomy of nurses, teachers, engineers, etc. in that they generally operate in bureaucratic institutions that limit the degree of discretion in their work.

The term marginalization is a less strident term than what some sociologists use to differentiate occupations, that is, full and semi-professions, in which semi-professions (e.g., nursing, teaching) possess several characteristics of the full professions (modeled by medicine and law), but fall short in that they are employed by bureaucracies, are often not life-long pursuits, and their knowledge base is short on complexity (Abbott, 1998).

Power or Market Models

The second type of classifications is one based on power relationships of an occupation collectively with society, individual clients, government, and other occupations. Generally, it is the characteristics and functions of the occupations within the context of the political economy that empowers occupations with professionalism. Freidson (2001), Larson (1977), and Abbott (1988) promote this power model of professionalism albeit with individual variances.

Freidson (1986, 1994, 2001) develops his model of the “third logic.” He proposes three different ways to theorize about the division of labor in society. His “first logic” is associated with the consumerism of the free market and, therefore, it is the consumer who controls the division of labor through competitive market forces. His “second logic” theorizes how management or bureaucratic institutions control the division of labor through regulation and planning. His “third logic” suggests that specialized skills and knowledge enables the profession to more effectively control the division of labor. Although none of the “logics” is found in their pure forms in

reality, they do provide a theory-based tool for analyzing an occupation. His model has several elements of occupational control and those occupations that can exercise these controls are professions.

Larson (1977) emphasizes the relationship of professions to the market and class systems. Her historical analysis focuses on how occupations in England and the U.S. organized to capture a monopoly in the market place in order to secure an elevated position and influence in society. She posits that organized bodies of specialized practitioners influence governmental bodies in order to restrict the practice in a field of knowledge and skill through legislation.

Abbott (1988) believes that the traditional, trait-based models are deficient in that they emphasize individual traits and overlook the actual professional activities of these occupations within society. Though also a power theorist, Abbott considers his theory not one of professionalization with its more sequential perspective. Abbott's *system of professions* is more specific in that it focuses on the interrelationships of occupational groups, their defining professional activities, and particularly the competition between similar groups for jurisdiction over a specialized body of knowledge and practice. The end result of this competition over time results in exclusion of all but those with the jurisdiction of the specialized skill and knowledge.

What are some of the Recognized Professions?

Changes in society, technology, and bureaucratic policies influence the status of occupations on a continuum. Pavalko (1971, p.16) explains that occupations and professions are not dichotomous concepts. It is not whether a kind of work is either an occupation or a profession, rather it is the "degree" or "extent" to which a work activity is a profession. In the final analysis, most sociologists consider the attribution of "profession" as an ideal-type (Vollmer & Mills, 1966, Freidson, 2001) with occupations undergoing the dynamic process of professionalization (and in some cases, de-professionalization).

Recognized Professions

Freidson (1986, p. 32) argues that "profession" is a changing historical concept. As an outgrowth of the medieval universities, the "learned professions" were accorded special status and included medicine, law, and the clergy (including university professors). Due to the patronage of royalty, governments, and the aristocracy, the military was also considered a profession. However, with the coming of capitalist industrialization, the emerging middle-class occupations began to vie for the privilege and status of "profession." Accountancy, engineering, nursing, school teaching, and social work (among many others) were subjected to analyses and case studies. In varying degrees and through various processes of professionalization these work activities became to be considered "occupational professions." Elliot (1972, p 14, 32) differentiated the "status" professions of medicine, law, and clergy from the newer "occupational professions" that resulted from industrialization.

Does IDT Fit within Any of the Professional Classification Systems?

Studying the sociological literature on the professions can be, at times, somewhat confusing. The different permutations used to analyze types of work, the positions of occupations in society, and the bureaucracies that regulate and perhaps protect occupations, leaves us searching for an appropriate model to analyze IDT field. Both trait- and power-model proponents look to medicine and law as ideal-typical "full" professions. By inference, then, those occupations, which do not exhibit all of the traits of these "recognized" professions, fall somewhat short of the mark. However, more contemporary views (i.e. Abbott, 1998) argue that the characteristics that in the past set law and medicine apart - "fee for service, internally enforced codes, and independent practice" - have changed with time (p.431). It is necessary to point out that even with the venerable "full" professions (i.e. medicine, law, etc.) would be considered as de-professionalizing in certain aspects of their fields based on strict trait and power models as guides. For instance, some doctors have unionized or now work for HMOs, which eliminates the dimension of autonomy for that particular profession. Therefore, the models of medicine and law may be inappropriate analogs for IDT.

Additionally, we mentioned the skill-based, economic model of occupations employed by the Department of Labor. Using terms with which our field identifies itself (ID, ISD, IT, ET) to search the Standard Occupational Classification system database, which resulted in no matches for our query. Therefore, the U.S. government's skill-based model is of little use to us in determining our professional status. We are uncertain what to make of this finding. It may be that the population of IDT professionals is so comparatively small that it fails to register on a national scale analysis.

If we to look at the common elements of the trait models, we find that IDT measures favorably in many of

the characteristics, which is based on Pavalko's model.

Theory and intellectual technique:

Theory and research form the basis of IDT practice. This is evidenced by the robust content of IDT graduate programs of study.

Relevance to social issues:

The improvement of learning, instruction, and performance represents the focus of IDT in the most socially relevant venues, education and industry.

Training period:

IDT training, to this point, has been the province of the graduate schools (Gustafson, 2001). Rigorous programs of studies at the Masters and Doctoral levels predominate. Training might also include the concept of credentialism (e.g., licensure or certification). Many recognized professions and "emerging" professions already have licensure or certification processes to recognize proven competence to work in the field. IDT has yet to establish a certification program. Movement has been made to identify competencies of IDT practitioners, but proof of attaining competence through certification has not arrived. Does IDT need certification? Two organizations, ISPI and ASTD are developing certification programs for instructional design and performance technology that will be recognized by industry and the government sector. Will there be a certification for IDT developed suitable for the educational field? Conflicting opinions exist, but the dialogue is clearly active.

Motivation:

Not self-serving, rather IDT is altruistic. An examination of the AECT code of ethics illustrates the principal concern of IDT is for the client learner. This is exemplified by Yeaman's (2004a, p. 7) comment in a recent issue of *TechTrends*, "...how a profession cares for those who it serves is what counts for its professional ethics."

Autonomy:

IDT practitioners are normally employed by bureaucracies. Therefore, autonomy is limited. However, at the work level, the level of creativity required of the IDT practitioner is autonomous by nature.

Sense of commitment:

Many enter the IDT field from other, perhaps related, occupations. However, once the one has completed the extensive educational and training program, a lifelong commitment to the field generally exists.

Sense of community:

IDT professionals can find a home in at least three international organizations, AECT, ISPI, and ASTD. These organizations serve as advocates of the field and foster research and practice. A professional community shares developed knowledge and acculturates its members through periodic conferences and publication of journals like *ETR&D* and *Tech Trends*.

Code of Ethics:

IDT has a well-developed code of ethics that recognizes that as technology changes and presents unforeseen challenges to our ethical practice, that code must be similarly dynamic (Yeaman, 2004b).

Regarding the power models, IDT has an interesting position with regard to the division of labor, the labor market place, and "social closure." It is a profession that is dependent upon other professions (teachers and trainers) to convey the products and processes of its industry (with perhaps e-learning as an exception). IDT is a profession that requires mutual respect and value of and by other professions (if considered idiosyncratic from education in general (i.e., is IDT a "specialization" within the larger profession of education?). It can neither dominate (i.e., be superordinate) as in a hierarchy nor subordinate to teaching/training in its function as consultant (internal to the education process) (Kerr, 1983). Perhaps, it may be that our professional organizations are not sufficiently powerful enough to control access to the IDT market. Furthermore, they make no attempt to regulate entry into the profession and have only tangential influence on IDT programs. Finally,

although certification has long been an issue with the IDT professionals within these organizations, it is only now that some process for certification is available; however, it is only available for a specialty of performance technology (Davidson-Shivers & Rasmussen, in press).

Are There Specializations within the IDT Field?

We are uncertain as to why either the trait or power model theorists did not include specialization as one of their criteria for professional status. As Parelius and Parelius (1987, p.203) explain “. . . there can be little doubt that specialization is conducive to the development of expertise and that expertise is central to the professional standing of an occupation.” Although the classification systems vary, a common factor among professions is that of specialization. A survey of the most traditionally recognized professions (i.e., medicine, law, accountancy, and engineering) reveals that the differentiation of skills occurs commensurate with the increase in that field’s body of knowledge and historically as the occupations professional status strengthened (Abbott, 1988). The field of IDT is no less complex; this complexity is based on its broad application as well as the technological advances that are associated with IDT work.

Richey, Fields, and Foxon (2001) discuss the nature of IDT specialization and suggest three general areas: analysis and evaluation, e-learning, and project management. Other areas, including those of designing and developing, might also be included. For instance, Davidson (1987) suggested that designers may focus not only on different aspects of the design process (e. g, analysis, design, development, implementation—training and instruction, and evaluation), but could also specialize by a particular technology or delivery (e.g., videography, platform training, computers, etc.), or be oriented toward a particular setting (e.g., business and industry, military, health care, education, etc.).

Even though specialization has been discussed in the IDT literature over the years, once again there is no process in place for recognizing or ordering specializations within our field and no organization to monitor this process. By contrast, with recognized traditional professions, an overarching organization typically controls and monitors the maturation of the subspecialties.

Summary

There are several equally supported perspectives on what identifies professions. Even though there is disagreement as to what determines the professional status of a field, it is important to not disregard these perspectives, especially in considering the IDT field as a profession. By most trait or power/market models, the IDT field as a whole is a profession.

The degree to which an occupation is considered a profession is very subjective. Consequently, the appropriateness of ascribing a descriptor or adjective to the term “profession” to assign status seems, at this point in the discourse, less productive than an examination of the strengths and weaknesses of the field in each of the characteristics of a profession and its relationship with other professions and its clients. Of more importance, IDT professionals should concentrate on refining the definition of the field, seeking consensus as to its identity and the names by which it is called, and continue strengthening the knowledge base. However, these tasks cannot be accomplished by the individual practitioners; instead they must be accomplished by the collective efforts of organizations, which represent the field (i.e., AECT, IBSTPI, ISPI, etc.). Hopefully, this paper will help trigger such efforts to begin, once again.

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Student Attitudes toward Web-enhanced and Web-based Versions of a Learning Tools Course

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Abstract

The presentation describes the revisions to a course and the resulting student attitudes and learning. Learning Tools was revised in 2003 from oncampus only to both oncampus and online delivery. Revisions were made by standardizing the two versions, updating the technology applications presented, and modifying the instructional strategies used. These changes were based, in part, on the evolving technology and survey data (former students and instructors). The results of student opinion survey will be presented as well as suggestions for future directions of the course.

Introduction

Christenson (2002) suggests that teaching technology has a positive effect on teacher opinions, including reduced computer anxiety and increased computer enjoyment, but noted a time lag for positive effects on students with technology tools. Factors that may affect teaching technology and corresponding student opinions include learner and instructor anxiety, experience level, and the evaluation instrument itself. For instance, student anxiety toward technology is increased for those with little or no computer experience (Necessary & Christensen, 1996) or who are required to take a course rather than choosing it as an elective (Parish & Necessary, 1996). Khine (2001) found that males are more confident and feel less anxiety than females when using computers, perhaps, because they have more computer experience. Marginal differences showed that females like to use computers and appreciate their usefulness, but still exhibit anxiety toward using computers.

Abbott and Faris (2000) suggest that positive attitudes toward instruction may be because students teach themselves; instructors foster collegial atmospheres in which students complete course requirements and are committed to providing successful technology experiences. Sweaney (2001) suggests that students are more likely to learn technology by being able to play with the technology. Furthermore, Koltich (1999) states that mutual respect by teacher and student facilitates positive attitudes and learning. A somewhat hidden implication for studying attitudes toward learning technology may lie in the instrument itself. Research findings by Koltich (1999) using the Student Evaluation of Instruction suggest that it may lead students toward opinions that reject alternative instructional methods involved with learning technology.

Historical Perspective to Changes to the Learning Tools Course

Learning Tools is a graduate course designed to introduce students to several basic media tools. Its purpose is to assist students with their coursework and ultimately in the work place (2002-2003 Undergraduate & Graduate Bulletin). Learning Tools has been taught as a weekend course for 1 credit and scored on a pass/fail basis for over the last 12 years. However, Learning Tools has evolved over a decade with the changes in the types of technology taught and how it has been implemented (Davidson-Shivers, Jackson, & Wimberg, 2003). Changes in the instructional strategies and delivery systems were based on the practical matter of needing an online version of the course, the evolving technology related to the IDT field, survey data of former students and instructors (Wimberg & Jackson, 2003), learning psychology principles that advocate practice and active participation (Driscoll, 2001; Mayer, 2003; Ormrod, 2003), and guidelines for teaching technology tools (Davidson-Shivers, Jackson, & Wimberg). A table of the chronology was shown at the presentation.

Because the changes were significant, it was decided to document the changes made and address what effect, if any, they had on student learning and attitudes toward the course. For example, in the past, it has been taught by an instructor in-charge with the use of additional facilitators and was delivered as a weekend course. The delivered only as an oncampus course with multiple instructors teaching the contents during two-hour intervals over a term. Fall 2003 marked the first time it was taught online using web resources, with one instructor being its facilitator while a second offering provided an on-campus course facilitated by two graduate

students. While the University requires that online courses be equivalent in content and course requirements to their on-campus counterparts, some differences occurred in order to take advantages of the Web environment and instill some sense of community among learners.

Methodology

Participants

The participants in this study were graduate students ($N=20$) in Master's and Doctoral IDT program at a southeastern university. These students have varied educational and professional backgrounds, often fully employed. Approximately equal numbers of males and females ($n=10$) were enrolled in the online version whereas the oncampus version ($n=10$) had only two males. The changes in the choices of software were based, in part, on data gathered from the student and instructor survey (Wimberg & Jackson, 2003). The most significant perception gathered from this survey was in the area of requiring assignments for a grade. Both instructors and students agreed that adding an assignment for a grade would improve the delivery of the learning tools course.

Course Redesign & Revision Guidelines

The underlying assumption for these changes is that students are becoming sophisticated in using technology; tools taught 10 years ago are now considered prerequisites for the current course offerings. A second reason for change is to keep students current on new technology tools as they emerge. The redesign and revision of the *Learning Tools* course resulted in the oncampus version becoming a web-enhanced instruction (WEI) and the addition of an online version with web-based instruction (WBI). The following guidelines were used in the development and implementation for both the WBI and WEI versions:

- 1) Provide an overview of learning tools for students to acquire basic skills rather than proficiency;
- 2) Provide meaningful assignments as indicators of knowledge gained;
- 3) Provide opportunities for collaboration and questions about assignments. A threaded discussion called "The Student Lounge" was provided for both versions.
- 4) Class size was not to exceed 12 students for adequate management and fostering of a collegial atmosphere.
- 5) Explain that students' roles were as self-regulated learners at the beginning of both versions.
- 6) Encourage students to search for other tutorials and materials through the Web, library, etc.
- 7) Explain that instructor is a facilitator, not sole knowledge authority or provider.
- 8) Instructors (faculty member and graduate assistants) assisted students when needed through emails, office hour meetings, and phone conversations; and
- 9) Both versions were developed and delivered by one faculty member and two graduate assistants who actively provided student support.

Learning Tools Content & Instructional Materials

The current versions contain eight technology sessions as follows: a) An introduction to Windows basics, the Web, and online library resources, b) MS Excel & Access, c) MS PowerPoint, d) Adobe Acrobat Reader, Inspiration, and media players, e) Adobe Photoshop f) Windows Sound Recorder and Cool Edit, g) Dreamweaver & Websites, and h) Course Wrap-up and Evaluations. Students were asked to purchase a textbook related to MS Office XP or 2000, depending on the software installed on their computers. In addition, a list of online reference materials and tutorials were provided for both versions of the course. Short biographies of students and instructor or teaching assistants were provided for both versions.

Text-based and PowerPoint lectures were supplied to the WBI version, and "live lectures" accompanied by the same PowerPoint materials were presented to the WEI. Both courses allowed for students and instructor/teaching assistants to communicate with each other through e-mail and threaded discussion. In addition, students had their own threaded discussion (entitled Student Lounge) in which students could post helpful suggestions or ask questions to each other. The teaching assistant monitored them as well in order to alleviate any frustrations due to technical difficulties.

Instruments

Three self-report instruments were used: Former Student and Instructor Survey, Proficiency Checklist, and Student Attitudes toward Learning Tools Course. In addition, extant data from course records provided the information for the changes recorded over the last decade. Extant Data, shown in the presentation, were

discovered by examining old course records and interviews with faculty members who had taught the course in the past.

The Former Student and Instructor Surveys were developed by one of the researchers and contained thirteen quantitative items. Table 1 shows the responses by former students and Table 2 shows response of former instructors. This survey also included eleven open-ended questions included a description of the course from the student's or instructor's perspective, how well he or she thought the class prepared the student, and a discussion of the chosen topics.

Table 1. *Results of Former Student Perceptions of the Learning Tools course*

| Question | Continuum | | | | | Average |
|--|----------------------------|------------------|------------------------|----------------------|---------------------------|---------|
| 1. How much did you learn about learning tools (software) in ISD 600? | 1 nothing | 2 not much | 3 a moderate amount | 4 a good amount | 5 a lot | 2.6 |
| 2. How well did ISD 600 prepare you for IDD classes? | 1 not well at all | 2 fairly well | 3 adequately | 4 very well | 5 extremely well | 2.2 |
| 3. How well did ISD 600 prepare you for your current job? | 1 not well at all | 2 fairly well | 3 adequately | 4 very well | 5 extremely well | 1.9 |
| 4. How beneficial was ISD 600? | 1 not at all beneficial | 2 fairly | 3 beneficial | 4 very beneficial | 5 extremely beneficial | 2.6 |
| 5. How effective was the instruction in ISD 600? | 1 not effective | 2 fairly | 3 effective | 4 very effective | 5 extremely effective | 2.3 |
| 6. How effective was the design of the course regarding the methods used to teach the course? | 1 not effective | 2 fairly | 3 effective | 4 very effective | 5 extremely effective | 2.2 |
| 7. If ISD 600 were an elective, I would recommend other students take the class. | 1 strongly disagree | 2 disagree | 3 somewhat agree | 4 agree | 5 strongly agree | 2.7 |
| 8. The class required I put forth much effort. | 1 strongly disagree | 2 disagree | 3 somewhat agree | 4 agree | 5 strongly agree | 2.4 |
| 9. The topics taught were too difficult. | 1 strongly agree | 2 agree | 3 somewhat agree | 4 disagree | 5 strongly disagree | 4.2 |
| 10. The topics taught were too easy. | 1 strongly agree | 2 agree | 3 somewhat agree | 4 disagree | 5 strongly disagree | 3.2 |
| 11. The class would have been better if I had to produce assignments for a grade. | 1 strongly agree | 2 agree | 3 somewhat agree | 4 disagree | 5 strongly disagree | 2.5 |
| 12. The amount of exposure to various learning tools was sufficient. | 1 strongly disagree | 2 disagree | 3 somewhat agree | 4 agree | 5 strongly agree | 2.7 |
| 13. ISD 600 was a waste of time? | 1 strongly agree | 2 agree | 3 somewhat agree | 4 disagree | 5 strongly disagree | 2.9 |

N = 12

Students were given the following choices: 1) F= Familiar = I have only heard of this software, 2) I = Intermediate = I have used this software often, but I am still unsure of some functions, 3) P = Proficient = I know this software well enough to teach it in its entirety. The following software was included in the checklist: Windows Basics, Internet & WWW, University Online Library, several Microsoft applications, Media Players, Photo, Sound, and Website Editors, and Web Management Systems. See Table 3 for the results.

Table 3 . *Results of Student Proficiency Checklist (WEI version only)*

| Software | Familiar | Intermediate | Proficient |
|---------------------------|-----------------|---------------------|-------------------|
| Windows Basics | 1 | 8 | 1 |
| MS Word | | 7 | 3 |
| Internet & WWW | | 9 | 1 |
| USA Library Online | 1 | 9 | |
| MS Excel spreadsheets | 2 | 6 | 2 |
| MS Access databases | 5 | 5 | |
| MS PowerPoint slideshows | 1 | 6 | 3 |
| Adobe Acrobat Reader .pdf | 2 | 7 | 1 |
| Inspiration | 5 | 4 | 1 |
| Windows Media Players | 3 | 7 | |
| Other Media Players | 5 | 5 | |
| Adobe Photoshop images | 8 | 2 | |
| Other Photo editing | 8 | 2 | |
| Windows Sound Recorder | 8 | 2 | |
| Cool Edit | 9 | 1 | |
| Other Audio File Editor | 10 | | |
| Dreamweaver | 9 | 1 | |
| Other Webpage Composer | 9 | 1 | |
| eCompanion | 6 | 4 | |
| eCollege | 4 | 6 | |

N = 10

The final instrument was the Student Attitudes toward Learning Tools Course, which contained thirty-seven items and asked students to report their opinions about the course. Students reported experience levels with computers and online courses, preferences of topics and instructional pace, expectations of instructor, and difficulties with assignments.

Procedures

The courses were conducted in fall 2003. The online, or WBI, version ran the entire semester whereas the on campus, or WEI, version was conducted during the last eight weeks of the semester (due to conflicts with another weekend course held on Friday afternoons). To accommodate for the compressed time of the WEI version, students were allowed to complete the course in two terms rather than in one semester.

The Proficiency Checklist was administered within the first two weeks of either version. Data from this checklist were reviewed at the time of its administration in order to make any necessary adjustments to the course. However, the only changes to types of software were due to the availability to free trial versions of the software rather than due to proficiencies. A second change to the WBI version was to open the last four sessions for the entire session enabling students to access the last four sessions at any time during the term rather than only having access to a session during the time scheduled within the web course.

The students were required to attend the sessions and were given time to complete assignments (two weeks for the WBI and one week for the WEI version); assignments were submitted either through an online drop box to the instructor or via email. Some assignments for the WBI were also to respond to either document sharing, threaded discussions, and/or locating websites. They received feedback from the instructor on their assignments one week after completion based on a range of scores from satisfactory plus (S+) to unsatisfactory minus (U-).

The Student Attitudes toward Learning Tools Course was given at the end of the course during the wrap-up session in both WEI and WBI. All data collected were analyzed after the course had ended and final grades

were posted.

Discussion and Summary of the Results

We are happy to report that all students passed the course (both versions) with a satisfactory grade. Their scores were due in part to meeting the requirements of the course, but also to their level of proficiency in using computers and the Web. Most students had had some experience with online courses as required to some degree by other courses in their IDT program. (Refer back to Table 3 for the student proficiency checklist results.) However, when dealing with audio, photo, sound, and website editors, most of the students reported only a familiarity with such software. In addition, the WEI students reported low proficiencies in the web management system.

The results from the Student Attitude toward a Learning Tools Course administered at the end of the semester indicated that students reported being proficient in using computers (70% in WEI and 89% in WBI) and students in both versions had high levels of comfort with using the Web (100% in WEI and 70% in WBI had previously taken an online course. The results of the Student Attitude toward Learning Tools Course questionnaire suggested that only 80% of the WEI students felt comfortable with that delivery format whereas 100% in the WBI student felt comfortable. 100% in WEI reported agreement that course topics were relevant whereas 89% in the WBI agreed, with 11% strongly disagreeing. Those disagreeing were most likely to have been very experienced with computers and thought that the expectations, content, and pace of the beginning session were set too low for them. It should be noted that because we were unable to gain information about the online students and their proficiency in the WBI until it began and to be on the conservative side, we used the first session to cover some of the basics with MS Office and the Web. Perhaps the 'bar' was set too low for this session and for the types of students who took the online version of this course.

We also found that 80% in both the WEI and the WBI liked the *student lounge* (their own threaded discussion) option and 56% in WBI also liked the option to discuss assignments. The WEI students (50%) reported that the instructor should be expected to help with technical problems whereas 70% in the WBI disagreed with that statement. Again, this finding may reflect a difference in experience level of those students who opt for the oncampus version vs. the online versions. Students in both versions reported finding the online tutorials were helpful and students of both versions agreed that the lectures were helpful. Almost all WEI students suggested that the units of instruction were clear. Most in both versions reported overall satisfaction with the course. The course, both versions, appears to be successful based on student opinion. Table 4 shows the results of the entire survey.

Table 4. Results of Student Attitudes toward a Learning Tools Course

| | Question | WEI Mean | WBI Mean |
|-----|---|----------|----------|
| 1 | I have a great deal of computer experience. | 2.80 | 3.22 |
| 2 | I have a great deal of prior knowledge or experience in instructional design. | 2.00 | 2.33 |
| 3 | I am very comfortable working on the Internet and the WWW. | 3.30 | 3.67 |
| 4 | Technical problems frustrate me. | 2.90 | 2.44 |
| 5 | The pace of the class was too rapid. | 1.87 | 1.33 |
| 6 | I think that I worked hardere in this class than if I were in the online version (classroom version). | 2.93 | 1.67 |
| 7 | I feel that as a student, I had enough control over my learning in this class. | 3.20 | 3.44 |
| 8 | The assignments for the units were not that difficult. | 2.80 | 3.11 |
| 9 | The feedback I received on assignments was sufficient for this class. | 3.25 | 3.22 |
| 10 | Removed. | | |
| 11 | I liked the student lounge option. | 3.11 | 2.86 |
| 12 | I have taken a web-enhanced (web-based) class prior to this one. | 2.60 | 3.11 |
| 13 | I expected immediate help from my instructor when I had problems. | 2.60 | 2.22 |
| 14 | I contacted my instructor during the semester about a problem or question. | 6Yes 4No | 7Yes 2No |
| 14a | The instructor or the teaching assistants helped me with my problem or question. | 3.83 | 3.63 |

| | | | |
|-----|--|-----------|----------|
| 14b | The instructor or the teaching assistants provided me with immediate help. | 3.67 | 3.38 |
| 15 | I am comfortable with web-enhanced (web-based) instruction. | 2.89 | 3.63 |
| 16 | The topics in this course are relevant. | 3.60 | 3.33 |
| 17 | The topics in this course will be helpful to me. | 3.70 | 3.22 |
| 18 | I liked being able to work at my own pace on course assignments. | 3.80 | 3.89 |
| 19 | I liked that each unit has a precise start and stop date. | 3.70 | 2.56 |
| 20 | I liked being able to access all of the units at once without waiting for the unit start date. | 3.00 | 3.78 |
| 21 | I contacted eCollege Help/support for technical problems | 0Yes 10No | 3Yes 6No |
| 21a | I was able to get help with technical problems from the eCollege/Help support desk. | N/A | 4.0 |
| 22 | It's realistic to expect my instructor to respond to my email concerns within a couple of hours. | 1.75 | 1.75 |
| 23 | I expected my instructor to help me with technical problems. | 2.67 | 1.75 |
| 24 | I found the online tutorials helpful (webliography). | 3.33 | 3.00 |
| 25 | I found the lectures (text or PowerPoint) helpful. | 3.20 | 3.22 |
| 26 | The assignments clearly identified the tasks to do for each unit. | 9Yes 1No | 8Yes 1No |
| 27 | I had very few technical problems. | 3.10 | 3.33 |
| 28 | I had very few problems with assignments. | 3.20 | 3.44 |
| 29 | The assignments took a long time to complete. | 1.90 | 1.56 |
| 30 | I needed more interaction with the instructor and the other students. | 2.10 | 1.67 |
| 31 | Overall, I am satisfied with this course. | 3.20 | 3.56 |
| | 1=Strongly Disagree 2=Disagree 3= Agree 4= Strongly Agree | N=10 | N=9 |

Future Implications Based on the Results

One of the implications for this course is that the types of software and delivery of the course will continue to evolve. We anticipate that future versions of the course will involve teaching about creating and using video for course projects as well as new Web features, such as blogging, as they become available. The course may also involve the use of other types of equipment such as PDAs, cell phones, etc. as well as video and audio conferencing. Again, introduction to software and hardware advances will be based on the availability of new versions, new innovations, and how student proficiency advance. Although it is too early to predict or prescribe, over time we may find out that those who take Learning Tools online may have higher proficiency levels than those who prefer the oncampus version and, hence, prefer topics that require more advanced computing skills for each session. However, much will depend on the level of lowest common denominator, effect of the computer equipment, high-speed accessibility for the participants.

The guidelines on which the on-campus and online versions were based seemed to be appropriate. The two versions were kept in alignment in terms of what was taught and required of student participants. In addition, the use of the Web resources and materials in both allowed for ease in accessing and using tutorials and free trial versions. The class size, being kept to a small number, was manageable for introducing technology; having teaching assistants also helped in terms of providing timely feedback and troubleshooting. We would advocate that such courses, especially when taught in a virtual classroom, be kept to a minimum number of students. Although the interaction required among students for both versions was kept to a minimum, they seemed to develop a sense of community. Because the WEI students had face-to-face interaction, the student lounge threaded discussion may have been less important or necessary for them. However, students in both versions seemed to enjoy this threaded discussion and those in the WBI enjoyed discussing the assignments amongst themselves. Hence, we think that the amount of interaction was set at the appropriate level.

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Investigation of Source of Motivation in a Hybrid Course

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Abstract

The current study investigated the sources of motivation for learning in a hybrid course. The subjects of the study were 25 students taking a hybrid course that was designed and developed covering computer networks topics. An interview form that revealed answers about the motivation source of the students was developed and used in the study. One on one interviews were made with the students. Students' answers to the questions were recorded and transcribed. The interview data for the students were analyzed by content analysis. Students' responses were interpreted and categorized into two types of motivation, extrinsic and intrinsic. Results indicated that intrinsic motivation and internally rewarded learning is the key element of web based instruction and hybrid courses. Interviews revealed that students with extrinsic motivation are more prone to losing motivation. It was seen that some students in the hybrid course with extrinsic motivation lost their motivation and will to learn easily by external factors, and were frustrated by the course content. On the other hand, students with internal motivation were more aware of objectives of the course and had the ability to plan and evaluate their own learning. An in depth analysis of students' sources of motivation in a hybrid course on computer networks revealed that intrinsic motivation plays a more important role than extrinsic motivation does.

Introduction

WBI and Hybrid Instruction

Web Based Instruction (WBI) was defined as a learning environment in which learning was fostered and supported through the use of the attributes and resources of the World Wide Web (Khan, 1997). The major advantage of WBI was stated as being able to communicate with any person and/or access many resources independent from time and distance (Hill, 1997). This structure was suitable for constructivism because of the time independency and freedom to access learning material at will. To understand the effectiveness of the WBI environment several instructional models were developed. The models of Reeves and Reeves (1997), Caladine (1999) and Welsh (1997) were important guidelines for the WBI designers.

The idea behind a hybrid/blended instruction is to redesign the instruction to use the advantages of both face to face and online modes of instruction. Some of the activities which students previously did in classroom or laboratory, such as listening to lecture, taking notes, quizzes, pre-lab assignments could be done online. This change could have positive effects on teaching resources like teachers workloads, accommodating various learning styles and hours of classroom time, and course budget. Actually hybridizing different methods of course delivery was not a new idea. Clark (2002) commented that hybridizing has deep roots that lay back to times where books, videos and print materials were used as an integral part of the instruction. Hybridizing could be understood as "mixing" or "blending". In general terms we can refer to hybrid instruction as the blending of classroom-based instruction with instruction via other media.

There are few studies on hybrid instruction. Most of them point towards the advantages of these courses. These advantages mainly come from the online enhancement of the face to face courses. These advantages were listed by Valerie Landau (2002):

- Accessible handouts, syllabi and notes online, cutting down time and resources in photocopying.
- Allows peer to peer collaboration on projects, helping to facilitate and document group work.
- Allows automatic grading of quizzes and tests.
- Allows students to discuss topics and review notes or other course material after the face to face part is over.

The hybrid course design was different than WBI in that it combined the advantages of face to face and online modes of instruction. Sands (2002) provided proposals for hybrid course design and development. Other studies on finding the ideal hybrid structure were done by (Marques et. al., 1998) and Jones, Cranitch and Jo (2001). In both studies hybrid courses were developed and descriptive studies were made. Both studies found

the hybrid course mode superior on traditional course mode. Studies on student achievement in hybrid course showed that students were more successful in the hybrid courses than they do in purely web based or traditional courses (Lilja, 2001; Truckman, 2002, Christman et. al.,1997; Christman and Badget, 1999; Persin 2002). The literature showed that students' course satisfaction was high in hybrid courses (Gray, 1999; Black, 2002). Students' attitudes toward technology and technology integrated courses were indicated as positive in hybrid courses. Several studies showed that a "mixed" course structure was preferred by the students and that hybrid courses effected students learning positively (Gunter, 2001; León de la Barra et al., 1999).

Student Motivation

There are many factors affecting the learning in hybrid courses and one of the important factors is the source of motivation of students. While some students have extrinsic motivation some others have intrinsic motivation. Extrinsic motivation in hybrid courses can lead to externally rewarded learning. Examples of this extrinsic motivation are grades, time, income, legislative power and so on. Intrinsic motivation can lead to internally rewarded learning. Intrinsic motivation is the desired motivation type in courses since individual meaning-making is a critical element of learning. This type of motivation is based on internal values like, the will to learn, the desire to solve a problem, the will to understand the course content, the meaning of course content. Intrinsic motivation can lead to higher levels of learning and critical thinking abilities.

The literature shows two models for defining motivation of students for learning. The first one is Malone's (Malone, 1981; Malone & Lepper, 1987, both cited in Alessi and Trollip, 2001, p.25) motivation theory in which he suggested four relevant factors of motivation: challenge, curiosity, control, and fantasy. Malone and Lepper (1987 cited in Alessi and Trollip, 2001, p.26) identified motivators as either intrinsic or extrinsic. Extrinsic motivators were described as independent of instruction. Lepper's (1985, cited in Alessi and Trollip, 2001, p.26) research provided evidence that "extrinsic motivators diminish one's interest in learning because the goal becomes the reward rather than their learning". Malone and Lepper (1987) proposed that intrinsic motivators play a more dominant role on students' learning than extrinsic motivators.

The second motivation theory was that of Keller (Keller & Suzuki, 1988, cited in Alessi and Trollip, 2001, p.25). Similar to Malone's theory he also suggested four components as essential factors of student motivation: attention, relevance, confidence, and satisfaction. The theory is known as Keller's ARCS model of motivation design. Keller did not indicate any desirability of intrinsic or extrinsic motivation, but rather he argues that the instructional designer must be proficient at motivation design as well as instructional strategy and content design.

Method

A "Computer Networks and Communications" course was offered as an elective course to all students of a state university in Turkey in Fall 2002 semester. Twenty-five students attended the hybrid course. In the beginning of the first meeting of the course a short orientation about how to use the web-site was given to the participants. Students were informed about things that were expected from them while using the web-site, what the security policies were, how the site functions, what the Internet address of the web-site was, and how to choose their username and passwords. Students' web-site usage was logged by the log system and the durations and activities of each student were checked each week. Every student had to visit the web-site of the course and had to be active for at least one hour each week. The student could not leave the page open and leave, since the system logged them out after 5 minute inactive time. Students met once a week for one hour to participate in the classroom activities and no lecturing was done in these meetings. As a prerequisite to the course all students, were required to have taken a computer literacy course. This was required to assure that all students participating in the study had the basic knowledge level about computers

The Website of the Course

The "Computer Networks and Communications" course was designed as a hybrid course which required self-paced learning time since the course content was online, creating a significant reduction in classroom lecture time. The course was offered to the students as a hybrid course, which was a mixture of face to face instruction with online learning. For this purpose, a web-site was developed to serve as the Web-based learning environment. The web-site of the course was developed by two faculty members of the Computer Education and Instructional Technology Department of a Turkish state university. Some of the Internet technologies used in developing the web-site can be listed as, Active Server Pages (ASP), Microsoft SQL Server 7.0, Dynamic HyperText Markup Language (DHTML), and Cascading Style Sheets (CSS). The course web-site consisted of course content, syllabus, announcements, assignments, forum and comments parts. In the

web-site there were also some cognitive tools to support student learning such as highlight, notebook, bookmark, search, glossary and history.

Before the study, the “Computer Networks and Communications” course was given as a must course. Although the course had been offered for a long time there were no written goals and objectives. The first step of redesign was analysis of the data about the course. Informal and formal data of students who already took the course in terms of student feedback and grades were investigated. Existing knowledge and skills of the students who registered for the course were also investigated. As the second step, the desired outcomes of the course in terms of goals and objectives were specified and specific learning objectives, assessment instruments, exercises, and topics to be included were documented. These were used to determine the content and visual elements of the web-site of the course. While there were new content and visuals created by the instructor, because of internal validity concerns, majority of the visual elements and the content were adapted to be used from a commercially well-known information source with permission. As the third step, the graphical user interface of the web-site was designed. As the last step of creating the web-site, the content and the visual materials were coded. The content was structured in the web-site according to the syllabus, which was organized week by week. The design and the web-pages were ready to use before the course started. As implementation, chapters were published for student access week by week. The effectiveness of the design and training materials were continuously evaluated through students’ comments. The web-site of the course was a dynamic one, working with conjunction to a database.

Because the course had high technical knowledge base and a loaded content, more procedural knowledge and skills, and had students with limited prior knowledge about the content, the web-site was relying on guided learning and the activities in the classroom on discovery. The instructional design of the hybrid course was a mixture of objectivist and constructivists approaches. The web-site included objectivist/instructivist (directed learning) and constructivist elements. The objectivist structure in terms of content presentation structure in the web-site was supported with constructivist elements especially in classroom meetings. Group works, games, discussions and projects were constructivist elements planned to go hand in hand with the online part of the course.

The users were authenticated with username and password to access the web-site of the course. The username supplied in authentication initiated the log system, which was internally bound to a database, to keep track of the activities of the students while going through the content and using the cognitive tools. The screen design of the web-site separated the web page into two main parts. One part was used for visual and/or graphical elements, and the other part was used for content related text in the whole content screen to provide the consistency. A sample content page is supplied in figure 1. A “Jump to” tool in the form of a drop-down menu enabled the students to navigate to any part of the web-site whenever they wanted. The students could always see where they were by the “You are here:” tool. Other tools to mention were site map and help, which were useful for students in navigating between different parts of the web-site.

The main page of the web-site included six links that the students could choose from (Course Content, Syllabus, Announcements, Assignment, Forum, and Comments). Additionally, there were three message notes, first one was a message from the instructor, second one was a note written by the students themselves to remind them things, and the last one highlighted the last content the current user/student visited.

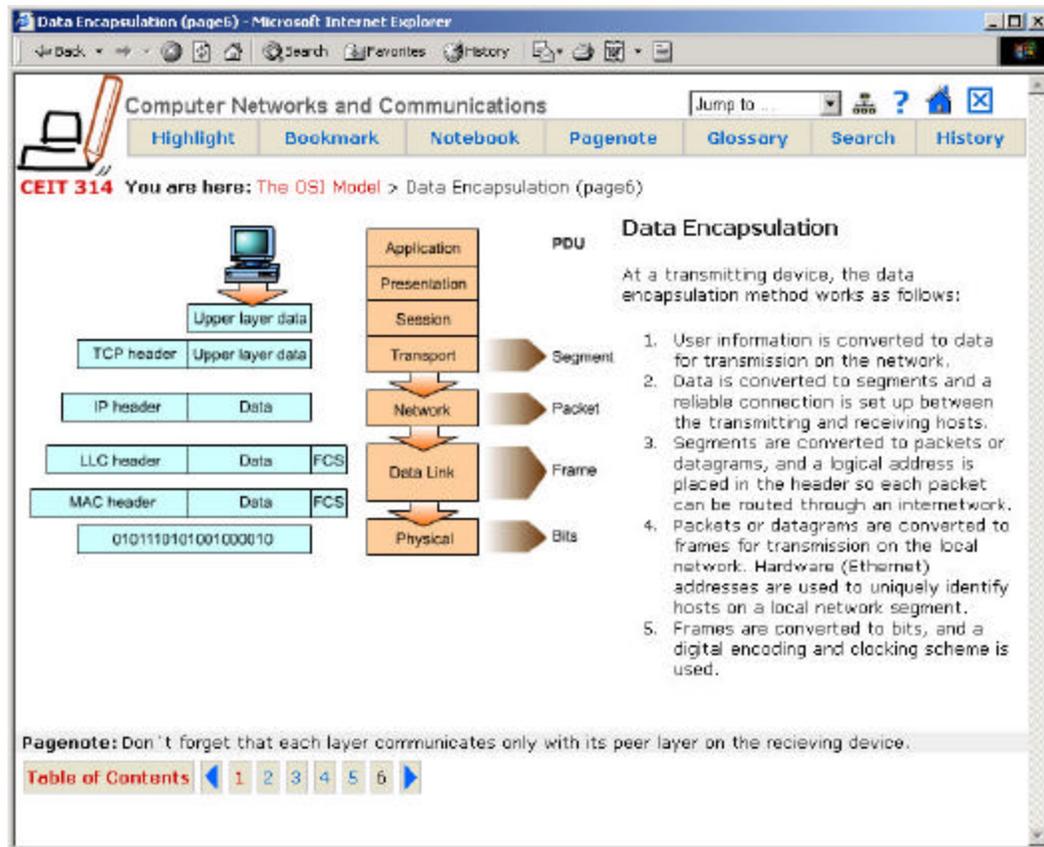


Figure 1- The Content Structure of the Web-Site

Procedures

Every student in the hybrid course had to visit the web-site of the course and had to be active for at least one hour each week. The student could not leave the page open and leave, since the system logged them out after 5 minute inactive time. In the one hour classroom meeting, students with suspicious activities and students with visiting time less than one hour were informed to be cautious about their performance related with the course web-site. The differences in learning and teaching activities between the hybrid course and the traditional course were shown by using Caladine's (1999) model which he called "A Model for Learning and Teaching Activities" (MOLTA). The differences between the two courses are summarized in Table 1. The common activities of the two courses are shown in Figure 1. MOLTA classified teaching and learning activities into five elements; delivery of material, interaction with materials, interaction with the teacher, interaction among students and intra-action.

Table 1-*The Differences between the Hybrid Course and the Traditional Course*

| Element | Traditional Course (3 hours of classroom meeting each week) | Hybrid Course (1 hour of classroom meeting each week) |
|-------------------------------------|--|---|
| Delivery of Material | Lectures supported with PowerPoint presentation | Web-site, on-line materials |
| Interaction with materials | Text books, notes, library books, homework, quizzes, classroom activities. | Multimedia, web browsing, cognitive web tools, homework, quizzes, classroom activities. |
| Interaction with the teacher | Classroom discussion, face to face questions, consultation | Web announcements, forum, phone, face to face questions, consultation |
| Interaction between students | Group works, classroom discussions, projects, classroom games | Web forum, e-mail, group works, classroom discussions, projects |
| Intra-action | Classroom discussions, group works | Classroom discussions, group works, web forum |

The students in the hybrid course were interviewed individually to get their perceptions about the dimensions of the hybrid course in terms of their effect on their motivation. The students in the hybrid course were interviewed one-on-one during the last two weeks of the semester. Each interview lasted for about 40-60 minutes. The interviews were recorded having taken students' consent. The recorded interview data was transcribed and analyzed to find out the students' motivation types. To understand students' major sources of motivation, content analysis was carried out on the answers to the questions on each dimension.

Results

The findings of the study showed that motivation and rewarded learning is very important for students' learning in the hybrid course. The analysis of the interview data to find out the type of motivation that was more effective on students learning in the course showed that students had both type of motivation, intrinsic and extrinsic but one of them was more dominant. One indication for intrinsic motivation was "enjoying" the course. Students indicated that they enjoyed some learning activities. Students did not enjoy reading the content from the website, but they enjoyed the real-life experiences, like making a cable installation, configuring a computer or a network device, and making a cabling design for a given building floor plan. They also enjoyed reading and applying real network protocols and addressing schemes like IP. A student said: "I always wondered why we configured the computers with IP address and subnet mask. Now I understand why and how we use it." There were parallel comments regarding student motivation and metacognition.

Students indicating their "joy" of learning the topics in the course were those students with metacognitive abilities knowing "what they learned" and "why and how they learned." For example, such a student said: "I expected that this course would change my way of understanding computer networks topic. My expectation became true, now I look at many things different. For example, when I enter a student computer lab I can determine that the line is going from there, the switch is located there, this is a good or bad way of installation." Students were asked which features of the hybrid course they liked the most and they indicated the following features:

1. The content of the hybrid course (22 students): Computer networks subjects were found interesting by most

of the students. Students stated that they liked to learn about these subjects because they would be useful in their professional life. Almost all students said that they would benefit from the course content in the future.

2. *The hybrid structure of the course (16 students):* Students indicated their enjoyment in taking an alternatively delivered course after so many traditional courses. It was something new for them. They stated that they found the course structure interesting and useful. They especially liked the course not being fully web based or fully traditional.

3. *The learning/instruction activities done in the classroom (15 students):* Students stated that they prefer doing activities rather than sitting silently and listening to the instructor. They indicated that they have enjoyed to do practice on the information they read from the web-site.

4. *The cognitive tools in the course website (14 students):* According to student comments, the cognitive tools were giving the course web-site a professional feeling, making it different than standard, electronic page turning web-sites. One student commented on this: "The tools in the web-site were very usable. I used them for accessing to information quickly and easily."

5. *The web-site of the course (12 students):* The web-site was found to be very user-friendly, nice looking in terms of graphics and well organized in terms of access to information. The students liked the navigation structure and the information presentation structure.

When the students' interview results on their likes and dislikes are compared, it could be seen that the students had internal and external motives throughout the course. The new hybrid structure, the user-friendly structure of the web-site and the cognitive tools were adding to students' external motivation. Students' enjoyment of the classroom activities and their interest in learning the technology related to computer networks were internal motivation in the hybrid course. One common view of students was that the classroom meetings and the face to face communication with instructor and the peers was a source of motivation. Students indicated that they liked especially to see the instructor and they got motivated through this. Regarding this, while some students said that they understood the topics better through interaction with the teacher and their friends, others indicated they liked to "talk" with the others. Detailed analysis pointed towards intrinsic motivation as the key element for success in the hybrid course. The findings about the factors effecting the students' motivation are summarized in Table 2.

Table 2-Summary of students' motivation types in the hybrid course

| Factors effecting students motivation | Type of Motivation | Effect on Students |
|---|--|---|
| Studying to the course content through the web-site | <i>Extrinsic</i> was an obligation to read at least for one hour, students were logged | Negative – complained about health problems like eye watering and availability of internet access |
| The structure of the course in terms of “students learning preferences” | <i>Intrinsic</i> Individual learning was supported | Positive - students were used to individual learning Negative- students expected to carry on their learning habits |
| The structure of the course in terms of “logistic preferences” | <i>Extrinsic</i> to choose their own study time class hour was only one hour | Positive - students preferred to study at their homes, get access to course content whenever they want. |
| Expectations from the course related to “external rewards” | <i>Extrinsic</i> expecting to find a job, to get a certificate, dedicate less time to the course | Negative - Students were frustrated easily when faced with the requirements of the course. |
| Expectations from the course related to “internal reward” | <i>Intrinsic</i> Enjoying learning computer networks related topics. | Positive - Students liked to understand the meaning and functioning of computer networks and internet they used in their daily life. |
| Classroom activities | <i>Intrinsic</i> enjoying to do practice of what is in the course content, being active rather than passive listeners | Positive – Students could use and show their knowledge to their peers and the instructor. |
| Cognitive tools in the course web-site | <i>Extrinsic & Intrinsic</i> organizing, searching and accessing information fast and easily | Positive – Students could customize the course web-site usage according to their learning preferences like taking notes, highlighting and searching, bookmarking and so forth. |
| The web-site of the course | <i>Extrinsic</i> appealing in terms of graphics design, navigation structure and information presentation | Positive – Students found the web-site easy to study, user-friendly and well organized. |
| Course content | <i>Intrinsic</i> new technology, subjects are valuable in the information society | Positive – Students were aware of that they learned new technologies. Negative – Students with non technical background or previous knowledge found the subjects too technical and hard to understand. |
| The instructor of the hybrid course | <i>Intrinsic</i> student-teacher interaction was informal and friendly, teacher motivated students with positive feedback | Positive – Students were relaxed, and easily communicated with each other and the instructor during the classroom activities. |

Conclusion and Discussion

Students' answers indicated two types of motivation while learning in a hybrid course; extrinsic and intrinsic. The study results found out that intrinsic motivation and internally rewarded learning is the key element of the hybrid course. Interviews revealed that students with extrinsic motivation are more prone to losing overall motivation. It was seen that some students in the hybrid course with extrinsic motivation lost their motivation and were frustrated by the course content. On the other hand, students with internal motivation were more aware of objectives of the course, had the ability to plan and evaluate their own learning. They also had the metacognitive skills which are referred by Flavell (1979, cited in Revees and Reeves, 1997) as skills one has in learning to learn. The interview results also indicated that the source of motivation is not discrete but a continuum. This can be interpreted as students have both types of motivation while learning but intrinsic motivation is more important in hybrid environments.

Research points on motivation as an important factor on student achievement. There is also research evidence that motivation is not only a determinant for student achievement but it has to be activated for each task (Weiner, 1990). There are different opinions about which type of motivation is more effective on students learning. The findings of the current study points towards intrinsic motivation as the dominant motivation type in students learning in the hybrid course. This result supports the findings of Lin and McKeachie (1999, cited in Lee & Park, 2003, p.657) who suggested that intrinsically motivated students engage in the task more intensively and show better performance than extrinsically motivated students. However, some older studies showed opposite results for traditional classroom settings (Fraser, Patrick, & Schumer, 1970, cited in Lee & Park, 2003, p.657). The contradictory findings have been explained as "possible interaction effects of different types of motivation with different students. For example, the intrinsic motivation may be more effective for students who are strongly goal oriented, like adult learners, while extrinsic motivation may be better for students who study because they have to, like many young children" (Park & Lee, 2003, p.657).

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The Impact of Technology Use on Low-Income and Minority Students' Academic Achievements: Educational Longitudinal Study of 2002

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Abstract

Analyzing data from the Education Longitudinal Study of 2002 (ELS:2002), this report examines how computer use produced generic benefit to all children and differential benefits to minority and poor children. Specifically, we examined computer use at home vis-à-vis computer use at school in relation to the academic performance of disadvantaged children and their peers. Home computer use typifies socially differentiated opportunities, whereas school computer use promises generic benefits for all children.

The findings suggest that, with other relevant conditions constant: (a) disadvantaged children did not lag far behind their peers in computer use at school, but they were much less likely to use computers at home; (b) computer use at home was far more significant than computer use at school in relation to high academic performance; (c) using a computer at school seemed to have dubious effects on learning; (d) disadvantaged children benefited less than other children from computer use, including computer use at home; and (e) compared to their peers, disadvantaged children's academic performance seemed less predictable by computer use than other predictor variables.

Introduction

It is overly simplistic to assume that new technologies applied to education will uniformly benefit all children in academic achievement. In this paper, we examine the relationship between computer use and academic achievement of students of different backgrounds. We propose generic benefits versus differential benefits of technologies as a conceptual tool to understand the relationship between computer use and student learning. Assessing how computer use at home vis-à-vis computer use at school provide generic and differential effects on student achievement, we analyzed data from the Education Longitudinal Study of 2002 (ELS:2002). We offer brief implications for improving curricula and instruction in technology-related programs to ensure equitable education.

Background: Social Stratification of Technologies

Dramatic technological advances promise to help educators realize the ideal of equal educational opportunity. Many believe that with powerful and cost-effective technologies, minority and poor children will be able to receive education of the same quality as their more fortunate peers (Gladieux & Swail, 1999; Panel on Educational Technology, 1997). New computing and network technologies can provide disadvantaged students with access to knowledge-building and communication tools and more individualized learning opportunities.

However, access to technology is not equitable across sociodemographic categories since it is determined by resources available to the schools, communities, and households. New technologies seem to best accommodate those who already take advantage of available educational opportunities (Barley, 1997). It is possible that use of these technologies may widen the educational gap in such a way that "advantage magnifies advantage" (Gladieux & Swail, 1999) as the advantaged benefit most from cutting-edge technologies whereas the most needy benefit least. Skeptics question whether new technologies per se, are able to improve educational equity since both access to and use of technologies are socially stratified.

There are clear patterns of uneven distribution of access to technologies, including computer and webTV ownership, Internet access, and email use (U.S. Department of Commerce, 1999). To date, the digital divide issue has turned on the concept of access (Ba, et al, 2001). Access has become an issue of social equity. Equal access to the technology and the skills to use it are increasingly necessary for economic success (Pachon, et al, 2000). Pearson (2002) indicated that there are large disparities between the access opportunities of the rich vs. poor and ethnic majority vs. ethnic minority populations. Concerning access to new technologies, poor and

minority students are at a disadvantage.

The rates of the Internet access among individuals with high income and higher education are greater than the rates among those with low income and less education. Race-ethnicity was an important stratification factor in the rate of Internet access. Blacks and Hispanics are less likely to have Internet access at home than Whites and Asian Pacific Islanders, although the gap is narrower for Internet access outside the home. (U.S. Department of Commerce, 1999). Uneven availability and access exist among public schools with different socioeconomic student populations. In multiple measures of access, schools with a large number of poor students, receiving free or reduced price lunch, rated lower than to schools with smaller numbers of poor students (National Center for Education Statistics [NCES], 1999b).

Computers have been increasingly regarded as learning tools in education, but not a panacea for educational concerns (Pachon, 2000). However, students who do not have access to high-quality computer experiences at home or school are not being provided with the opportunities they need to be successful in society (Pearson, 2002). Lack of proper education is an important barrier to technology access and adoption (Hoffman & Novak, 1999).

The process of using technologies is socially differentiated as well. There are substantial differences between affluent and poor schools in the processes used by teachers in instructing their students on computer and Internet use. Teachers and students in poor schools are more likely to use the computer for drill practice and less likely to use it for research work when compared with their counterparts in affluent schools (NCES, 2000a). Disadvantaged students often attend unchallenging computer-related courses. They are more likely to take computer literacy classes than to use computers in the study of key subject areas. High-socioeconomic status (SES) students are more likely than low-SES students to engage in computer programming as opposed to lower-level computer-related tasks) and to use computers primarily for “higher-order” or “mixed” activities (rather than drill-and-practice activities). For challenging computer activities, High-SES students disproportionately receive better learning opportunities than poor and minority students (Wenlinsky, 1998). School reform involving new technological applications does not seem to narrow the divide, as revealed in a contrast between an impoverished public school and an elite private school (Warschauer, 2000). Students attending different schools are systematically channeled into distinctive futures via the *process* of assignment to technology-based programs: for the affluent, academic and research-oriented higher education; for the poor, workplace-oriented vocational learning.

Significantly, access to technologies at home has a great deal to do with *how* technologies are learned in school. Students whose families provide ready access to a computer are likely to take advanced computer classes at school involving such tasks as the analysis of complex systems and college-oriented academic work. In contrast, students who have no experience with computer at home often are placed in computer courses emphasizing routine skill learning or workplace-oriented training (e.g., Gladieux & Swail, 1999; Wenglinsky, 1998).

Concepts and Research Issues

We used a dual construct to examine computer use and academic performance, namely, *technically generic benefits versus socially differentiated benefits*. The former refers to the possibility that application of technology consistently benefits every student. Socially differential benefits, in contrast, hypothesize that the effects of technology vary by the social grouping of its users and by the social settings of its use.

Under the rubric of generic benefits, educational applications of technologies such as online instruction and interactive systems allow all learners to readily access vast amounts of information and to learn in an individualized process that accommodates their unique needs, abilities, and learning styles, thus helping to reduce learning gaps related to students’ social backgrounds (Panel on Educational Technology, 1997).

The perspective of socially differentiated benefits argues that disadvantaged children do not benefit from technologies as much as other children (Wenglinsky, 1998). Disadvantaged children, even with access to new technologies, are more likely to use them for rote learning activities rather than for intellectually demanding inquiries. The social conditions in which educational technologies are implemented and used may influence the technologies’ ability to narrow or widen historical disparities. Research has found that the traditional patterns of classroom organization might be impermeable to change, even with the wide availability of computers at school (e.g., Warschauer, 2000).

With the perspective of social stratification, the extent to which educational technologies improve student learning varies, partly depending on students’ socio-demographic backgrounds. From this perspective, home access to cutting-edge technologies is a key indicator of learning opportunity. Research has found that children with access to computers and the Internet at home are more confident and resourceful in using

computer-related technologies at school. Lack of access at home, even when access is provided at school, handicaps many poor and minority children in productively using computers. Home access to a computer and the Internet, differentiated by SES, may be a significant source of educational inequality in the United States (Gladieux & Swail, 1999).

Further, we argue that computer use at home may help shape fundamentally different attitudes about using technologies for learning. Children from families with adequate material and cultural resources tend to “grow up with” cutting-edge technologies. They often are interested in new technological developments and intimately relate themselves to these changes by developing some sort of self-identity with technological products. Constantly curious about evolving high tech areas, these children are able to actively take advantage of new technologies for the study of core academic subjects as well as for entertainment.

In contrast, children from deprived home environments are not only unfamiliar with the novel ways of learning with new technologies, but also could be alienated from the rapidly-changing technologies that they have to deal with outside of home, including those found in the classroom. Without a technology-friendly home environment to foster their confidence and interest in computer-based learning, their attitude toward technologies could be indifferent or even hostile. In this study, we see that the use of computers at home typifies the socially differentiated benefit of technologies because it is largely determined by family material and cultural resources. School-provided access to computer-based learning, on the other hand, is presumably a remedy to the social stratification of technologies. It is expected to provide generic benefits of technology to all children since public schooling by default promises equitable education. Examining computer use at home and at school is thus the focus of this study.

Academic achievement is also conditioned by many other factors. School resources, instruction and curriculum, teacher expectation, and individual students’ motivation to learn, are widely documented factors that influence academic performance. To isolate technologies’ generic versus differential effects, we analyzed these factors together with computer use at home and at school in accounting for student academic performance.

Specifically, we attempt to address the following issues:

1. To what extent did disadvantaged students lag behind other students in computer use at school and computer use at home?
2. *Ceteris paribus*, how did computer use at home and school relate to high school students’ academic achievement (generic benefits)?
3. Does the relationship between computer use and academic achievement differ across racial-ethnic and SES subgroups (differential benefits)? and
4. Did computer use help narrow achievement gaps associated with income and race-ethnicity among the NELS cohort? (gap-reduction effect)?

Methods

Data Source

The Education Longitudinal Study of 2002 (ELS:2002) will provide trend data about critical transitions experienced by 2002 base year 10th grade students as they proceed through high school and into postsecondary education or their careers. Base year ELS:2002 was carried out in the spring term of the 2001–02 school year with a national probability sample of 752 public, Catholic, and other private schools. Data collection methods consisted of five separate questionnaires (student, parent, teacher, school administrator, and library media center), two achievement tests (assessments in reading and mathematics), and a school observation form (facilities checklist). Base year questionnaires were completed by 15,362 of the 17,591 selected sophomores, 13,488 parents, 7,135 teachers, 743 principals, and 718 librarians. The multilevel focus of ELS:2002 provides researchers with a comprehensive perspective of influences on the student including home, school, and the community. This perspective is essentially unified, the basic unit of analysis is the student.

Multiple regression analysis was used to examine each independent variable’s relationship with academic performance, controlling for the other variables. A series of initial tests were run to explore alternative equations that could yield reasonably good fit with the data. In the final analysis, a series of equations were specified to assess the racial-ethnic and SES gaps in achievement in connection to computer access and other variables.

Variables

A description of each variable follows. The extracted data were edited and/or re-scaled. *Student academic performance* represented by the composite math/reading standardized test score at 10th grade was used as the outcome indicator in this study. The composite score is the average of the math and reading

standardized scores, re-standardized to a national mean of 50.0 and standard deviation of 10.0. The standardized T score provides a norm-referenced measurement of achievement relative to the population, Spring 2002 10th graders, as a whole. *Race-ethnicity* was a seven-category variable for (a) American Indian/Alaska Native, non-Hispanic, (b) Asian, Hawaii/Pacific Islander (API), non-Hispanic, (c) Black or African American, non-Hispanic, (d) Hispanic, no race specified, (e) Hispanic, race specified, (f) Multiracial, non-Hispanic, and (g) White. In multiple regression analysis, the grouping was dichotomous, one for American Indian/Alaska Native, Black or African American, Hispanic, and Multiracial, and the other for White and API. Combining White and API into a group was based on the established fact that the API group on average has similar computer access and academic performance as whites (see, for example, U.S. Department of Commerce, 1999; NCES 1999b; Jencks & Phillips, 1998). *SES* was indicated by a composite score derived from parents' educational attainment, parents' occupation, and household income. A derived quartile variable was used to define low-income students as those who were in the lowest quartile of the derived SES.

Computer use was represented by a series of variables, including student self-reported home computer use, school computer use, frequency of computer use at home and school, different modes of computer use, computer use in English and math courses, and computer use by English and math teachers for instruction. To examine the potential generic and differential benefits of technology access in connection to academic achievement, we attempted to sort out complex relationships between a group of relevant explanatory factors and academic performance which follow.

School factors included school socioeconomic composition, school geographic locale (urban, suburban, and rural), and school provision of computer-related programs and facilities. *Instruction/curriculum and teacher's expectation* indicated by students' placement of advanced placement program (versus general and vocational programs). English and math teachers' expectation for students' future education was viewed as another condition leading to meaningful use of technology in academic growth. *Family resource and support* indicated by SES, availability of a home computer, and parent's expectation for the child's education.

Analysis

Variables were analyzed through two-sample "t" test statistical procedures and multiple regression procedures. In the bivariate analysis, a large number of variables conceptually relevant to academic achievement and computer access were examined. Based on descriptive and bivariate analysis multiple regression analysis was conducted to examine the predictor variables' unique and joint relationships with academic performance. A series of initial tests were run to explore alternative equations that could yield reasonably good fit with the data. Particular attention was paid to testing of two-way interaction effects in order to detect joint effects of predictors on achievement. The tests include interactions between computer use/access and race-ethnicity, SES, curriculum and coursework, teacher educational expectations, and parent student educational expectations.

In the final analysis, a series of equations were specified to assess the racial-ethnic and SES gaps in computer access and the possible generic and differential benefits of computer use on academic performance. The first equation simply demonstrates the existing racial-ethnic and SES gaps in computer access. Subsequently, school, program, family, and psychobehavioral variables are entered into the equations to estimate how the two gaps might change. SPSS v12.0 was used to conduct descriptive procedures and AM v.0.06, provided by the American Institutes of Research and Jon Cohen and recommended by NCES for use with ELS:2002 data, was used to conduct multiple regression procedures.

Results

Research Issue 1: Computer Access and Use

Differences in computer use at home are evident both in race/ethnicity and SES subgroups (see Table 1). With regard to race, APIs (41.58%) and Whites (40.49%) frequency of computer use at home was well above the frequency of use for minorities, specifically Blacks/African Americans (28.40%) and Hispanics (26.98%). As one might expect, the low SES subgroup revealed less frequency of computer use when compared to higher SES subgroups. However, as we alluded to earlier, frequency of computer use at school was relatively similar across all race/ethnicity and SES subgroups. Frequency of computer use for school work revealed differences in the race/ethnicity subgroups, again between the non-API minorities using computers less and Whites/APIs with a higher percentage of computers use. The low SES subgroup revealed less computer use for school work than higher SES subgroups. Only minor differences in use of computers by students to learn on their own were evident in race/ethnicity and SES subgroups.

Table 1 *Computer Access/Use Gaps: Percentage of Computer Access/Use by Race-Ethnicity and Low-Income Status Subgroups of Base Year 2002 Sophomores*

| Subgroup | How often uses computer at home ^a | How often uses computer at school ^b | How often uses computer for school work ^c | How often uses computer to learn on own ^d |
|-----------------------------|--|--|--|--|
| Amer. Indian/Alaska Native | 30.17% | 19.52% | 19.89% | 18.65% |
| Asian, Hawaii/Pac. Islander | 41.58 | 15.37 | 30.94 | 25.58 |
| Black or African American | 28.40 | 17.32 | 21.21 | 22.14 |
| Hispanic, no race specified | 29.71 | 15.21 | 21.11 | 20.31 |
| Hispanic, race specified | 26.98 | 14.61 | 21.08 | 19.34 |
| Multiracial, non-Hispanic | 34.29 | 16.94 | 22.80 | 21.05 |
| White | 40.49 | 16.62 | 24.97 | 21.07 |
| Other SES | 39.74 | 16.28 | 25.03 | 21.04 |
| Low SES | 26.71 | 16.93 | 17.98 | 17.16 |

Note. Values enclosed in parentheses represent standard errors. From U.S. Department of Education, National Center for Educational Statistics, Education Longitudinal Study of 2002 (ELS:2002), “Base Year” panel data. ^aBased on BYS47A, a scale ranging from 1 through 5 indicating increasing frequency of computer use, where use was defined as a 4 and 5 rating average. ^bBased on BYS47A. ^cBased on BYS47A. ^dBased on BYS47A.

Research Issue 2: The Generic Benefits of Computer Use

We examined the generic benefit of computer use at home and at school with different variables in relation to the math and reading composite score, upon controlling for the effects of variables that have been documented as relevant to achievement (*ceteris paribus* for correlation statements thereafter). In Table 2, with the first equation, we estimated the achievement gaps associated with SES and race-ethnicity. SES is a strong positive predictor of the achievement (with $\beta = 4.94$, and $p < 0.01$). We separately estimated the racial differences with six binary variables, each representing a contrast between a given minority group and Whites. The API and Multiracial groups had a higher average score than the Whites ($\beta = -4.68$ and -1.79 at $p < 0.01$ respectively). Blacks/African Americans and Hispanics, race specified, showed significantly lower average achievement (2.31 and 0.91 respectively, at the $p < 0.01$ level). The American Indian/Alaska Native and Hispanic, race not specified, revealed no significance.

We then recoded the race-ethnicity into a single binary variable, which contrasted non-API minority groups with Whites and APIs. In equation 2, we entered a set of individual and school background variables that were presumably predictive of achievement, together with SES and the non-API minority dichotomy. This procedure allowed us to demonstrate that most background variables were related to achievement, as expected, and then to further test the effects of computer use/access measures after controlling for these background variables.

Note that the achievement gaps related to SES and race-ethnicity decreased as those individual and school variables entered into the equation. This implies that those predictor variables accounted for a large portion of the two gaps, meaning that providing the similar conditions on those variables, low-income and minority students would have done less poorly in math and reading tests relative to Whites and APIs.

To identify a generic benefit of computer use and access in raising the achievement level, we entered into equation 3 a group of nine variables measuring computer use and access. Of these variables, six estimates were statistically significant. Owning a home computer was found to be significantly related to high achievement ($\beta = 1.05$ at $p < 0.01$). Three variables related to frequency of computer use at home, at school, and computer use for school work revealed significance ($\beta = 0.62$, 0.36 , and 0.96 respectively, all at the $p < 0.01$ level). While computer use in 9th grade fall and spring math did not produce significance, computer use in 9th grade fall and spring English revealed an interesting finding: both produced significance at the $p < 0.01$ level, however, the effect was different for fall and spring ($\beta = -1.25$ and 1.45 respectively).

Table 2 *SES and Racial-Ethnic Gaps in Math and Reading Composite Test Score and Generic Benefit of Access to and Using Computer: Multiple Linear Regression Coefficient Estimates*

| Independent Variables | Equation 1: SES and race-ethnicity gaps | Equation 2: SES and racial-ethnic gaps net of backgrounds | Equation 3: Generic benefit of computer access/use |
|-----------------------|---|---|--|
|-----------------------|---|---|--|

| | | | |
|--|----------------|---------------|----------------|
| Socio-economic status composite, v.2 | 4.94 (0.14)** | 4.80 (0.14)** | 3.92 (0.17)** |
| Non-API minorities vs. White | -- -- | 5.34 (0.26)** | 4.42 (0.30)** |
| Amer. Indian/Alaska Native, non-Hispanic vs White | 0.68 (0.72) | -- -- | -- -- |
| Asian, Hawaii/Pac. Islander,non-Hispanic vs. White | -4.68 (0.39)** | -- -- | --- |
| Black or African American, non-Hispanic vs. White | 2.31 (0.29)** | -- -- | --- |
| Hispanic, no race specified vs. White | 0.28 (0.34) | -- -- | --- |
| Hispanic, race specified vs. White | 0.91 (0.35)** | -- -- | --- |
| Multiracial, non-Hispanic vs. White | -1.79 (0.42)** | -- -- | --- |
| Advanced Placement Courses | | 4.36 (0.25)** | 4.12 (0.27)** |
| School urbanicity | | 0.05 (0.21) | 0.01 (0.22) |
| Grade 10 percent free lunch-categorical | | -0.52 (0.34) | -0.44 (0.44) |
| Family has a computer | | | 1.05 (0.51)* |
| How often uses computer at home | | | 0.62 (0.13)** |
| How often uses computer at school | | | 0.36 (0.12)** |
| How often uses computer for school work | | | 0.96 (0.13)** |
| How often uses computer to learn on own | | | 0.08 (0.10) |
| Used computer in 9th grade fall English | | | -1.25 (0.49)** |
| Used computer in 9th grade spring English | | | 1.45 (0.39)** |
| Used computer in 9th grade fall math | | | -0.37 (0.48) |
| Used computer in 9th grade spring math | | | -0.55 (0.46) |
| Intercept | 73.40 | 69.80 | 63.22 |
| R ² | 0.26** | 0.29** | 0.33** |
| Number of parameters | 7 | 5 | 14 |
| N of weighted cases ^a | 15362 | 11639 | 8647 |

Note. Values enclosed in parentheses represent standard errors. From U.S. Department of Education, National Center for Educational Statistics, Education Longitudinal Study of 2002 (ELS:2002), "Base Year" panel data.

^aThe number of cases changed across equations due to list-wise deletion of missing cases.

* $p < 0.05$. ** $p < 0.01$.

Research Issue 3: The Differential Benefits

Does computer use help some children but not others? Or does it help one group *more* than other groups? To examine the role of computer use in promoting academic performance of students of different SES and racial-ethnic backgrounds, we separated the analysis by the subgroups. Table 3 shows multiple regression coefficient estimates for comparison of non-Asian minorities against APIs and Whites and of the low-SES group, defined by the lowest quartile of the SES composite score, against the group of other SES quartiles. Between the two racial-ethnic groups, there were differences in effects of several predictor variables including advanced placement courses, and parents' expectations for students' college education.

One particular computer-relevant variable differed in relation to achievement across the both race and SES groups. Computer use for school work produced a positive effect on the API and White group (beta= 0.39 and $p < 0.01$) whereas it did not make a difference among minority students. This variable also produced a positive effect on the Other SES quartile group (beta= 0.33 and $p < 0.01$) whereas it did not make a difference among Low SES quartile students.

Table 3 Examining Differential Benefit of Access to and Using Computer by Race-Ethnicity and SES: Multiple Linear Regression Estimates for Racial-Ethnic and SES Subgroups

| Independent variables | Non-API minority students | API and White students | Lowest SES quartile students | Other SES quartile students |
|---|---------------------------|------------------------|------------------------------|-----------------------------|
| Socio-economic status composite, v.2 | 2.83 (0.21)** | 2.97 (0.18)** | --- | -- -- |
| Non-API minorities | --- | --- | 4.84(0.40)** | 5.72 (0.29)** |
| Grade 10 percent free lunch-categorical | -0.10 (0.05)* | -0.05(0.04) | -0.05(0.05) | -0.11 (0.04)** |
| School urbanicity | 0.45 (0.30) | 0.10(0.23) | 0.19(0.28) | -0.01 (0.22) |
| Advanced Placement Courses | 2.51 (0.40)** | 3.50(0.27)** | 2.57(0.55)** | 3.53 (0.26)** |

| | | | | |
|--|---------------|---------------|--------------|---------------|
| How far teacher expects student to get in school (English) | 0.21 (0.05)** | 0.22 (0.04)** | 0.24(0.06)** | 0.25 (0.04)** |
| How far teacher expects student to get in school (math) | 0.21 (0.05)** | 0.39(0.04)** | 0.29(0.05)** | 0.38 (0.04)** |
| How far in school student thinks will get-composite | 0.62 (0.07)** | 0.54 (0.05)** | 0.52(0.08)** | 0.69 (0.05)** |
| How far in school parent wants 10th grader to go-composite | 0.63 (0.11)** | 1.39(0.09)** | 1.06(0.11)** | 1.33 (0.09)** |
| Family has a computer | 0.27 (0.04)** | 0.18 (0.04)** | 0.28(0.05)** | 0.20 (0.04)** |
| How often uses computer at home | 0.34 (0.07)** | 0.26(0.07)** | 0.25(0.08)** | 0.40 (0.07)** |
| How often uses computer at school | 0.01 (0.08) | 0.04 (0.06) | 0.01(0.09) | -0.04 (0.06) |
| How often uses computer for school work | -0.09 (0.10) | 0.39 (0.08)** | 0.02(0.11) | 0.33 (0.09)** |
| How often uses computer to learn on own | 0.09 (0.09) | -0.01(0.07) | 0.00(0.10) | 0.01 (0.07) |
| Mean Square Error | 64.02 | 58.85 | 59.92 | 63.76 |
| R ² | 0.23** | 0.33* | 0.24** | 0.32** |
| | | * | | |
| Number of parameters | 13 | 13 | 13 | 13 |
| N of weighted cases | 4788 | 9689 | 2945 | 10146 |

Note. Values enclosed in parentheses represent standard errors. From U.S. Department of Education, National Center for Educational Statistics, Education Longitudinal Study of 2002 (ELS:2002), “Base Year” panel data. * $p < 0.05$. ** $p < 0.01$.

Research Issue 4: The Gap-Reduction Effect

How does computer use/access at home help narrow achievement gaps associated with income and race-ethnicity? With frequency of home computer we could distinguish the ELS:2002 respondents into three groups. A majority group (n=5,667) included the students who use computers at home ranging from once or twice a week to everyday or almost everyday (frequent), the second group (n=1,061) who use computers at home ranging from less than once a week to never (not frequent), and a third group (673) that did not have a computer at home (no computer)(see Table 4). Separately estimating the same regression equation for the three groups revealed considerable differences in academic achievement gaps relating to income, race-ethnicity, and other relevant variables. The advanced placement course variable produced a positive effect on the frequent home computer use group (beta=2.64 at $p < .01$) with no effect on the not frequent and no home computer groups. Variables related to college expectations including English and math teachers’, parents’, and student’s, all produced a positive effect on students that own a home computer. Frequency of computer use at school revealed positive effects for the frequent and not frequent home computer use groups (beta 0.31 at $p < 0.01$ and beta 0.70 at $p < .05$ respectively). The effect of the frequency of computer use to learn on own variable revealed a positive effect (beta 0.32 at $p < 0.01$) for the frequent home computer use group and a negative effect (-0.61 at $p < 0.05$) for the group with no home computer.

Table 4 *Gap-Reduction Effect: Multiple Linear Regression Coefficient Estimates in Equations for Students Who Used PC at Home and Students Who Did Not Have a PC*

| Independent variables | Students that used PC at home once or twice a week to everyday or almost everyday | | Students that used PC at home less than once a week to never | | Students that did not have a PC at home | |
|--|---|----------|--|----------|---|----------|
| | | | | | | |
| Socio-economic status composite, v.2 | 1.41 | (0.20)** | 1.02 | (0.40)* | 0.39 | (0.57) |
| Non-API minorities | 3.85 | (0.36)** | 4.61 | (0.60)** | 4.03 | (0.66)** |
| Grade 10 percent free lunch-categorical | -0.45 | (0.08)** | -0.51 | (0.18)** | -0.66 | (0.20)** |
| School urbanicity | 0.57 | (0.22)** | 0.44 | (0.40) | 0.23 | (0.46) |
| Advanced Placement Courses | 2.64 | (0.26)** | 0.94 | (0.72) | 0.09 | (0.92) |
| How far teacher expects student to get in school (English) | 1.71 | (0.12)** | 1.50 | (0.24)** | 1.56 | (0.28) |
| How far teacher expects student to get in school (math) | 2.02 | (0.11)** | 1.87 | (0.23)** | 2.00 | (0.29) |

| | | | | | | |
|--|--------|----------|--------|----------|--------|---------|
| How far in school student thinks will get-composite | 0.11 | (0.06)** | 0.29 | (0.13)* | 0.14 | (0.14) |
| How far in school parent wants 10th grader to go-composite | 0.54 | (0.10)** | 0.67 | (0.19)** | 0.40 | (0.23) |
| How often uses computer at school | 0.31 | (0.12)** | 0.70 | (0.29)* | 0.63 | (0.34) |
| How often uses computer for school work | -0.08 | (0.15) | -0.15 | (0.28) | 0.01 | (0.32) |
| How often uses computer to learn on own | 0.32 | (0.10)** | 0.21 | (0.26) | -0.61 | (0.29)* |
| Mean Square Error | 45.18 | | 50.73 | | 50.26 | |
| R ² | 0.50** | | 0.44** | | 0.38** | |
| Number of parameters | 12 | | 12 | | 12 | |
| N of weighted cases | 5667 | | 1061 | | 673 | |

Note. Values enclosed in parentheses represent standard errors. From U.S. Department of Education, National Center for Educational Statistics, Education Longitudinal Study of 2002 (ELS:2002), “Base Year” panel data. * $p < 0.05$. ** $p < 0.01$.

Discussion

Our analysis of the NELS data, adjusted for a series of individual and school background factors, generated the following findings: (a) disadvantaged children did not lag far behind their peers in computer use at school, but they were much less likely to use computers at home; (b) computer use at home was far more significant than computer use at school in relation to high academic performance; (c) using a computer at school seemed to have dubious effects on learning--taking computer science courses at school related consistently to low performance for both the disadvantaged and their peers; (d) disadvantaged children benefited less than other children from computer use, including computer use at home; and (e) compared to their peers, disadvantaged children’s academic performance seemed less predictable by computer use than other predictor variables.

Income is a stronger indicator than race regarding the use of computers and students’ achievement, and the strength of the evidence seems to be clear that socioeconomic factors appear to play a disturbing role in student access to computers. In many cases, there are demographic correlations between ethnicity and income level; however, affluence is the key factor in determining the positive influence of computer use on student performance. Focus should therefore be given not only to racial minorities but also to the SES minority in order to best implement technology for achievement.

Computer use at home was far more significant than computer use at school in relating to high academic performance, but this effect was absent for minority and low-SES children. These findings support the notion that seemingly ubiquitous computer-based technologies are nevertheless differentially available and functioning by social and demographic groups. Public education has not remedied the problems imposed by the social stratification of technologies. The findings refute the over-simplistic belief that application of technology could benefit all children in public schools by closing achievement gaps.

This analysis seems to underscore a need for reform of technology policies and computer-related curricula/instruction to provide equitable education for all children. The pattern that computer science classes in general were related to low achievement points to the possibility that ill-designed curriculum or poor instruction rendered such technology-oriented programs disappointing. Also, achievement-irrelevance of a number of variables of computer use-at school or setting-free-suggests that technologies per se may not work to help performance. Especially, technologies alone would not work well for closing achievement gaps as the performance of minority and poor children was related to computer use to only a limited extent.

These findings present clear evidence in terms of the relationship between socioeconomic factors, equitable distribution and use of computers, teacher technology training, and students’ performance. In light of this, it is imperative that “equity” in school computer usage must involve not only equity in access but also equity in consideration of the learning needs of low-income and minority students. It follows, then, that teacher technology training is as important as socioeconomic factors in determining the level of SES achievement by the career graduate. Increased access to computers will only have positive results when the educator has a complete grasp of the role and use of computers, and an understanding of the student’s home environment and how their deficiencies must be met in order to realize their full potential, thus enhancing society instead of reducing the average achievement.

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Teaching Computer Skills to Beginners: What and How?

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Summary

This report describes an evaluation of Computer Literacy, which is an undergraduate general studies course, offered by College of Education at a large southwestern university. The purpose of this course is to provide knowledge about computer and computing, and application skills in using Microsoft Office software. The course is coordinated by a professor and is currently delivered in multiple sections by teaching assistants.

The evaluation employed a questionnaire survey and an interview as the primary data collection methods. In total, 329 students and all 11 instructors responded to the survey. The interview data were collected from five student focus groups, five instructors, and the course coordinator. In addition, mean scores of quizzes, the midterm exam and the final were obtained from all class sections.

The survey and interview results suggested that the topics taught were useful to students, especially the hands-on skills. Among the different teaching strategies used, hands-on projects and in-class activities were found to be more helpful to students, whereas reading from textbook and online discussion forum were not helpful. The results suggest that 'learning by doing' is good for learning skills, whereas reading and group work are not helpful unless they can make the class more interesting.

Overall, the evaluation revealed that the Computer Literacy course is successful in providing basic understanding and application of computer. Recommendations on alternative teaching strategies are made to improve learning effectiveness.

Introduction

Computer literacy is expected for both academic and career achievement (Davis, 1999). Instructors at school expect their students to have some degree of computer literacy when they enter college (Hirschbuhl & Faseyitan, 1994) and when they graduate (Furst-Bowe, Boger & Franklin, 1995). In the job market, corporate recruiters have reported that core computer competency skills are very important to the employability of a recent college graduate (Davis, 1997). Ndahi and Gupta (2000) explained that this is because computer literate employees have better prospective in workplace-specific training and more likely to be successful in their field. As a result, employers seek computer literacy in almost everyone their hire (Ndahi & Gupta, 2000). Thus, a job applicant who lacks computer skills is seriously handicapped, both in obtaining a job and qualifying for promotion (Martin, Carrier & Hill, 1997).

To meet the demand of computer-literate graduates, it is important to determine what constitutes desired computer competency and how they should be taught. Tucker and Garnick (1991) argued that a computer literacy course should be characterized to emphasize using computers as tools alongside the uses of computers in society. Ndahi and Gupta (2000) conducted a survey on computer literacy in workplace training, and the results suggested that word processing was the most required skill. The report also showed a strong interest in learning file management and making a PowerPoint presentation. The demand for knowing database software was also increasing. These results were consistent with Furst-Bowe, Boger and Franklin's study (1995), which indicated that skills in word processing, spreadsheets, database management, graphics, and information retrieval are required for many jobs. In terms of teaching strategies, previous studies found that students learn more when they are allowed to work in a lab together, or when informal peer tutoring and support are available (Davis, 1999). Learners also prefer to customize learning at their own pace (Smith & Tarkow, 1998).

Course description

The evaluated Computer Literacy course is a 3-credit general studies course required for undergraduate students. In the 14 three-hour weekly meetings with instructors, students learn not only fundamental concepts and knowledge about computers, such as how data are input, processed, stored and output (IPSO), but also how to actually use computer applications for productivity, such as using Microsoft Word, Excel and PowerPoint.

The administering of the course incorporates Blackboard, a course management system widely used on campus. All course information, including presentation notes, hand-outs, assignments, and quizzes/exams can be accessed from Blackboard.

In spring 2003, there were 444 students enrolled in 21 sections of the Computer Literacy course taught by 11 teaching assistants. The class size of each section ranged from 18 to 24 people. One professor coordinated all these sections. A formal evaluation was conducted to improve learning effectiveness.

Elements evaluated include the contents taught, the skills learned, and the teaching strategies used in the course. Student and instructor perceptions of the course were also noted.

Method

Participants

The participants in the evaluation were the students, instructors, and coordinator of the Computer Literacy course. An online survey was administered to the 444 undergraduate college students enrolled in the course. Twenty-five students were interviewed in focus groups. They were volunteers from five different sections with five students in each group. The 11 instructors who taught this course were surveyed and five of them were interviewed. The course coordinator was also interviewed.

Data sources

A variety of evaluation instruments were employed to assess the course in a comprehensive manner. Data were collected with regards to the contents covered, skills learned, teaching strategies used, and student and instructor attitude towards the course. The instruments include: 1) Student survey, 2) Instructor survey, 3) Student interview of the focus groups, 4) Interview of instructors, 5) Interview of the course coordinator, and 6) Test scores of all 21 sections.

Student survey. The 26-item student survey was designed to determine the general perception of the Computer Literacy course in terms of the contents covered and teaching strategies used. The survey was distributed through Blackboard to all students enrolled in the course. Responses to the questions were anonymous and were scored on a four-point Likert type scale from “most agree with the description (3)” to “least agree with the description (0)”. The respondents were also given the opportunity to provide additional comments.

Instructor survey. The instructors were administered a paper-based survey that was similar to the student survey. Their attitudes towards the content and the teaching strategies were rated on the same four-point Likert type scale.

Interview protocol. Interviews with the instructors, focus group students, and the course coordinator were designed to collect detailed information on topics covered by the course, teaching strategies used, and student learning gain at the end of the semester. The questions were directly aligned to the questions on the survey. All interviewees were given the chance to address any issue relevant to the course.

Test scores. Student performance on the online quizzes, online midterm exam, and hands-on final were analyzed to determine the usefulness of content and helpfulness of strategies. The online tests were multiple-choice questions that assess student knowledge about computers and skills of using a computer. The hands-on final exam tested students how to use Microsoft Word, Excel, and PowerPoint. Students needed to complete editing, analysis, and design activities as requested. The four 10-point quizzes covered the primary topics of the course, namely: Quiz 1 – File Management, Word, Internet and World Wide Web, Quiz 2 – IPSO, Quiz 3 – Excel and Data Analysis, and Quiz 4 – PowerPoint. Topics covered during the first half of the semester (Quiz 1 and 2) were tested in the online midterm exam. The maximum score of the online midterm and the Hands-on final was 30 points.

Results

Survey responses. Based on a four-point Likert-type scale scoring from 3 (most agree with the description) to 0 (least agree with the description), the survey responses of 329 students and 11 instructors on the usefulness of the contents are shown in Table 1, and the helpfulness of teaching strategies are shown in Table 2.

In terms of the usefulness of the contents taught, student and instructor survey responses revealed the topics covered in this course are generally considered very useful or useful (student rating $M = 2.08$, instructor rating $M = 2.44$). Among the seven items that were rated, *Microsoft Word*, *PowerPoint*, *Internet and World Wide Web* were the top three highest ratings across students and instructors. Knowledge on *IPSO* was rated the

least useful (student rating $M = 1.53$, instructor rating $M = 1.64$). It is worth noting that there was a big difference in the perceived usefulness on *File Management* between students ($M = 1.74$) and instructors ($M = 2.45$).

In terms of teaching strategies, both students and instructors ranked that *Hands-on Projects*, *In-class Activities to Develop Practical Skills*, and *Handouts for Activities and Projects* were the three most helpful strategies. Students and instructors agreed that the two least helpful strategies are *Readings* by students (student rating $M = .73$, instructor rating $M = 1.09$) and *Online Discussion Forums* (student $M = 1.22$, instructor rating $M = 0.82$).

The responses to the open-ended question at the end of the survey are summarized in Table 3. Twenty-nine people said they were satisfied with the course and no change needed to be made. There were also suggestions in terms of contents taught and teaching strategies used. Many students preferred to have more hands-on activities in class ($N = 36$) and get more individual attention from the instructor ($N = 21$). Students also commented that lectures in the form of PowerPoint presentations were too long ($N = 19$). The group *Online Discussion Forum* was considered not helpful ($N = 12$) due to the difficulty of cooperation among group members. Students also considered reading textbook as not helpful ($N = 12$), and the quiz questions did not test the skills learned but how much details remembered ($N = 6$).

Interviews. The results of the interviews of instructors and student focus groups were consistent with those of the survey on the topics covered in the course. In addition, both students and instructors emphasized that more practices were needed for *File Management*. Specific step-by-step instructions were needed for complicated subjects such as *Excel* and *Create a Personal Website*.

The interview with the course coordinator revealed that this course is meant to provide fundamental knowledge and skills that students can start with. Software application skills (*Microsoft Word*, *Excel*, *PowerPoint*, and *Create a Personal Website*) were long-term gains for the students. It was difficult to maintain consistency of teaching across 21 sections and 11 instructors. PowerPoint presentations were pre-designed and distributed to instructors to maintain the consistency.

Text scores The mean scores and percentages of achievement of all tests across the 21 sections are summarized in Table 4. Among the online tests, students performed the best in Quiz 2 on *IPSO* ($M = 8.14$) and Quiz 3 on *Excel* ($M = 8.09$). The highest achievement was their hands-on final exam ($M = 26.17$), which is a 87.23% of the maximum score.

Discussion

What to teach?

According to the survey results, the contents taught in the course achieved a rating of 2.26 across students and instructors, indicating that the topics covered by the Computer Literacy course are useful or very useful. However, there appears to be a big difference in learner interest of learning knowledge and learning application skills. It seems that application skills ($M = 2.44$), including *Word*, *Excel*, *PowerPoint*, and *Create a Personal Website*, were rated more useful than concept knowledge ($M = 2.04$) that consisted of *File Management*, *Internet and World Wide Web*, *IPSO*. Does this mean concept knowledge is less important than application skills?

Interestingly, the concept of *File Management* was rated 2.45 by the instructors, 0.71 point higher than student rating ($M = 1.74$). In addition, students in the interview suggested more practice on *File Management*. This might be because many students were not able to realize that mastering *File Management* is essential to working with their documents correctly and efficiently. Poor file management may not be a problem until late in the semester when student have to hyperlink all their assignments to their personal websites. If this is the case, how can the concept knowledge be taught in a more interesting way? Can the knowledge be integrated with the teaching of application skills?

How to teach?

The survey results showed that all of the three hands-on strategies (*Hands-on projects*, *In-class activities*, *Handouts for activities and projects*) were helpful. In addition, the overall rating of hands-on strategies ($M = 2.53$) is much higher than the overall rating of other strategies ($M = 1.48$). This result is consistent with student and instructor interview. It indicates that skills are learned through hands-on practice with instructor feedback. In order to give students more attention in class, the class size should be small enough for the instructor to provide individual assistance. For a class that has 18 to 24 students, it might be better to downsize the class if there is only one instructor available. Alternatively, there can be a second instructor added to assist hands-on practices.

Both the survey results and interview revealed that the current *Online Discussion Forum* is not a

preferred teaching strategy. Some student reported that the group work did not work as it was supposed to. This might be because students have different schedules and it is hard to work as a group after class. To improve collaboration among students, it is advisable to provide more opportunities in class to work together. Furthermore, each student should have a clear idea of his or her responsibility and how their job will be rated. Instructor supervision over the discussion forum needs to be enhanced. Guidance and feedback provided by the instructor will also motivate students to do a better job.

An interesting phenomenon is that the type of assessment may influence student performance. As shown in Table 4, student's achievement in the online tests was lower than the final hands-on exam. Students reported that the online quizzes were "too detailed" and "did not test the skills learned" but "how much is memorized". The majority of online test questions were multiple-choice format, which was used to assess concept knowledge and practical application skills. Since the skills would be tested without actually using the application software, the multiple-choice format seems to have changed the nature of application skills from "hands-on" to memory-based. Consequently, student performance was hampered by this type of assessment. This may also explain why Quiz 2 had the highest mean scores among all the online tests since the subject of *Input, Processing, Storage, and Output* was mostly factual knowledge as opposed to application skills. Along the same line, the reason why Quiz 3 on *Excel and Data Analysis* had achieved a high average might be because the questions were not just theoretical knowledge but it also tested some hands on excel skills, and students had to do calculations using Excel worksheet. In this case, students could actually work in the software instead of recalling where to access a command and under which menu. It appears that students perform better when hands-on skills are assessed in a hands-on way.

Recommendations

The Computer Literacy course is considered as a good general studies course that provides students with basic understanding of computer and application skills to use a computer. Based on the evaluation results, the following recommendations are made:

1. Reinforce the understanding of concept knowledge in teaching application skills.
2. More in-class, hands-on activities should be emphasized in teaching facilitated by appropriate student-instructor ratio.
3. Online discussion forums can be used for sharing experience of using application software.
4. Use hands-on tests to assess application skills.

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Table 1 *Student and Instructor Survey Mean Scores on the Usefulness of Content*

| Application Skills | Students | Instructors | Total |
|------------------------------------|----------|-------------|-------|
| Word | 2.53 | 2.73 | 2.63 |
| Excel | 2.13 | 2.55 | 2.34 |
| PowerPoint | 2.35 | 2.82 | 2.59 |
| Create a Personal Web Site | 2.01 | 2.36 | 2.19 |
| Subtotal | 2.26 | 2.62 | 2.44 |
| Concept Knowledge | | | |
| File Management | 1.74 | 2.45 | 2.10 |
| Internet and World Wide Web | 2.30 | 2.55 | 2.43 |
| Input, Processing, Storage, Output | 1.53 | 1.64 | 1.59 |
| Subtotal | 1.86 | 2.21 | 2.04 |
| Total | 2.08 | 2.44 | 2.26 |

Table 2 *Student and Instructor Ratings of the Helpfulness of Teaching Strategies in the Course*

| Hands-on Strategies | Students | Instructors | Total |
|---|----------|-------------|-------|
| Hands-on projects | 2.52 | 2.91 | 2.72 |
| In-class activities | 2.28 | 2.64 | 2.46 |
| Handouts for activities and projects | 2.27 | 2.55 | 2.41 |
| Subtotal | 2.36 | 2.70 | 2.53 |
| Other Strategies | | | |
| PowerPoint presentations to deliver lecture | 2.12 | 1.82 | 1.97 |
| Online multiple-choice tests | 1.84 | 2.09 | 1.97 |
| External website links | 1.69 | 1.64 | 1.67 |
| Co-operative group work | 1.34 | 1.27 | 1.31 |
| Online discussion forums | 1.22 | 0.82 | 1.02 |
| Reading textbooks | 0.73 | 1.09 | 0.91 |
| Subtotal | 1.49 | 1.46 | 1.48 |
| Total | 1.78 | 1.87 | 1.83 |

Table 3 *A Summary of the Answers to the Opened-ended Question in Student Survey*

| Student Comments | Frequency |
|---|-----------|
| 1. Satisfied with the content taught; the course was well organized; no changes need to be made. | 29 |
| 2. To include more hands-on practice/examples or step-by-step instructions in class, especially when teaching complicated subjects. | 36 |
| 3. Need more than one instructor for a class size of 18-24 people; instructors should give more individual attention to students. | 21 |
| 4. The lectures and presentations were long and boring; demonstrations are more interesting. | 19 |
| 5. The group Online Discussion Forum should be removed or changed; the group activity designed did not work. | 12 |
| 6. Reading from the textbook had little value. | 12 |
| 7. Split the weekly three-hour class into two shorter meetings. | 9 |
| 8. The quizzes were too detailed; the quizzes did not reflect skills learned but tested memorization. | 6 |
| 9. To include more collaborative activities to make the class more interesting. | 6 |

Table 4 *Mean Scores of Quizzes and Exams across All Sections*

| Quiz 1 Word, File Management, Internet and WWW | Quiz 2 Input, Processing, Storage, Output | Midterm Including Quiz 1 and Quiz 2 | Quiz 3 Excel and Data Analysis | Quiz 4 PowerPoint | Hands-on Final Word, Excel, PowerPoint |
|--|---|---|--------------------------------------|----------------------|--|
| 6.85 | 8.14 | 22.83 | 8.10 | 7.00 | 25.57 |
| 69% | 81% | 76% | 81% | 70% | 85.23% |

An Investigation of the Relationships Between Reading Speed and Paper Hue Intensity, Age and Gender

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Introduction

Due in part to health care improvements and the post World War Two Baby Boom, (Siegel, 1972), the population of older adults is growing and will continue to grow. By 2030 approximately 20 percent of the U.S. population will be over age 65 (Verma, 1989). By attending to readability (the ease of reading a printed page) and legibility (the speed with each letter or word can be recognized), some age-related difficulties may be circumvented.

Beginning with a 1931 study, Tinker and Paterson began reporting about their research on reading speed and other reading factors. Additional researchers, especially Stanton and Burt (1935) added to that research. Based in part on the 1931 study Tinker and Paterson (1940) later published a little research-based book (*How to Make Type Readable. A Manual for Typographers, Printers and Advertisers, 1940*) which defined color combinations, leading, line width and type face choices. In this book, Paterson & Tinker stated that greater contrast between paper hue and ink color allows improved differentiation of letter shapes from the background.

A literature review revealed several factors that affect gender-related readability and legibility for aging adults. The literature review explored five relevant areas: (1) aging process of the eye, (2) contrast sensitivity with aging, (3) research utilizing reading speed as the significant criterion, (4) contrast legibility studies and (5) gender and readability studies.

Aging Process of the Eye

Sight allows humans to learn about the environment through reading, movies, television and observation of others. Vision begins when light enters the eye via the transparent lens, is changed into electrical signals by the retina which sends them to the brain where they are interpreted. Around the age of twenty, each of these elements begins to change and some visual functions diminish. Verner and Davison (1982) state that defective vision increases from 23 percent at age twenty to 95 percent at the age of seventy.

Accommodation difficulty changing focus from near to distant objects) and Presbyopia (the inability to see small print or focus on nearby images) affect all aging adults. Around age 65 almost 100 percent of adults cannot focus on close objects. Other causes of vision changes can include prescription drugs, environmental factors and various diseases. Health problems can include glaucoma, cataracts, miosis, macular degeneration and diabetic retinopathy (Verma, 1989, Lyle, 1974).

Contrast Sensitivity with Aging

Perceiving edges and sharp outlines allows one to see shapes (Arden, 1978). Caird & Williamson (1986) found that decreasing contrast sensitivity can be a major cause of visual difficulty especially in dim light or under glaring lights. Several studies have used contrast sensitivity as the preferred method of measuring vision. Owsley, Sekuler and Siemsen (1983) found that contrast sensitivity function is a good predictor of a subject's visual performance. They surmise that it can probably be attributed to the amount of light reaching the retina.

Reading Speed as a Significant Criterion

Legge, Rubin, Pelli, et al. (1988), Brown (1981), Cooper (1985) utilized reading speed as a major criterion in studies. Their results found that reduced contrast or low light levels can create problems for most low vision subjects. Reading speed is also easier and more straightforward to use than legibility as an objective measure (Legge, Rubin, Pelli & Schleske, 1985a; Legge, Rubin & Luebker, 1987; Legge, Rubin, Pelli, et al., 1988).

Contrast Legibility Studies

Paterson and Tinker stated in 1940 that printers should have the maximum contrast between the ink and background. The best arrangement is a dark hue for the letters and a light hue for the background (for example, dark blue or black for the ink and white or cream for the paper).

Gender and Readability Studies

Three international studies found that women were significantly more likely to have vision problems with age. The Attebo, Mitchell and Smith (1996) study (the Blue Mountains Eye Study from Australia) found that seventy nine percent of the persons with severe visual impairment over 49 years of age were female. Taylor, Livingston, Stanislavsky and McCarty (1997) reported that Australian urban women older than 40 years of age had significantly higher rates of blindness. Age adjusted rates of blindness were .066% in men and .17% in women. The West, Munoz, Rubin, Schein, Bandeen-Roche, Zeger, German and Fried (1997) study from Baltimore, Maryland (the Salisbury Eye Evaluation Project), confirmed higher rates of vision loss in women which affected daily life and could contribute to more women in care settings.

These studies form the foundation for this study that measured contrast sensitivity as people age. While many people have researched legibility and readability, no studies have defined gender-related contrast sensitivity as it correlated to paper of various hues and intensities for aging adults.

This study extended Paterson and Tinker's (1940) and Stanton and Burt's (1935) research to include older adults and also to determine if there are gender differences in the ability to read on various hue intensities. It utilized updated statistical methods, a wider age range, gender identification, the use of a modern reading test and modern paper choices and test replication.

The specific research questions addressed in this study were:

1. To what extent does paper hue intensity affect the reading speed of persons of varying ages?
2. To what extent do paper hue intensity and gender affect the reading speed of persons of varying ages?
3. What are the relationships between reading speed and paper hue intensity, age and gender?

Methods

Research Design

This study utilized a repeated measure single subject design and sampled adults aged twenty and over. This research added middle aged and older adults to Stanton and Burt's 1935 study. Keppel and Zedeck (1989) define the repeated measures single subject design as "an experiment in which [all] subjects are each tested under all treatment conditions" (p. 267).

Advantages of a repeated measure single subject design included:

1. A smaller error term, since by using one subject the natural differences between subjects did not need to be part of the factor.
2. Individual differences were controlled since each subject served as his or her own control, thus increasing homogeneity.
3. A significantly reduced need for subjects (Keppel & Zedeck, 1989).

To lessen the disadvantages of this design (sensitization effects, practice effects and carry-over effects) measures were taken such as counterbalancing the treatment order, creating awareness of the purpose and design of the study and providing specific directions to participants.

The independent variable studied was the hue intensity of paper. Dependent variables studied were gender, age and reading speed. Controlled variables included room environment, type size and the ability to read and vision problems.

One hundred fifty subjects were determined to be statistically necessary for this study. Equal numbers of male and female subjects (75 each) were evenly divided into five age groups with an age range was 76 years (20 years to 96 years). Age groupings were 20-32, 33-45, 46-58, 59-71 and 72-96. The mean age was 51.83 years old and the median age was 50 years. The standard deviation was 17.31.

Ethnic backgrounds of the sample included Caucasian (88.7%), African American (7.3%), Native American and Pacific Islander (1.3% each), Arabic (.7%) and other nationalities (.7%). Education levels of the subjects included less than high school or finished high school (13.3 percent), some college (32.7 percent), bachelor's degree (28.0 percent) and graduate degree (26 percent).

The convenience sample was drawn from a church in a northern Detroit suburb (n=119) and educational settings in a hospital and two universities (n=31).

The three colors used in the research were black-and-white photographed with an artist's gray scale. The formula " $(L_{\text{Letters}} - L_{\text{background}}) \div (L_{\text{Letters}} + L_{\text{background}})$ " (Legge, Rubin, & Luebker, 1987) was utilized for a

contrast number. The ink color equaled black and the paper hue equaled the number from the formula. The paper hues with the greatest range (blues, reds and greens) were chosen for this research. Their ranges were .086, .134 and .134. The Metropolitan Achievement Test (MAT6) (1985) was used to measure reading speed.

Research data consisted of demographic data, reading speed scores and paper hue intensity. The statistical analysis used for questions one and two was a one factor repeated measures analysis of variance. It tested for age and gender-related reading speed differences on the three intensities of colored papers. The statistical analyses for question three were correlations plus stepwise regressions. They were conducted to explain differences in the dependent variables.

Results

Question One

To answer question one, “To what extent does paper hue intensity affect the reading speed of persons of varying ages?”, paper hue intensity scores, MAT6 reading speed scores and the five age groups were needed. A general factorial ANOVA was used as a test of significance. Table 1 identifies the mean number of lines read on all three paper intensities

Table 1
Means of Lines Read by Age Groups on Light, Medium and Dark Intensities

| Ages in Group | Means | | |
|---------------|-----------------|------------------|----------------|
| | Light Intensity | Medium Intensity | Dark Intensity |
| 20-32 | 31.77 | 33.53 | 36.16 |
| 33-45 | 40.67 | 36.50 | 37.93 |
| 46-58 | 35.60 | 34.77 | 35.37 |
| 59-71 | 34.67 | 33.10 | 35.57 |
| More than 72 | 29.50 | 31.80 | 29.80 |

Scores on light intensities indicated that the three light intensities are statistically diverse and that there are also differences in the reading speed scores of the five age groups. An interaction was also found between reading speed scores on the three light paper intensities when combined with age. Table 2 presents the results of the analysis of variance among the light paper intensities, age groups and reading speed.

Table 2

The Relationships Among Age Groups and Reading Speed Scores on Light Intensities of Paper

| Source of Variation | Significance of F |
|-------------------------------|-------------------|
| Light Paper Intensities | .000* |
| Age Groups | .023* |
| Light Intensity by Age Groups | .000* |

*p < .05

No statistically significant relationship among age, medium intensities of paper and reading speed was found. Table 3 presents the results of the analysis of variance among the medium paper intensities, age groups and reading speed.

Table 3

The Relationships Among Age Groups and Reading Speed Scores on Medium Intensities of Paper

| Source of Variation | Sig. of F |
|----------------------------------|-----------|
| Medium Paper Intensities | .283 |
| Age Groups | .060 |
| Medium Intensities by Age Groups | .065 |

*p < .05

Scores on dark intensities indicated statistical diversity. An interaction was also found between reading speed scores on the three dark paper intensities when combined with age. Table 4 presents the results of the analysis of variance among the dark paper intensities, age groups and reading speed.

Table 4

The Relationships Among Age Groups and Reading Speed Scores on Dark Intensities of Paper

| Source of Variation | Sig. of F |
|--------------------------------|-----------|
| Dark Paper Intensity | .008* |
| Age Groups | .364 |
| Dark Intensities by Age Groups | .044* |

*p < .05

The first research question addressed the relationships among paper hue intensity, reading speed and age. Light and dark intensities varied significantly among age groups. In this research, reading speeds on both light and dark intensities of paper hue became slower (fewer lines read) as the adults aged. Medium intensity had no significant variance indicating that reading speed did not vary significantly with these paper hue intensities.

Question Two

The second research question considered the question of paper hue intensity and gender affecting the reading speed of persons of varying ages. A general factorial ANOVA was employed to compare the reading speed scores on each of the three paper intensities with the five age groups. No statistical interaction was found among the three hues, age groups and gender (Tables 5).

Table 5

Means of Lines Read by Gender on Light, Medium and Dark Intensities

| Gender | Means | | | N=150 |
|--------|-----------------|------------------|----------------|-------|
| | Light Intensity | Medium Intensity | Dark Intensity | N |
| Male | 33.63 | 35.41 | 35.19 | 75 |
| Female | 35.25 | 32.47 | 34.75 | 75 |

Participants' reading speed scores on light intensities of paper hues indicated that a statistical interaction was found between the three light hues and age groups. The ANOVA results in Table 6 illustrate the data regarding light paper intensities.

Table 6

The Relationships Among Reading Level Scores, Light Intensities of Paper, Age Groups and Gender

| Source of Variation | SS | DF | MS | F | Sig. of F |
|---|----------|-----|--------|------|-----------|
| Within + Residual | 8297.60 | 120 | 69.15 | | |
| Hue Name | 419.68 | 2 | 209.84 | 3.03 | .052* |
| Age Groups | 2151.56 | 4 | 537.89 | 7.78 | .000* |
| Gender | 99.23 | 1 | 99.23 | 1.44 | .233 |
| Light Paper Intensity by Age Group | 1248.52 | 8 | 156.07 | 2.26 | .028* |
| Light Paper Intensity by Gender | 117.49 | 2 | 58.75 | .85 | .430 |
| Age Groups by Gender | 149.51 | 4 | 37.38 | .54 | .706 |
| Light Paper Intensity by Age Groups by Gender | 411.37 | 8 | 51.42 | .74 | .653 |
| (Model) | 4597.36 | 29 | 158.53 | 2.29 | .001 |
| (Total) | 12894.96 | 149 | 86.54 | | |

*p < .05

Scores on the medium intensities indicated a statistically significant interaction with gender. Table 7 highlights the relationship between gender and medium intensity paper hues and presents the complete analysis of variance results.

Table 7

The Relationships Among Reading Level Scores, Medium Intensities of Paper, Age Groups and Gender

| Source of Variation | SS | DF | MS | F | Sig. of F |
|---------------------------------|----------|-----|--------|------|-----------|
| Within + Residual | 9309.60 | 135 | 77.68 | | |
| Hue Name | 228.76 | 2 | 114.38 | 1.47 | .233 |
| Age Groups | 380.63 | 4 | 95.16 | 1.23 | .303 |
| Gender | 325.61 | 1 | 325.61 | 4.20 | .043* |
| Hue Name by Age Groups | 1153.57 | 8 | 144.20 | 1.86 | .073 |
| Hue Name by Gender | 55.61 | 2 | 27.81 | .36 | .700 |
| Age Groups by Gender | 167.03 | 4 | 41.76 | .54 | .708 |
| Hue Name by Age Group by Gender | 209.65 | 8 | 26.21 | .34 | .950 |
| (Model) | 2520.86 | 29 | 86.93 | 1.12 | .326 |
| (Total) | 11830.46 | 149 | 79.40 | | |

* $p < .05$

Scores on the dark intensities indicated a statistically significant interaction with age and gender. Table 8 highlights the relationship between gender and age and dark intensity paper hues and presents the complete analysis of variance results.

Table 8

The Relationships Among Reading Level Scores, Dark Intensities of Paper, Age Groups and Gender

| Source of Variation | SS | DF | MS | F | Sig. of F |
|----------------------------------|----------|-----|--------|------|-----------|
| Within + Residual | 8909.20 | 135 | 74.24 | | |
| Hue Name | 154.49 | 2 | 77.25 | 1.04 | .356 |
| Age Groups | 1123.67 | 4 | 280.92 | 3.78 | .006* |
| Gender | 7.26 | 1 | 7.26 | .10 | .755 |
| Hue Name by Age Groups | 687.17 | 8 | 85.90 | 1.16 | .331 |
| Hue Name by Gender | 504.76 | 2 | 252.38 | 3.40 | .037* |
| Age Groups by Gender | 171.11 | 4 | 42.78 | .58 | .680 |
| Hue Name by Age Groups by Gender | 909.17 | 8 | 113.65 | 1.53 | .154 |
| (Model) | 3557.63 | 29 | 122.68 | 1.65 | .032 |
| (Total) | 12466.83 | 149 | 83.67 | | |

* $p < .05$

Reading level scores, paper intensity, age group and gender were examined in question two. An analysis of variance for light paper intensities indicated an interaction among age groups. For medium intensities, gender was significant and age and gender were significant for dark paper intensities.

Question Three

To answer question three, three stepwise multiple regressions correlated each paper hue intensity with participants' age and gender. Negative results indicated that older adults read fewer lines in the time allotted. Therefore, they experienced increased difficulty when reading on both light and dark paper intensities (Tables 9 and 10).

Table 9

The Relationships Between Three Light Paper Hue Intensities and Reading Level, Age & Gender

| | | B | T | Sig T |
|----------------|------|-------|-------|-------|
| Age | | -.086 | -2.23 | .028 |
| (Constant) | | 38.98 | 17.93 | .000 |
| r | .18 | | | |
| R ² | .032 | | | |
| F | 4.95 | | | |
| Sig F | .028 | | | |

Table 10

The Relationships Between Three Dark Paper Hue Intensities, Age & Gender

| | | B | T | Sig T |
|----------------|------|-------|-------|-------|
| Age | | -.11 | -3.01 | .003 |
| (Constant) | | 40.93 | 19.40 | .000 |
| r | .24 | | | |
| R ² | .06 | | | |
| F | 9.08 | | | |
| Sig F | .003 | | | |

Gender also was negatively correlated with medium paper intensities. Table 11 summarizes medium paper hue intensities and their relationships between reading speed and gender. The negative results indicated that women read fewer lines than men in the time allotted. Therefore, women experienced increased difficulty when reading on all three hues' medium intensities.

Table 11

The Relationships Between Three Medium Paper Hue Intensities, Age & Gender

| | | B | T | Sig T |
|----------------|------|--------|-------|-------|
| Gender | | -2.947 | -2.05 | .043 |
| (Constant) | | 38.36 | 16.85 | .000 |
| r | .17 | | | |
| R ² | .03 | | | |
| F | 4.19 | | | .043 |
| Sig F | | | | |

T-tests were conducted separately with each light, medium and dark paper hue (green, red and blue). A Scheffe' test (at a significance level of .05) found no two groups were significantly different at the .05 level. This indicated that the three light, medium and dark paper intensity means were not significantly different; they were homogeneous subsets.

Correlations between participants' reading speed on the green hues indicated that participant's age and gender were correlated with the dark green paper intensity. This negative correlation indicated that older women experienced difficulty when reading on the dark green paper hue. No correlations were found with the blue paper hue.

When stepwise regressions were conducted, participants' reading speed scores were correlated with the

three paper intensities. Participants' ages were significant with light and dark paper intensities. Medium paper intensity was correlated with gender.

Table 12

Summarized Findings of Research Questions

| Question | Source of Data | Significant Relationships |
|--|--|---|
| 1. To what extent does paper hue intensity affect the reading speed of persons of varying ages? | MAT6 Reading Test Scores Participants' ages | Relationships among reading speed scores, age and paper intensity were significant for: <ul style="list-style-type: none"> ▶ light intensities of paper with age groups. ▶ dark intensities of paper with age groups. |
| 2. To what extent do paper intensity and gender affect the reading speed of persons of varying ages? | MAT6 Reading Test Scores Participants' gender | Relationships among paper intensity, gender and age were significant for <ul style="list-style-type: none"> ▶ light intensities of paper and age groups. ▶ medium intensities of paper and gender. ▶ dark intensities of paper and gender with age groups. |
| 3. What are the relationships between reading speed and paper hue intensity, age and gender? | MAT6 Reading Test Scores Participants' ages Participants' gender | Stepwise regressions discovered significant relationships between participants' age and reading speed on the light and dark red paper hues. Participants' reading speed on the dark green paper hue demonstrated a significant relationship with age and gender. Blue indicated no significant relationships. The light and dark paper shades were significantly related to participants' age. Participants' reading speed on medium shades was significant with gender. |

Discussion

It is becoming increasingly important to create materials that are easy to read for the aging population as this group will soon will encompass 25 percent of the population. Lifelong learning as well as recreational, health, financial and legal reading are important for this group of aging adults. Unless care is taken to ensure that the printed pages are readable and legible, they are useless. More attention is being paid to older adults in designing many products (for example, automobiles and homes). Implications of this research may influence a photocopying business, typesetter or printing company's ability to aid customers as well as health care, education and recreational reading.

While it appears sensible to produce materials that all persons can utilize, it is not a commonly accepted practice. These questions are universally needed for a complete picture of printed materials and aging.

Two additional questions might be:

1. Does type size affect the reading speed of adults of varying ages as they read on an assortment of paper hue intensities?
2. What are the effects of line length on reading speed as people age?

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Measuring Mindset Change in the Systemic Transformation of Education

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Introduction

As the whole society is experiencing a notable shift from the industrial age to the information age, an urgent need for a mindset change in education has been frequently discussed during the past decades. This paper will approach the mindset change through three interconnected sections: the first section reviews the conceptualization of mindset and then gives our definition of mindset concentrating on understanding its unique significance to the educational system. The second section presents, compares, and contrasts the key markers of the information-age mindset and the industrial-age mindset. The third section displays an instrument designed and developed by the authors that can be used to measure the status of individual and group mindset.

Definitions and Significance of Mindset

What is a mindset?

Since this paper is a part of a transforming education system project, we need to define our “mindsets” concept in order to explore the interaction and interrelationships between peoples’ mindsets and systemic change in education. Webster’s dictionary (n.d.) defines mindset in two ways: the first is “a mental attitude or inclination” and the second is “a fixed state of mind”. Both definitions explain the mindset as something that occurs in a person’s head; however, the mindset also has the power to control a person’s attitudes, and potentially influences a person’s behavior.

In order to have a deeper understanding of the mindset and its importance, our exploration of the mindset definition goes beyond a literal explanation. A few related terms are examined, including paradigm, belief, and worldview. These concepts provide insight into the meaning of mindset.

Kuhn defined and popularized the concept of paradigm in his remarkable *The Structure of Scientific Revolutions*, in which he argues that a paradigm consists of “rules that guide particular normal tradition” (p16). In many areas including education, a paradigm is a model or an exemplar that forms the foundation that prepares people for professional practice. In most social structures, paradigms are well-defined and rigid. And when people accept a paradigm, it becomes a firmly fixed belief in their mind. However, paradigm shift does take place when an anomaly undermines the basic beliefs underlying the basic practice. The paradigm shift doesn’t refer to a piecemeal change or a minor modification of the current practice, instead it is a revolution, a transformation, or a kind of metamorphosis. In a word, it is a fundamental change from one way of thinking to another.

Mindset sometimes can be simply expressed as “I (we) believe.” Belief is the major component of the mindset, because people set up their expectations and goals based on what they believe the nature of situations should be. Their activities are guided by their beliefs and they are inclined to act to implement the paradigm in the life. For example, learners’, educators’, and administrators’ beliefs about what schools should achieve determines the face of school systems, such as the design of schools’ key characteristics and their major functions.

A worldview describes “a consistent and integral sense of existence and provides a framework for generating, sustaining and applying knowledge.” (WorldIQ, n.d.). Mindset understood through the worldview perspective focuses on the interaction between the mindset owners and the global/local environments. Mindset here is “a habitual or characteristic mental attitude that determines how people will interpret and respond to situations” (HyperDictionary, 2003). People originate their worldview from the unique experience they have perceived, by their own or through heritage, and then forge their opinions and engage in activities based on their worldview. For example, Shantz and Rideout (2003) pointed out that the industrial-age worldview might interpret learning as “possession of knowledge and ability contained in the overt curriculum” (p 203), and thus stress the standardization and centralization in schools.

Our definition denotes a comprehensive set of the mindset components that are the basis of people’s

cognitive process and their operational guidance. Therefore, we define mindsets as the basic assumption, beliefs, core values, goals and expectations shared by a group of people who are committed to a specific field, and what they will use as rules to guide their attitudes and practice in the field.

Why are mindsets important?

Kuhn said that a shift in paradigm occurs as a response to crisis. In most cases, a crisis begins from the awareness of an anomaly in a changing environment, such as the emergence of new objects. If the existing paradigms fail to explain the emerging phenomena or solve the new puzzles, a search for creative or adaptive responses will be demanded. During the past decades, there have been massive changes around the world, stimulated by the advancement of information technology. These changes present a number of key markers that distinguish the emerging new age, the information age, from the industrial age (Reigeluth, 2001). As the industrial-age mindset still pervades the ways we see the world and we do things, these changes force us to question the industrial-age mindset and its capability to solve the information-age puzzles. For example, the business world has found that the traditional-centralized organization is obsolete for providing customized services demanded by the information-age customers, so shifts have taken place in business culture from working around departments to working around process that provide value to the customers (Hammer & Champy, 1993).

In exploring the complexities of human history, Toffler has seen three great waves: the first agricultural revolution that began to move people from hunting to peasant societies about 10,000 years ago; the second industrial revolution which took the shape in the 18th century when people began to leave the peasant culture of farming to come to work in city factories; and now the whole society is undergoing a third wave that is transforming the industrial era to a knowledge-based era, triggered by the rise of the analog and then digital technologies. The current transition from brute force to brain force accompanies a painful dislocation of all the aspects of our lives. Institutions that were designed to work in a factory-based society are gasping for their last breath.

The history of educational reform has proved that when a society is undergoing fundamental changes, education needs to change fundamentally, too. A good example is the systemic change that took place in education when we moved from the one room schoolhouse to industrialized mass education during the transition from agriculture age to the industrial age. The Lancastrian model of education made it possible to provide a large amount of skilled labor for the factory-centered society. However, when the third wave came along, the information age, the prevailing mindset in education, as well as in many other social facets, was unable to generate effective solutions to the problems of the information age. Because of this, another mindset change is urgently needed.

The predominant industrial paradigm of education became entrenched in the early 20th century. During the past hundred years, learning has been defined as the acquisition of knowledge or ability in a separately enclosed learning environment by a group of learners. It requires learners' adherence and obedience to the covert curriculum and the design of schooling is a typical conformity system: diverse learners learn same content at the same time and with the same rate. (Shantz & Rideout, 2003)

The report *A Nation at Risk* (1983) discloses a number of risks the industrial-age education system has generated in the information era: from high dropout rate to low academic achievement, from enlarging the functionally illiterate population to a declined proportion of exceptional performance in standard tests. With a continuously improved awareness of the crisis of education, many crucial questions have been raised about the influence of information-age characteristics on education. The implications of the new trends have been examined in educational technology, instructional theory, and instructional systems technology and a call for the emergence of an information-age mindset could be heard more and more, including the transformation from a closed system to an open one, from a bureaucratic approach to a team-based one, and from a student-screening focus to a learner-enabling one (Banathy, 1992; Cornell, 1999; Deuchar, 2004; O'Neill, 2003/2004; Reigeluth, 1999; Solomon, 2000).

In the 21st century, which will be dominated by information-age trends, it is important for educators to recognize the industrial-age mindset that limits our thinking and empower the education system through a redesign or transformation to the information-age mindset.

Information-Age Mindset vs. Industrial-Age Mindset

In the section one we have briefly discussed the movement to the information-age mindset from industrial-era mindset. However, many may still wish clarification about the distinction between these two mindsets. This section will focus on what are the key markers of these two mindsets and contrast their features in order to generate a deep understanding of the two mindsets' impact on education system design.

As transforming from the industrial age to the information age, tremendous changes have taken place in the society's structure and the way people behave themselves in their lives. Passi, Michelet and Passi (2003) compare and contrast the industrial age and the information age from a broad scope of interests, including economy, family, social activities, technology, education, among other things. Table 1 displays the major characteristics that the authors have used to distinguish the two eras.

| | Industrial Era | Information Era |
|-------------------------|--|--|
| Wealth | Industry/Tangible Assets | Information/Knowledge |
| Dimensions of Life | Earth + Universe | Earth + Universe + Cyberspace |
| Habitat and Social Unit | Mega-city Static (tied to factory) | Global community Mobile (link through Web) |
| Social Classes | Owners, workers | By level of knowledge and ideas |
| Warfare | Mechanical technology, mass destruction | (Dis) Information technology, targeted destruction for control |
| Economy | National/International | Global, vet local |
| Energy Source | Non-renewable: fossil, fuels, gas, oil, coal | Renewable: solar, nuclear, laser |
| Production | Mass-produced and distributed (cheap) for others | Mass-customized (cheap)for others |
| Family | Small, nuclear, mobile | Individual, mono-parental, mobile |
| Education | Mass-education, same for all (3 Rs) | |
| Position Determined by | Wealth | Individualized and differentiated for all |
| Management | By rationality | By responsibility (?) |

Table 1: *Key Markers of Industrial Age and Information Age*. Adapted from Passi, et. al. (2003).

The changes occurring in the environment have a great impact on the whole human culture. Key markers of both the industrial age and the information age, such as core values, principles, philosophies, and organizational management, have been described and analyzed as to distinguish these two eras (Berge, 2003; Gordon, Morgan, & Ponticell 1994; Hanna, 2003; Reigeluth, 2003). Table 2 depicts these key markers and how they represent the two fundamentally different ages.

| Key markers (global items) | Industrial Age | Information Age |
|----------------------------|---|--|
| Philosophy | Standardization | Customization |
| Relationship | Mass production, etc. Adversarial relationships CEO or boss (teacher) as "king" Compliance | Customized production Cooperative relationships Customer as "King" Initiative |
| Value | Bureaucratic organization | Team-based organization |
| Decision making | Conformity (compliance) Autocratic decision making | Diversity Shared decision making |
| Communication | One-way communications Compartmentalization | Networking Holism |
| Process | Parts oriented (division of labor) Planned obsolescence | Process oriented (integration of tasks) Total quality |
| Quality control | Centralized control | Autonomy with accountability |

Table 2: *Key markers that distinguish industrial age and information age organization*. Sources from: Reigeluth (1999, 2001, *n.d.*). Key marker added.

Education, as any other social aspect, is unavoidably influenced by the changes triggered by the information age. Table 3 presents a comparison between the industrial age education and the information age education, particularly as these differences correspond to philosophy, leadership, teaching, assessment, and relationship.

| Key markers (education-focused items) | Industrial Age | Information Age |
|---------------------------------------|---|---|
| <i>Philosophy</i> | Focus on teaching | Focus on learning |
| | Teaching (caring about) a subject | Teaching (caring about) Caring about the whole student |
| | All students learn the same thing | Cultivate special talents of each students |
| <i>Leadership</i> | Command & control leadership | Participatory/empowering leadership |
| <i>Teaching</i> | Students progress at the same pace (students all learn the same thing at the same time) | Each students progresses upon mastery (Students learn what they ready to learn when they are ready) |
| | Focus on presenting all the materials | Focus on learning all the materials |
| | Grade levels | Continuous progress |
| | Covering the content | Outcomes-based learning |
| | Group-based content delivery | Personal learning plans |
| | Classrooms | Learning centers |
| <i>Teacher' s role</i> | Teacher as sage on the stage, Teacher as dispenser of knowledge of learning | Teacher as guide on the side, Teacher as coach or facilitator |
| <i>Purpose</i> | Only the good students succeed | All students succeed |
| <i>Assessment</i> | Non-authentic assessment | Performance-based assessment |
| | Norm-based testing (compared students to each other) | Criterion-based testing (compares students to a standard) |
| | Norm-referenced testing | Individualized testing |
| <i>Relationship</i> | Adversarial learning | Cooperative learning |
| | Separate from community | Community involvement |
| | Parents as occasional spectators | Parents as partners |
| <i>Content</i> | Memorization of meaningless facts skills | Thinking, proble m-solving and meaning making |
| | Isolated reading, writing skills | Communication skills |

Key markers related to education-focused items. Sources: Reigeluth (2004).

As shown in the above tables, we see a total departure of information-age mindset from the industrial-age key markers. The recognition of the information-age mindset not only forces us as educators to think about their implication on the education, but also enable us to redesign today's schools in order to serve learners diverse potentials and multiple intelligences.

An Instrument of Measuring Minds

Why the measurement of mindset is important?

As the mindset change in education is gaining more and more proponents, we have little appreciation

and few criteria for measuring the status of mindset. Too little of the education literature provides clear criteria for assessing the positions of mindset in a practical continuum. So it is the focus of this section to advance clear criteria that others can use in evaluating people's mindset and to what extent and in what manner it is going to change.

The context for the instrument application

Mindset change has been discussed tremendously in various contexts, from sociology to pure technology, and we have found that there is a lack of consistence regarding the definition and application of the mindset concept in all these contexts. The measurement of mindset also has different criteria under various circumstances. In order to enhance the practicability, the instrument we created would like to limit the boundaries only in the education field, with a concentration on systemic change.

A tool for measurement

Mindset indicators Based on this definition, people's cognition, affection and behaviors are engaged in the notion of mindset. In other words, if somebody has the information-age mindset (or the industrial age mindset) about education, he/she may have explicit and/or implicit knowledge about the information-age (or the industrial-age mindset) through experiences and/or learning. He/she also may have positive attitudes and affective evaluation about his/her mindsets and its relevant events or situations whereas he/she may have relatively negative attitudes towards irrelevant situations. In addition, naively speaking, his/her consistent behaviors with his/her mindset can be also expected. In three domains (cognitive domain, affective domain, and behavioral domain) all factors such as applications of cognition to situations, affective reactions such as favorability or affective evaluation, and intention of behaviors can be indicators of people's mindsets.

Cognition and its application to various situations. Mindsets are unlike human traits; therefore, they are not innate but learned. Current mindsets that people possess are products of learning from their experiences, and for mindset evolution, formal or informal learning processes need to be engaged. During learning processes for mindset evolution, people should acquire notions of new mindsets, and by evolving mindsets they can apply new mindsets to relevant situations naturally. In addition, mindsets are relatively consistent frameworks to see, accept, and understand situations, and events. Therefore, people's knowledge and especially, its application to various situations can be an appropriate indicator to show people's mindset

Based on this point, mindset about education may be measured using:

- Artificial scenarios which contain conflicts between information-age mindset and industrial-age mindset about education, and people's open-ended responses.
- Small group discussion with real cases or scenarios about education evaluated by discussion peers and/or third party evaluators who are knowledgeable about mindset change in education.

Affective reactions When measuring cognition and its application to various situations, it may be helpful to measure affective reactions and evaluation about the situations since mindset is not only about cognitive processes but also about people's affective attitudes. In other words, people may tend to be more favorable to situations which are more relevant with their mindsets. People with the information-age mindset will rate that situations or decisions which support the information-age mindset are more 'favorable', 'appropriate', 'beneficial' and/or 'correct' than those related to industrial-age mindset, and vice versa.

Based on this, as one of the indicators of the mindset about education affective reactions can be measured using;

- People's self report concerning possible decisions about scenarios (for cognition application above) using 5 point Likert scale for example; inappropriate – appropriate, unfavorable-favorable, incorrect-correct, not-preferable -preferable, etc.
- (if possible) after the small group discussion about real cases or scenarios about education, peers and/or third party evaluators assess people's affective attitudes towards situations and cases

Intention of behaviors One of the ultimate goals of mindset change is people's behavior change. However, it is hard to measure actual behaviors based on evolved mindset because many studies about attitudes, and theories of reasoned behaviors show that it takes time to reflect people's mindsets including cognitions and attitudes to their behaviors, and more complex processes and variables involve in behavior changes. Therefore, in the current situation, instead of actual behavior change, the intention of behaviors can be preferably measurable.

To reflect ideas of behavior intention in the scenarios above, questions need to be asked using the first party viewpoint instead of the third party view point such as “if you were in the situation, how would you behave?”

Self-report vs. measurement by others The self report method to measure mindset is one of the possibilities. Through the self-report method such as responding to given scenarios people’s understanding level about mindset and its components can be clearly disclosed. In spite of this strength it is dangerous to use self-report as the only measurement because social preference can contaminate measuring the mindset. Currently the targeted subjects to measure mindsets are leadership team members, and they might respond with what they have learned in the leadership team of Systemic Change in Decatur School District and with preferable answers of the team rather than individual beliefs intentionally or unintentionally. The issue of intentional deception to respond can be reduced by emphasis of self-disclosure and the purpose of measurement which is not for evaluation but for diagnosis and help. However, the issue of unintentional deception in responding -- people reflect knowledge they learn in the team instead of their beliefs-- can still be problematic in self-report method.

To complement the weakness of self reporting, it would be preferable to use the measurement conducted by others. In regular meetings and small group discussions peers and knowledgeable third party observers can assess people’s mindsets, and the data from others can be triangulated with self-reports. This triangulation can provide higher reliability of data.

In summary, in reference of measurement tools firstly scenarios with open-ended questions, Likert scales for emotional reaction, and questions about intention of behavior will be used in self report. Secondly, small group discussions and rubrics for peer evaluation and third party evaluation will be used to complement the self-report. The rubrics will contain standards for people’s knowledge levels, application of knowledge, and emotional reactions.

| Type of measurement | Applications of cognition | Indicators | |
|-----------------------|---|--|------------------------|
| | | Affective reactions | Intention of behaviors |
| Self-report | Open-ended scenarios | Affective adjectives rating using Likert scale about the scenarios | Open-ended scenarios |
| Measurement by others | Small group discussions and peer- third party- evaluation | Attitudes toward situations and topics in discussion | - |

Table 4. *Measurement Methodology*

Conclusion

As massive changes are forcing the whole society moving toward the information age, education will prepare students for a world that doesn’t exist anymore if it is still dominated by the industrial age mindset. However, before we can know how the mindset will change, we must be aware of the current status of the mindset. In order to facilitate the mindset shift in education, this paper creates a three-indicators instrument that provide the practical criteria for measuring mindset, and therefore, help educators to gain more insights about the relevance between mindset and systemic change.

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Designing for Self-Regulated Learning: Implications for Video-Centric Instruction

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Abstract

This paper reports on a qualitative study of student Self-Regulated Learning behaviors in a video-centric, multimedia course. Of interest was how student viewing habits, generally, and their manipulation of playback controls, specifically, supported their learning. Data revealed that the use of playback controls to regulate learning was largely, but not always, purposeful, and that numerous variables including fatigue, interface design and course deadlines influenced self-regulated learning behavior. The research suggests that self-regulated learning can be supported in digital video-based instruction by increasing control affordances in the interface. In addition, explicit strategies/instruction should be given to learners on how such affordances might help them regulate their learning.

Statement of the Problem

I have long held that instruction and learning can be both inhibited and promoted with the use of technology. Some of this is due to features of the technology itself, with other variables being dependant on the learner. That is, people's perceptions and attitudes towards technology can be equally inhibiting and facilitative to learning. Self-Regulated Learning (SRL) generally stipulates that students "personally activate and sustain behaviors, cognitions, and affects, which we re systematically oriented toward the attainment of learning goals" (Schunk, 2004 p.355). SRL also describes how learners purposefully control the interactions between *themselves*, their *learning*, and their *environment* (Bandura, 1986; Zimmerman, 1989).

The nature of video-centric instructional environments pose some particular challenges to designing for SRL. The video medium's "linear-ness" makes skimming and purposeful navigation through video (and audio) materials a challenge. Of particular interest in this study was the control affordance of Variable Speed Playback (VSP) or the ability to control the playback speed of digitized audio and video. Learners can now listen to audio/video-centric multimedia instruction at their desired speed—speeds they deem conducive to their learning, regardless of how quickly or slowly a lecturer originally spoke, or whether developers ever intended the materials to be accelerated. This study served to explore how VSP and other course features facilitated or inhibited SRL behaviors. Our understanding of SRL specific to various computing technologies is very limited (Winne & Stockley, 1998) and scarcely addresses these types of questions.

It is perhaps obvious that the locus of control for SRL behavior remains within the learner. This in turn, points to the perhaps less-obvious deduction that the *environment* is really the only element over which instructional designers have significant direct control to help support student learning. Schunk (2004) states that "the potential for self-regulation varies depending on control choices available to learners" (p. 122). Thus, if students are to exercise self-regulation, efforts must be made to design video-centric environments with high levels of learner-control affordances, thereby providing learners with control over how, when, what and where they engage in learning activities.

Background

Variable Speed Playback (VSP)

As the use of VSP emerged as such a significant self regulating tool in this study and in this context of video-centric instruction, I will devote some time here addressing the issue of VSP directly. Today's VSP technology allows one to speed up and slow down audio and video presentations without pitch distortions or the high speed "chipmunk" sound associated with accelerating audio cassettes and CDs—or reaching way back—our old vinyl records. It has recently experienced a resurgence in both availability and popularity and is included now by default in Microsoft's Windows Media Player.

In an earlier survey study on VSP functionality (Galbraith & Spencer, 2001), students reported regularly accelerating through instructional presentations up to 2.5 times (2.5x) the normal playback speed by the end of the semester. Through difficult to provide the reader with a sense of what 2.x speed means, it suffices to say that it is nearly unintelligibly fast to the untrained ear. At the same time, a few students choose to use no, or very little, acceleration. Their self-reported motivations varied widely. Importantly, VSP differs

from fixed-rate acceleration in that users can dynamically adjust video presentation speed to individually comfortable rates. It was hoped to learn how, if at all, students might be varying playback speed—a regulating behavior—in response to their perceived learning. Studies have shown (Harrigan, 1995) that giving the user or learner control over the rate of acceleration is generally better than “locking” acceleration in at a given rate.

In my years as a professional non-linear video editor I learned the value of being able to swiftly navigate and view--“speed read”--vast amounts of media at high speeds while still being able to comprehend the content. In my more recent years as an instructional media designer/developer I built VSP functionality into the accounting course allowing students to dynamically control the playback rate or speed at which the instructional presentations (audio, video, graphics and animation) played. It is important to note that prior to introducing VSP to the multimedia course, student surveys indicated quite positive attitudes toward the course. Their single biggest frustration, however, was that the professor spoke too slowly and repeated himself too often. I recall some students asking--pleading--for a way to “speed him up”. As courseware developers, I and my team were personally all-too-aware of the student’s sentiment. We had just spent months listening to these materials, videotaping, digitizing, editing, programming, testing, revising, retesting the course materials and had listened to more than our share of the content! A solution to accelerate the hypermedia lectures would benefit the developers as much as the students.

We were capable and had considered accelerating the course videos by a fixed or pre-determined percentage, but how much should we speed things up? Was the effort worth a global 10% speed up? Would that hurt some learners? It was determined that accelerating the audio by a pre-determined percentage was not in the best interest of students, and that the solution would have to give learners control over the playback speed. A solution was identified (2xAV plugin from Enounce Inc.) that allowed learners to dynamically adjust the playback speed to suit their preference and it was immediately integrated midway through the school semester. Course feedback and positive ratings skyrocketed that semester—we were on to something! We had struck something valuable, but were not sure what; and did not fully understand its properties nor its effects.

As the designer, I was very pleased that since introducing VSP functionality, student frustration levels had subsided, and I hoped now that motivation and comprehension might also increase, and that students would use acceleration responsibly. I feared, however, that the positive response might have been simply due to the fact that they could “whip” through the material faster than before. I was left with questions as to when, where, how and why students might use VSP technologies to support and regulate their learning. Some survey responses clearly reflected use of VSP as a regulatory strategy to help maintain attentiveness and comprehension. Other student responses showed signs of regulatory practice, but not in support of learning—rather time management. As feared, some students appeared to be using VSP to make up for procrastination using the tool to simply skim through materials before a quiz deadline or to avoid missing a bus.

All the literature I had come across on accelerated audio focused primarily on listener comprehension of accelerated speech, or the effectiveness of various speech compression algorithms, but not the usage patterns--and certainly not couched in the context of self-regulated learning. I found one usability study published by Microsoft that evaluated such technology in a modified version of an early media player (Omoigui, He, Gupta, Grudin, & Sanocki, 1999). Like other studies, it did not assess learner intent and motivation--why users were motivated to adjust speeds? but it did record and report on how their viewers interacted with 5 video samples that varied in content and duration, over the period of a couple days of viewing.

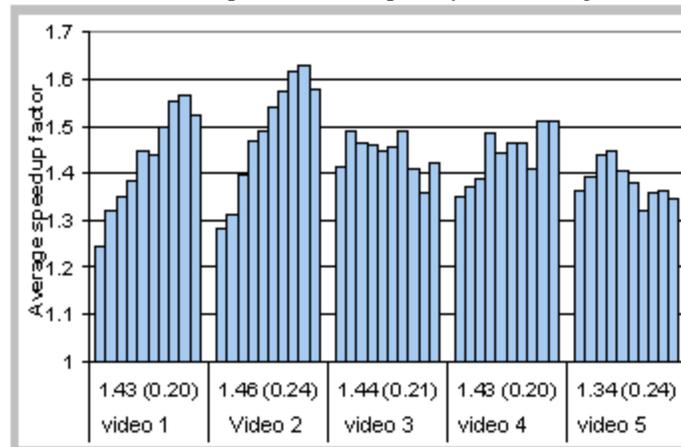


Figure 1--Chart from Omoigui et al. study (1999)

Figure 1 shows how the researchers tracked average speeds of users for every 10% segment of the video. Of their observations, they noted, "...we clearly see that the subjects are watching them faster as they get deeper into the video. There is some slowdown right at the end, an area that corresponds to the concluding remarks" (Omoigui et al., 1999, p.5). I was generally impressed with their study and with the detailed observation data they were able to collect, but it was the last line about an implied, but not corroborated, connection between viewing habits and concluding or summary remarks that really stood out to me. I knew that I wanted similar kinds of data to the Microsoft study. It would help us understand first *how*—and only thereafter, *why* users were interacting with course features the way they did (specifically VSP functionality). Moreover, as an instructional designer and educational researcher, I desired to understand how purposeful such regulatory behavior was.

Methods

The qualitative research approach looked to be an appropriate method to explore the nature of student self-regulated learning behaviors using course features. It was a way to help the implicit emerge and become explicit; a way to generate hypotheses from social research data that is systematically obtained and analyzed (Glaser & Strauss, 1967). The study looked at a small group of learners in an entry level accounting course at a large western university. The course was a computer-based, video-centric, multimedia course, comprising of video lectures recorded expressly for this format, supported by supplemental media and simple animations that were synchronized with the lectures. The study was designed to better understand SRL behavior at a micro level (within individual lessons) including how that behavior both influenced and was influenced by more macro level SRL behavior related to study habits and time management. I made one hour observations of students studying, followed by another 40-60 minutes of interview. Numerous other spontaneous, non-formal observations were made of other accounting students in the computer labs whom I did not subsequently interview.

The software and course design provided learners with a good amount of control and autonomy within the bounds of a traditional four-month semester. For example, at the macro level, the course was largely self-paced, with weekly quizzes scheduled to help students stay on target (a level of structure deemed necessary from earlier course trials). Students were provided with course CDs allowing them to work most any place they had access to a computer. The class met only six times during the semester, with one class section dispensing with face-to-face meetings altogether. At the micro level, in addition to traditional playback controls (play, pause stop, rewind) the courseware interface also provided a detailed hyperlinked index/menu of the lesson segments, independent controls for supplemental media (slides), and what proved to be highly relevant to SRL, was a variable speed controller allowing learners to dynamically adjust the playback rate of the course materials.

Researcher Identity

To be sure, I am no "disinterested" or objective observer. My interest in this topic is personal. It springs from many of my own experiences and observations, some of which I have already described. I was the chief designer of the software used to deliver the instruction some four years prior to this study. This study was, however, not a formative evaluation of the courseware, nor a summative effectiveness study. Instead, it hoped to focus on learner self-monitoring abilities and their regulating practices and strategies. Study participants were likely not affected by my having designed their course software—because this was not disclosed to them—but this is not to say that the research as a whole was unaffected. As the researcher, I found it difficult at times to stay out of the usability-testing mode, and remain focused on my primary research question. My focus, unlike in previous studies, and on other projects, was no longer looking for ways to improve a particular product or software, but rather to understand the learners and how they employed features of this course to support their learning.

Access & Participants

I arranged access to the students through the instructor, with whom I had worked closely in the past to develop instructional tools. By way of reminder, unlike many large 200 level college courses, this course did not meet regularly in a classroom. Instead students studied course materials on their own. The mode of instruction arguably requires a good deal more self-regulation than traditional face to face classes.

I chose not to disclose to students that I had been the designer of the software they were using. This was a conscious decision on my part because I did not want that information to unduly influence their

conversations with me. I believe that most students simply perceived me as I had been introduced to them—an alumnus conducting research at my alma mater.

Eleven participants were selected from among a host of volunteers. Volunteers responded to either an announcement made in class by their instructor, or to the same announcement posted on their course website. In volunteering, they were to indicate the following through email. 1) when they generally studied—what days, what time, what environment? and 2) How often they adjusted speed controls (hardly ever, sometimes, a lot). I quickly received over 100 volunteers, and knew I could only ever deal with up to 15 participants. Generally, I attempted to get a variety of cases that would likely generate, to the fullest extent, as many diverse properties of the categories as possible (Glaser & Strauss, 1967 p.49).

When I had “down time” between scheduled observation/interviews, I ended up “trolling” the computer labs on campus for prospective participants. As the course enrolls over 1,200 students each semester, finding students in this manner presented no significant challenge. At any given time of day, the large labs I visited had at least two-six people working on the accounting course. As an interesting side note, on March 31st I wrote in my journal:

Today (3/31/04) one Acc lab TA I talked to mentioned that I should contact evening TAs as it is they who deal with students who may have procrastinated trying to prepare for and take quizzes that are due by midnight (every Tuesday and Thursday night). Interestingly, it is those very students who might not have time to talk to me, and they would be an interesting group to include. I did not seek out people who were “early birds”, but seem to have found people that were staying well ahead of the game with the exception of only one I think.

As I noted in my journal, there was a group of alleged “procrastinators” with whom I did not speak. They might have been struggling with self-regulatory practices and whose perspective would certainly have added to this story, but were unfortunately not included. Despite this, ecological validity was still important for me. That is, it was important for me to observe participants in the environments that they commonly used to study. Observations and interviews took place in student apartments, a home, an office and in various campus computer labs. In my journal, I recorded some of my thoughts on three of my participants whose names I have changed.

Dave was an interesting find. I overheard that he was an accounting major, and was surprised because of the amount of questions he asked of the acc TAs in the lab. He also seemed to be struggling with simple concepts. It was later when I approached him that I learned he was an accounting major. I also observed that he was viewing materials at 1.2 and 1.5x [comparatively slow]. Again, surprising since he was an accounting major and should be “getting this stuff”. While speed use is no race, I was surprised to see a[n accounting] major proceeding so slowly and deliberately. It is good to see a tool that is so flexible, and can accommodate many different types of learners and their self-regulation practices.

Chris was also of particular interest to me. Chris is a handsome trendy-looking young man. I had run into his father on campus, an old casual acquaintance of mine. His father told me of how Chris was taking the class for the second time and that Chris was diagnosed as having ADD—but was currently not taking any medication. Since failing is so hard to do in this class, [in my opinion] and since his ADD would be an interesting case in relation to self-regulation, I was interested in his story and arranged to observe and interview him at his home the next day.

Troy was anxious to talk to me. In response to my recruitment email, he said he had opinions on the course, and had taken many distance education and technology courses. I thought his perspective might be interesting... for one, simply because he seemed so anxious to talk to me! I expected to get an earful!, and not necessarily about the topic of my research. Troy was a 40+- year old professional considering an executive MBA program. He seemed eager to continue his education, perhaps to secure a more stable life. Because I had followed a career path similar to his, and sought some stability for my family, perhaps I am projecting my rationale onto him. We'll see.

These were all interesting people to say the least, but I don't get the sense that these are extreme cases. Everyone in the class—all 1,200 of them—probably has equally interesting backgrounds and stories that bring

them to this course. I felt extremely privileged to be allowed into my participant's minds and their study time.

Findings

In this section, I will begin to describe what appears to be emerging from the data—a preliminary description of some major themes found in the interviews. As not all the data has been thoroughly reviewed at this time of, findings are not reflective of the more thorough data analysis processes included in open, axial, and selective coding recommended for such a study by Strauss & Corbin (1998).

Students in general appeared to actively self-monitor—and quite deliberate about how they used course playback controls. Controlling the speed seemed to play an important early role in their regulatory behavior of all the participants. But, once comfortable speeds were identified fewer speed adjustments were made within lessons and other control affordances such as repetition, became more dominant. They did not adjust very often, (not dynamically) and chose instead to repeat sections rather than slow down. I wondered out loud with one participant if perhaps an acceleration foot pedal might be a nice device to have for speed control—sewing machine like. Would such a device encourage more dynamic and frequent employment of VSP as a self-regulated learning? The worst case scenario for using VSP controls meant that a participant had to set aside their notes from off their lap, lean physically forward, clear a space on the desk for the notes, put their pen down, grab the mouse, navigate to the VSP controls and then make an adjustment. It was not a necessarily easy and natural task, yet most participants situated themselves such that regulating playback speed in relation to their comprehension, took far less effort.

Another recurring self-monitoring and regulating theme was regarding attentiveness and concentration. “Speeding up helps me stay focused and keeps my attention better than normal speed” said Susie. “It saves time” said another participant.

“I mean the quicker I can get through the lesson the better. But I also want to understand it, you know. At first when I started doing it, I started at normal speed but that just drove me nuts because it just seemed so slow. So then I put it on double speed and that worked good for a while and then it just seemed like it was too slow too, so I sped up to about 2.2 and that seemed to work out good. Also, like, it forces me to focus and to concentrate because it's going so fast that if I don't—like if I doze off or something I'll miss so much. Whereas if it's just on normal speed, it's kind of monotonous, it's easy to not focus your thoughts, so I think it does kind of help you to focus when its going faster.

Repeating (replaying) lesson sections became a more dominant way of regulating comprehension than dynamic and frequent speed adjustments. Repeating still all occurred at higher than normal (1x) speeds. Jack mused that he expected his mind wandered less at higher speeds and that it actually reduced the number of times he'd have to rewind and repeat phrases or thoughts. This sentiment seemed universally held although a couple did relate equal mind wandering when viewing too fast. Both points are borne out in the literature. (See Harrigan 1995, 2000; Gutenko, 1995; and King & Behnke, 1989 for a discussion on these issues.) In either case, when participants felt they missed particular content, they chose more often to repeat a few lines rather than adjust speed.

This of course, does not shed light on the speed adjustments that did occur. Two of my three female participants, Laura and Trisha, adjusted speed a couple different times during the lesson for related reasons. Laura started out her lesson in the accounting lab by setting her speed at 2.0x (2 times normal speed—or double speed). After about a minute, she released the mouse and sat back in her seat, listening with her course packet notes open in front of her. She jotted down notes now and then, seemingly following along with the lectures. After about six minutes she leans forward and increased her speed to 2.1x, and sits back to view and write again. In about another eight minutes she slowed down the presentation noticeably to 1.7 times normal speed for about 1 minute, after which she accelerated back up to 1.9x. Never did she stop or replay sections. When asked what motivated her to slow down the audio, she said that the content was complicated, and she wasn't getting it—so she slowed down. This is a powerful example of using VSP as a self-regulated learning practice. Her lack of distraction was especially noteworthy to me since at one point the lab TA approached me and attempted persistently to engage me in conversation about what I was doing. I tried without success for what seemed like minutes to communicate that I was busy and didn't want to chat. In interviews Laura recalled the distraction, but ignored it. Laura and I were both wearing headphones.

It's an interesting idea that the use of headphones by all the participants, except those studying their materials at home, helped them manage and regulate their attention. Participants never said as much, but common sense would suggest it did help them concentrate and minimize distractions particularly in noisy lab setting like the accounting lab where TAs consulted with students and study groups met regularly and talked out

loud.

Trisha also started her lesson out at 2.0x. She yawned repeatedly during the lessons. After one big yawn, she reached over and tried unsuccessfully to accelerate the presentation above 2.0x, but the control was maxed out. I chuckled inside. Since I was listening simultaneously with her, I knew what she was going through. Having not even had the background of this lesson, I easily understood the “common sense” material and was ready to pick up the pace and wished (as did she apparently) that the presentation could have been accelerated at that point. Her particular computer configuration did not allow higher speeds than 2.0x. Rather than skip ahead and risk missing something, Trisha relied strictly on VSP and acceleration to pick up the pace. When she ran into a more challenging section, she, like Laura slowed down to 1.8x for about 4 minutes. Her “slow” period in contrast to Laura, was interrupted with numerous short section replays—of course still at the relatively high speed of 1.8x.

The use of variable speed playback is not an isolated event. It appeared to significantly impact the way other more typical media playback controls are used such as “Pause”, “Rewind” and “Fast Forward” and has arguably spawned new controls such as “Jump Back x” [seconds]. Todd also employed VSP in a unique way. He chooses to not adjust speeds during lessons sometimes even during the boring parts, instructor stories, or content he’s familiar with. “During slow times, I’ll get up and get some other things done...make me a sandwich and stuff.” He said. “I like to keep the sound running so I don’t miss stuff, but can still get other things done until I get to new material, and then I come back.” He even described slowing lessons down a bit further, so he could get more other tasks done at the same time.

When I posed the question about what got in the way of her learning in this course, Laura stated emphatically “The instructor’s examples! I think he waaaaa over-explains things, way! And it bugs me cuz I still have to go through it.” She also felt the need to accelerate through materials rather than skip ahead. As alluded to earlier, this fear of skipping ahead is probably related to the medium of video. Video cannot be skimmed in the same way or as efficiently as text. The use of VSP to accelerate presentations, likely acts as a speed-reading tactic for learners.

Discussion

Overall, course control affordances seem to facilitate SRL. All my participants were ahead of schedule in their course, rather than procrastinating. They hadn’t painted themselves into a corner—forcing themselves to go faster than they should have, just to meet course deadlines—although recall that a TA had mentioned that some class members did fall prey to that scenario. Students were motivated by the flexibility of the course. Its asynchronous nature helped them manage their study time both in this class as well as in their other, less flexible, classes. Jack’s words represent the feelings of all the participants in this regard:

I like being able to do it on my own time. I’m able to listen to the cds and what not, and also you can get ahead. You can kinda plan your weeks out...If you have a lot of homework in your other classes one week, you can look ahead—and get ahead in the accounting lessons, and if that week gets too hectic for ya, you don’t have to worry about it.

An interesting aspect of student’s self-regulation is that despite their limited time, participants will wind up viewing far more material than they ever would have received in the face-to-face class. They choose to view everything. They view all the remedial lessons, and helps that were designed for struggling students. Most participants believed that because they accelerated, they must be saving time. There were approximately 25 hours of additional instruction recorded for this course above and beyond what a student would have encountered in the face-to face version of the course. This fact, combined with the amount of replayed segments that I observed, was not likely compensated for by student acceleration rates.

The course quiz structure was not generally conducive to self-regulated learning, making it difficult to be learning for the right reasons. Perhaps out of necessity in such a large class, test scores are the primary form of feedback continually being given to students. This is in contrast to qualitative forms of feedback that might prompt deeper self-reflection in learners (Corno & Randi, 1999). Yet, here too, students seem to be taking responsibility for their learning and not just studying to perform well on the quizzes. Elliott & Dweck (1988) found in a study with 5th graders that when children using performance goals (i.e. must score high on quiz), failure and challenges are more likely to provoke a helpless response. But when children were instead focused on learning goals, failure and challenges were more likely to “provoke continued effort” (p.17). It would appear that in learning environments such as this video-centric accounting course, students that scored low seemed to feel like they just needed to study harder, slow the video down or study more effectively. One TA spoke to this issue when he described helping people in the accounting lab:

A lot of students will come to me and say, ‘hey I didn’t get any of this’, and I’ll ask, ‘what speed did you watch it at?’ The majority of the time they listened to it at an accelerated pace, so I usually tell them to go back and listen to it again, slower.

Rather than blame their intelligence, abilities or the teacher—the course seems to be structured to support self-regulatory practices and encourages students to take responsibility for both their learning as well as for the study strategies they employ. This is perhaps due to the “independent study” nature of the course and the levels of user control built into the course interface. As the designer of the technological aspects of the course (media and interface, but not pacing, assignments, course schedule or syllabus) it was my intent to build in a great deal of flexibility into a medium (video) not commonly known for its user-control affordances. As Kozma (1991) states, students benefit most from technology based learning environments when the capabilities of the environment are used to perform or model certain cognitive operations that are important to the learning task but that the learners cannot, or do not, perform themselves. Although numerous themes emerged from the data along these lines, three central themes are addressed that help describe how students used the playback controls of the learning environment to regulate their learning. Each theme is discussed below.

Theme One

Students adjusted playback speeds in an effort to influence their attentiveness and concentration. Self-monitoring and regulation were evident as students purposefully adjusted playback speeds in an effort to regulate their attentiveness and concentration. Students reported less mind wandering at higher speeds and that it actually reduced the number of times to rewind and repeat phrases or thoughts. Speed adjustments played an early role in the regulatory behavior for all the participants as they reported more frequently adjusting the speed of the lectures in the first few weeks of the semester, until they found their “sweet spot”. This “sweet spot” tended to gradually increase over time as they got used to it.

Theme Two

Once comfortable speeds were identified, fewer speed adjustments were made and other playback control affordances such as repetition, became more dominant. It was clear during student observations and interviews, that when students felt they missed particular content, or were not comprehending concepts, they chose more often to repeat--replay--a few lines or whole segment rather than adjust playback speed to slower rates. A student noted that “It’s just easier to jump back a bit if my room mate distracts me...and if I’m not understanding a section, I just understand it better if I play the section again. I usually always get it the second time.” When students did slow down to aid in comprehension, adjustments were relatively minor in all but one case where the student replayed course materials at real-time or normal speed.

Theme Three

Students choose to view all course materials—including “remedial” content. In an interesting twist with regard to self-regulation, students reported viewing all lesson content—including additional or remedial instruction designed for struggling students. This was likely unnecessary for some students, but because they were accelerating lessons, there seemed to be a perception of time saved, which justified viewing more material. There were approximately 25 hours of additional instruction recorded for this course, above and beyond what a student would have encountered in the face-to face version of the course. This fact, combined with the amount of replayed segments observed, was not likely compensated for by student acceleration rates. “Multitasking also helped save time” said another student. “Rather than skip content I am familiar with, I’ll get up and get some other things done...make me a sandwich and stuff. I like to keep the sound running so I don’t miss stuff, but can still get other things done until I get to new material, and then I come back.”

Conclusion

Learning environments should be designed such that they either promote learner self-regulation or make up for a lack of it (McCombs & Marizano, 1990). Additional research is needed to explore the relationship between control affordances and self-regulated learning, but it is clear that some SRL behaviors cannot occur without a certain level of learner autonomy (Zimmerman and Schunk, 2001) and control over the video medium. Of the available micro controls, variable speed playback appeared to play a central regulatory role with these learners in this multimedia accounting course. VSP was pervasive in so many of the participant’s SRL strategies, influencing the way they attended to, and interacted with their course materials. Its influence even carried over into their traditional face-to-face lecture courses where some students lamented not

having the ability to accelerate and replay all their university instructors in like manner.

If learning performance is indeed determined, in large measure, by learners' self-regulation ability, it should not be assumed that all students are equally skilled or experienced or consistent in their self-regulating behavior. The findings seemed to support the notion or hypothesis that explicitly sharing of effective SRL strategies with students would help foster practices that facilitate learning and discourage practices that may hinder it--such as using VSP to simply race through materials to meet course deadlines.

Able self-regulating learners purposefully monitor and guide their own learning while learners less skilled at self-regulating, are more motivationally and metacognitively passive in their reception of instruction (McManus, 1998). But not all SRL strategies are equally effective. Traditional, perhaps more macro, strategies outlined by Zimmerman & Schunk (1989), Winne & Stockley (1998), Ley & Young (2001) and Pintrich (1995) are likely more critical in developing sustainable and broadly applicable SRL habits, than are the micro SRL processes focused on in this study. Nevertheless, attempting to better understand the supporting role of technology in the development and facilitation of SRL strategies in video-centric environments is deemed to be a valuable pursuit for designers and continued research is encouraged that attempts to validate and test the hypotheses generated by this study.

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An Analysis of Citation Patterns in ETR&D, 1990-99

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Abstract

The results of a citation pattern analysis on the journal Educational Technology Research and Development (ETR&D) for the period 1990-99 are presented. Reference lists for the 260 articles published during that period were compiled along with over 1,600 citations of those articles in other social science journals. Breakdowns of most commonly cited references during that period are presented along with an analysis of the journals more cited by and most citing of ETR&D.

Introduction

I want to see the book you stole there after reading it, to keep others from reading it, and you hid it here, protecting it cleverly, and you did not destroy it because a man like you does not destroy a book, but simply guards it and makes sure no one touches it. I want to see _____, the book that everyone has believed lost or never written, and of which you hold perhaps the only copy.

Brother William of Baskerville
In Umberto Eco's *The Name of the Rose*

There is a growing mountain of research. But there is increased evidence that we are being bogged down today as specialization extends. The investigator is staggered by the findings and conclusions of thousands of other workers—conclusions which he cannot find time to grasp, much less remember, as they appear...A record, if it is to be useful to science, must be continuously extended, it must be stored, and above all it must be consulted.

Vannevar Bush
"As We May Think" in *Atlantic Monthly*, 1945

Social science research is itself a social endeavor. Although media representations often depict researchers as solitary figures struggling independently to discover "truth," productive research is conducted within the framework of a community. "Research is complete only when the results are shared with the scientific community." (APA, 2001, p. 3). In addition to collaboration with other researchers and the need to build upon (and sometimes tear down) the work of predecessors, the highest goals of research are defined by peer review. This examination of works by a qualified audience is required to ensure that conference presentations and published articles represent the best that the field has to offer.

The examination of the artifacts of this process inform us of not only the perceptions and viewpoints of the individual authors, but also of these "peers" who serve as science's gatekeepers. A number of researchers have examined the content of academic journals in order to capture trends or patterns of research behavior. Klein (1997) examined a nine-year period of publication of the development section of Educational Technology Research and Development (ETR&D). His content analysis indicated the "ID for Computer Technologies" and "Instructional Design & Development" were the most popular article topics and that almost half of all articles were descriptions of different activities with little or no supporting data. In a separate analysis, Klein (2002) performed a similar analysis on four years of research published in Performance Improvement Quarterly. In that analysis, about one-third of the articles contained empirical research. This follow-up research not only demonstrates that similar methodology can be applied to different journals in the field, but also that different journals in the same field may have uniquely differing publication patterns. In terms of looking for similarities, ETR&D was one of four journals examined by a group of researchers from the University of Kentucky (Anglin, Cain, Whitehouse, Cunningham, Newcomer, and Cunningham, 2003). The other three journals were the British

Journal of Educational Technology, Educational Technology, and the Journal of Research on Technology in Education. During the five year period examined (1997-2001), they identified the ERIC descriptors “the educational process: classroom perspectives” and “the educational process: societal perspectives” as the most used in indexing article content. Driscoll & Lee (2003) identified trends in distance education by analyzing article content for four selected journals over a five-year period. Among other results, they found that developmental research was rare and that case studies were the most prominent type of article.

Citation analysis in particular provides an opportunity for authors to understand the influence and influencers of their work. At the level of an individual article, an author cites others so that the reader can see the social construction of knowledge. Publication represents successfully completing the peer review process, but citation of one’s work is a greater indicator of the influence of the work. Although those who cite may agree or disagree with an author’s work, citation denotes that the previous work was worthy of discussion. Citation analysis is less common than other types of research on publication patterns, but should become more accessible with improvements in on-line resources and databases. For example, Frisby (1998) examined citation patterns in five years of seven major journals in school psychology. An interesting aspect of this research was his definition of self-citation within a journal as “within-journal inbreeding,” a negative characteristic from his point of view. Another interesting example of citation analysis, was conducted by Oppenheim and Smith (2001). They focused on the citation patterns of final year students in an information science department. In direct contrast to “refereed” publications, their analysis indicated an increasing trend of students citing Internet resources rather than more traditional sources. Creamer (1998) examined citation patterns as a possible measure of faculty publication productivity. She reported that authors tend to cite more heavily other authors of the same gender. However, she suggested that this may be reflective of homogeneous gender informal professional networks rather than conscious bias.

Limitations

The current study is decidedly descriptive in nature. Also, the researchers believe that citations are *a* measure of importance, not *the* measure of importance. It must be added that not all citations are equal, their relative importance varies and a citation may be made to show agreement or disagreement with a particular point. However, it is suggested that patterns of citation data are informative, certainly as much as course surveys or opinion polls.

Method

For the current study, the journal Educational Technology Research and Development (ETRD) was examined over a ten-year publication period, 1990-99. This journal was selected because of its reputation in the field. For example, Maushak, Price, and Wang (2000) conducted a survey of 85 faculty members in the field of educational technology. According to their analysis, ETR&D was the overwhelming choice as the top journal in the field. During this period, 40 issues were published containing 260 journal articles. For the purpose of this study, only articles that were part of the Research or Development sections were considered.

The tables of content for the issues were photocopied and used to uniquely identify each article and record relevant data into an Excel worksheet. One research , using the online version of the Social Science Citation Index (SSCI), performed a search on each article and recorded information on each citing article into a second worksheet (N=1,553).

Another researcher created a photocopied record of the reference lists for the 260 articles. Due to the large number of references (N = 10,055), a number of individuals manually entered this reference data into a third worksheet. After these references were coded, one individual reviewed each entry in comparison with the printed record to ensure consistency and correct minor errors.

All analysis was conducted manually and/or using the functionality of Excel (for example, to count or aggregate results). During analysis, the photocopied indices and reference lists were consulted to clarify and/or correct entries.

As with any intensive data entry endeavor, errors were made in collecting and recording the data. All attempts were made to correct identified errors and the impact on aggregated results should be minimal.

The limited journal scope (only ETR&D) and publication period (10 years) were selected arbitrarily by the researchers. Due to the descriptive nature of the analysis, any inference or interpretation must be made cautiously.

Results

Of the 260 core journal articles, 94 (36.15%) were authored by one individual. Two authors were involved in the writing of 98 articles (37.69%). Sixty-eight articles (26.15%) were written by three or more authors with nine authors being the most for any article.

The researchers attempted to establish the gender of the various authors. This was largely idiosyncratic. A large number of authors were identified via professional contact or a gender-specific name. Others were identified by locating biographical information on the Internet. For the 94 articles written by one author, 58% were male; 33% were female; and 9% were unknown. ETR&D uses a blind review process in which the identity and gender of the author are unknown. Without additional knowledge of submissions by gender or general gender makeup of the field, it is impossible to determine specific causes for the lower publication numbers for females. For the 166 articles of multiple authorship, 44% included at least one male and one female; 27% had exclusively male authors; 9% had exclusively female authors; and 20% could not be determined. The large number of undetermined makes analysis difficult. The large number of mixed gender efforts is encouraging. The large discrepancy between male-only (27%) and female-only (9%) efforts may again reflect gender distribution in the field or preferences in informal networking.

Author productivity was classified according to order of authorship (see Table 1). Those that had the largest number of first author articles were arbitrarily labeled “The Prolific” to represent the primary importance given to first authors in academic communities. Those with the largest number of second author articles were labeled “The Mentors,” suggesting their role in helping others with attaining first author credits in this journal. Lastly, those that had the greatest number of authorships of third or later priority were labeled “The Collaborators,” tenuously identifying them for a more minor yet continuing role in assisting in authorship.

Table 1. *Author Productivity*

| The Prolific (First Authors) | Number of Articles |
|--|---------------------------|
| Mable B. Kinzie | 6 |
| Lloyd Rieber | 6 |
| Martin Tessmer | 6 |
| The Mentors (Second Authors) | Number of Articles |
| Michael J. Hannafin | 8 |
| Howard J. Sullivan | 7 |
| James D. Klein | 5 |
| The Collaborators (Third...Authors) | Number of Articles |
| Gary R. Morrison | 4 |
| John F. Wedman | 4 |
| John Bransford | 3 |

Of the 10,055 references cited by the core articles, 53% were to journal articles; 36% were to books; and 11% were classified as other (e.g. websites, technical reports, dissertations, etc.). The most cited journals and most cited journal article authors are presented in Table 2.

Table 2. *Most Cited Journals and Journal Article Authors*

| Journals | Number of References |
|-----------------------------------|-----------------------------|
| ETR&D | 494 (9.40%) |
| Educational Technology | 351 (6.68%) |
| Journal of Educational Psychology | 331 (6.30%) |
| Review of Educational Research | 177 (3.37%) |
| Educational Researcher | 163 (3.10%) |
| Journal Article Authors | Number of References |
| David H. Jonassen | 76 (1.45%) |
| Michael J. Hannafin | 64 (1.22%) |
| Gavriel Salomon | 60 (1.14%) |
| Robert D. Tennyson | 59 (1.12%) |
| Richard E. Mayer | 58 (1.10%) |
| Steve M. Ross | 58 (1.10%) |

The references to books were further subdivided into edited and non-edited books. The most cited for both categories are shown in Table 3. For this analysis, multiple editions of a work were counted together (the year of the earliest edition is provided in the table).

Table 3 . *Most Cited Edited and Non-edited Books*

| Edited Books | Editor | Number of References |
|--|----------------|-----------------------------|
| Instructional Design Theories and Models: An Overview of Their Current Status (1983) | C.M. Reigeluth | 55 |
| Instructional Technology: Foundations (1987) | R.M. Gagne | 34 |
| Handbook of Research on Educational Communications and Technology (1996) | D.H. Jonassen | 33 |
| Instructional Technology: Past, Present, and Future (1991) | G.J. Anglin | 31 |
| Knowing, Learning, and Instruction: Essays in Honor of Robert Glaser (1989) | L.B. Resnick | 28 |
| Non-edited Books | Authors | Number of References |
| The Systematic Design of Instruction (1978) | W. Dick | 40 |
| The Conditions of Learning and Theory of Instruction | L. Carey | |
| | R.M. Gagne | 39 |
| Principles of Instructional Design (1974) | R.M. Gagne | 35 |
| Cooperative Learning: Theory, Research, and Practice (1983) | R.E. Slavin | 14 |
| Mind in Society: The Development of Higher Psychological Processes (1978) | L.S. Vygotsky | 13 |
| Teaching for Competence (1983) | H. Sullivan | 12 |

The 260 core articles were entered into the Social Science Citation Index (SSCI) in late 2003 to determine in which journals these articles were cited. Table 4 displays the most citing journals and the core articles that were the most cited. Because the core articles were published over a period of 10 years and the SSCI data represented a snapshot of all citations to that point, it was determined that average citations since year of publication would provide the most unbiased measure of influence.

Table 4. *Most Citing Journals and Most Cited Articles*

| Citing Journals | Number of Citations |
|---|----------------------------|
| ETR&D | 475 (30.59%) |
| Journal of Educational Computing Research | 100 (6.44%) |
| Computers in Human Behavior | 59 (3.80%) |
| Instructional Science | 51 (3.28%) |
| British Journal of Educational Technology | 50 (3.22%) |
| Most Cited Articles | Citations/Yr |
| Media Will Never Influence Learning by R.E. Clark | 7.78 |
| Objectivism versus Constructivism: Do We Need a New Philosophical Paradigm by D.H. Jonassen | 4.83 |
| Instructional Design for Situated Learning by M.F. Young | 4.40 |

Conclusion

These preliminary results provide guidance for professionals and students in the field as to what some consider the influential works and individuals with which one should be familiar. The methodology used advances what has previously been published in the form of course/program surveys and opinion polls.

A more complete presentation is currently being developed for eventual publication. The research team has also begun to collect data on related journals during the same time period. This will allow comparison and triangulation with this dataset. Also, data collection has begun with ETR&D for the next five-year period (2000-2004). This will allow chronological comparison with the present dataset. Finally, the improvement of online tools continues to make the process more manageable. As journals and databases add functionality and online content, more advanced analysis will become increasingly automated and informative.

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A Modified Laptop Program: Putting the Carts in the Classrooms

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Abstract

Four fifth grade classrooms embarked on a modified ubiquitous computing initiative in Fall 2003. Two 15-computer wireless laptop carts were shared among the four classrooms in an effort to integrate technology across the curriculum and affect change in student learning and teacher pedagogy. This initiative—in contrast to other 1:1 programs and stationary labs—offers public schools alternatives to budget constraints and instructional space overhead. Results indicate positive teacher technology competence and confidence, as well as instructional strategies that were student centered made meaningful uses of technology. Teacher pedagogical knowledge, technological knowledge and a supportive culture seem to be strong indicators for impacting technology integration in this context.

As access to computer technologies continues to increase (National Center for Educational Statistics, 2001), there has also been a movement to decrease the computer to student ratio, as well. Windschitl and Sahl (2002) report “more than a thousand schools nationwide have committed themselves to some form of laptop computer initiative” (p. 165). Goals of these types of initiatives vary, but include increased student achievement and learning, increased home and school interaction and increased technology access for low income families (Penuel et al., 2002).

A number of evaluations and case studies have documented mixed results with ubiquitous computing approaches (e.g., Edwards, 2003; Hill, Reeves, Grant, Wang, & Hans, in press; Lowther, Ross, & Morrison, 2003; Mowen, 2003; Rockman et al., 1997, 2000). Successes have included improved student achievements, broader access and equity for students, increased communications among faculty, administrators, students and parents and reports of reductions in absenteeism and school dropout rates. However, teachers and students alike struggled with managing learning issues, such as time on task; pedagogical issues, such as transitioning to student-centered learning; and classroom management issues, such as monitoring student distractions with email, the Internet and gaming.

Advocating a one-to-one student to computer ratio is appealing, and the goals are admirable. A similar statewide initiative (Bickford, Tharp, McFarling, & Beglau, 2002) has attempted to compromise on the student to computer ratio at two students to everyone one computer. However, this program has also been challenged with lack of change in teacher practice. And more recently, funding limits have placed the onus of support on the individual school districts.

The funding for such innovative programs cannot be discounted. Supplying every student and teacher with an Internet-capable computer is a substantial capital commitment for school budgets. One principal admits his middle school has “invested well over \$1 million in laptop technology...since 2000” (Mowen, 2003, Introduction section, para. 3). For this reason many early laptop initiatives were implemented in private and parochial schools (e.g., Hill et al., in press; Newhouse, 2001; Rockman et al., 1997).

As an alternative to a one-to-one initiative for a select group of students, some schools have purchased mobile laptop carts. These carts of 5 to 25 mobile computers are typically wireless and can be wheeled from classroom to classroom as needed. Schools have used this model to promote collaboration among students and aid in transitioning among groups of students and in classroom settings (e.g., Gwaltney, 2003). In addition, these mobile carts have also offered an alternative to committing instructional space to computer laboratories.

Little research has been reported about these mobile laboratories. This small evaluation study presents the findings of one school’s experience, identified with the pseudonym Green River Elementary, with using mobile laptop carts to affect change in teacher practice and student learning. The laptop program evaluation was structured around five primary research questions that focused on classroom practices, degree and type of technology use, academically focused time, student engagement, teacher technology skills, teacher attitudes toward technology, as well as student and teacher reactions to the program. The research questions were:

1. In what ways has the effectiveness of instruction through the use of student laptop computer been impacted?
2. To what degree and in what ways have teachers integrated technology with classroom instruction?
3. To what degree do teachers use methodologies that stress higher-order learning and student-centered learning activities?
4. To what degree has the laptop program impacted teacher attitudes toward technology?

Design

The evaluation design was based on both quantitative and qualitative data collected from classroom observations, teacher surveys, and focus groups with teachers and students. The four fifth grade teachers and their intact classrooms at Green River Elementary participated in the evaluation.

Context

Green River Elementary, serving grades K-8, was situated in a suburban city outside a large urban city in the southeast United States. The laptop program was a pilot project designed to determine the impact of changing the ways students learn and teachers instruct in a technology-enhanced learning environment. The original concept included a laptop for each student in fifth grade, replicating Rockman et al.'s (1997) concentrated implementation model, with dedicated technology integration training for the fifth grade teachers. Unfortunately, costs and lack of significant grant funding prohibited the implementation of the project to this extent.

Instead, the context for the laptop program and this evaluation consisted of four fifth grade classes in which two Apple iBook wireless laptop carts were shared among the four fifth grade teachers' classrooms. In addition, the four teachers each received a personal Apple PowerBook laptop to use during the initiative and individually focused their professional development opportunities on technology-related training offered through the local school district. Each of the fifth-grade teachers taught one of the core subject areas, language arts, math, science and social studies. So every fifth-grade student rotated through each teacher's classroom during the day. The number of students per class ranged from 23 to 27.

Data Collection

Five instruments and focus group interviews were used to collect the evaluation data (three classroom observation measures, two teacher surveys and four interviews).

Classroom Observation Measures. Observations were made focusing on targeted classes (scheduled visits) using three instruments. Descriptive statistics were used for analyses. The *School Observation Measure (SOM)*[®] examined the frequency of usage of 24 instructional strategies, including traditional practices (e.g., direct instruction and independent seatwork) and alternative, predominately student-centered methods associated with educational reforms (e.g., cooperative learning, project-based learning, inquiry, discussion, using technology as a learning tool) (Ross, Smith, & Alberg, 1999). The observer summarized the frequency with which each of the strategies was observed on a data summary form. The frequency is recorded via a 5-point rubric that ranges from (0) Not Observed to (4) Extensively. Two global items used three-point scales (low, moderate, high) to rate, respectively, the use of academically focused instructional time and degree of student attention and interest. Targeted observations were conducted in this evaluation to examine classroom instruction during prearranged one-hour sessions in which the teachers demonstrated a prepared lesson using technology. Observation forms were completed every 15 minutes of the lesson then were condensed on a summary form. To triangulate the reliability of these results, multiple researchers observed class sessions.

The *Survey of Computer Use (SCU)*[®] examined availability of and student use of technology and software applications (Lowther & Ross, 1999). Four primary types of data were recorded: (a) computer capacity and currency, (b) configuration, (c) student computer ability and (b) student activities while using computers. Computer capacity and currency was defined as the age and type of computers available for student use and whether or not Internet access was available. Configuration referred to the number of students working at each computer (e.g., alone, in pairs, in small groups). Student computer ability was assessed by recording the number of students who were computer literate (e.g., easily used software features/menus, saved or printed documents) and the number of students who easily used the keyboard to enter text or numerical information. Student use of computers was focused on the types of computer-mediated activities, subject areas of activities, and software being used. The computer activities were divided into three categories based on the type of software tool (i.e., production tools, Internet/research tools, and educational software). The final section of the SCU was an "overall rubric" designed to assess the degree (1: Low-level use of computers, 2: Somewhat

meaningful, 3: Meaningful, 4: Very meaningful) to which the activity reflects “meaningful use” of computers as a tool to enhance learning.

Finally, the *Rubric for Student-Centered Activities (RSCA)*[®] rated the degree of learner engagement in cooperative learning, project-based learning, higher-level questioning, experiential/hands-on learning, student independent inquiry/research, student discussion, and students as producers of knowledge using technology (Lowther, Ross, & Plants, 2000). These strategies reflected emphasis on higher-order learning and attainment of deep understanding of content and whether or not technology was utilized as a component of the strategy. Such learning outcomes seemed consistent with those likely to be engendered by well-designed, real-world linked exercises, projects, or problems utilizing technology as a learning tool. Each item included a two-part rating scale. The first was a four-point scale, ranging from (1) indicating a very low level of application to (5) representing a high level of application. The second was a Yes/No option to the question: “Was technology used?” with space provided to write a brief description of the technology use.

Surveys. Two surveys were used to obtain self-perceptions of attitudes and skills. The *Teacher Technology Questionnaire (TTQ)* collected teacher perceptions of computers and technology. In the first section, teachers rate their level of agreement with 20 statements regarding five technology-related areas: (a) impact on classroom instruction, (a) impact on students, (c) teacher readiness to integrate technology, (d) overall support for technology in the school and (e) technical support. Items were rated with a five-point Likert-type scale that ranges from (1) Strongly Disagree to (5) Strongly Agree. A sixth section was added specifically to address perceptions of the laptop program also rated on a five-point scale from (1) Strongly Disagree to (5) Strongly Agree.

In addition, the *Technology Skills Assessment (TSA)* assessed the self-perceived technological abilities of the teachers in these areas: (a) computer basics, (b) software basics, (c) multimedia basics, (d) Internet basics, (e) advanced skills, (f) using technology for learning and (g) attitudes toward the laptop program. The survey consisted of 47 items with three levels (1:Not at All, 2: Somewhat, 3: Very Easily). All of the questions were aligned to the International Society for Technology in Education’s (ISTE) National Educational Technology Standards (NETS).

Focus Groups. Focus groups were conducted with all four fifth grade teachers and eight to ten fifth grade students at the beginning of the initiative in Fall 2003 and again at the conclusion of the academic year in May 2004. A semi-structured interview protocol was used in order to variation in the order and phrasing of the questions, as well as probes to specific individuals (Patton, 1990). Questions addressed three areas: (a) use of laptop computers, (b) expectations for the laptop program and (c) reservations about the laptop program. Analysis of the data followed a general qualitative analysis process (Cresswell, 1998; Merriam, 1998). From audio recordings and facilitator notes, themes were derived from the participants.

Procedure

Data for this evaluation study were collected primarily in Spring 2004. The SOM, SCU and RSCA were completed for each targeted observations. These consisted of prearranged one-hour sessions in which the fifth grade teachers demonstrated a prepared lesson using technology. Observation forms were completed every 15 minutes of the lesson. A total of 9 visits across the four fifth grade classrooms were completed. The teacher surveys (TTQ and TSA) were administered in May 2004 prior to a focus group interview. Focus group interviews were conducted with students and teachers in Fall 2003 and again in May 2004.

Results

Below is a brief summary of the results grouped by Classroom Observation Results, Survey Results and Focus Group Results.

Classroom Observation Measures The data for 9 classroom observations were collected with SOMs, SCUs and RSCAs during prearranged sessions in which teachers implemented a lesson using technology. Results from each measure are described in the sections below.

School Observation Measure (SOM)[®]. The SOM revealed nine instructional strategies that were observed during the targeted observations ($N=9$): (a) project-based learning, (b) technology as a learning tool or resource, (c) teacher acting as coach/facilitator, (d) independent seatwork, (e) cooperative/collaborative learning, (f) independent inquiry/research on the part of the students, (g) higher level instructional feedback to students, (h) use of higher-level questioning strategies and (i) direct instruction. These strategies were observed during 11.1% of the visits to 100% of the classroom visits. Project-based learning and technology as a learning tool or resource were observed during every visit (100%). Teacher acting as coach/facilitator and independent

seatwork were observed at least 50% of the time, 88.9% and 55.6% of the time respectively. Three more instructional strategies were observed in at least one third of the visits: cooperative/collaborative learning (44.4%), independent inquiry/research (44.4%) and higher-level instructional feedback (33.3). Academically focused class time and student engagement were observed to be high 100% of the time.

Survey of Computer Use (SCU[®]). In all of the visits ($N=9$) (100%), 11 or more computers were available for student use in the classrooms. All of the computers (100%) were observed to be up-to-date, and all the computers (100%) were connected to the Internet. It is important to note that during two of the pre-arranged visits, the school's internal network was intermittent. So while the computers were capable of accessing the intranet and Internet, students were unable to do so consistently. Student primarily worked alone (88.9%) and in pairs (11.1%). Computer literacy skills were observed to be consistently very good (100%), and keyboarding skills were also very good (100%). Three student computer activities were observed in at least 40% of the classroom visits: Internet browsers (66.7%), draw/paint/graphics (44.4%) and electronic presentations (44.4%). Computer activities were observed in all subject areas. Productivity tool (i.e. word processing, draw/paint/graphics, spreadsheets, etc.) were observed in language arts (33.3%), mathematics (33.3%), social studies (22.2%) and science (11.1%). Internet/research tools were observed in language arts (22.2%), social studies (22.2%), mathematics (11.1%) and science (11.1%). Drill/practice/tutorial were the only educational software observed and only observed in mathematics (11.1%). Meaningful uses of computers were extensively observed in over 50% of the visits (55.6%) and very meaningful computer applications were extensively observed in over 30% of the classrooms (33.3%).

Rubric for Student-Centered Activities (RSCA[®]). Five of the seven activities noted on the RSCA were observed during visits ($N=9$): (a) project-based learning (100%), (b) students as producers of knowledge (88.9%), (c) cooperative learning (44.4%), (d) independent inquiry/research (44.4%) and higher-level questioning strategies (11.1%). Notably, project-based learning was observed during all observations and students as producers of knowledge were observed during almost 90% of the visits. The most meaningful applications of student-centered activities, that is those activities where somewhat strong and strong applications were observed in at least 30% of the classroom visits, included cooperative learning (44.4%), project-based learning (77.7%) and students as producers of knowledge (77.8%). Technology was used to support three of these strategies: project-based learning (100%), cooperative learning (44.4%) and independent inquiry/research (44.4%).

Survey Results

Two surveys (TTQ and TSA) were administered to the teachers prior to a focus group interview in May 2003. Results of the two surveys are presented below.

Teacher Technology Questionnaire (TTQ). The fifth grade teachers ($N=4$) responded very positively to the program. Mean scores for all six sections were between 4 ("Agree") and 5 ("Strongly Agree"). This indicates the teachers felt the laptop program has had a positive impact on (a) classroom instruction, (b) technology with students, (c) the teachers' readiness to integrate technology, (d) the school and district's overall support for technology, (e) appropriate technical support and (f) a positive attitude toward the laptop program. Notable are the questions that the teachers responded in unison. Within the section on overall support for technology in the school, two questions addressed the parent, community and administrative support necessary for technology to impact teaching and learning, both with scores of 5 = "Strongly Agree." Within the technical support section, the teachers concurred that they could readily answer technology related questions with a score of 4 = "Agree." Within the section on attitudes toward the laptop program, two questions represented the teachers' enthusiasm for the program and confidence about their abilities, both with scores of 5 = Strongly Agree. Also notable is a question, "School computers are well maintained," which received the lowest mean score of 3.75 between "Neither Disagree nor Agree" (3) and "Agree" (4). This question while receiving the lowest mean score also had the largest amount of variance among the respondents ($SD = 1.26$).

Technology Skills Assessment (TSA). The TSA revealed very high levels of confidence by the fifth grade teachers ($N=4$) to use technology throughout six basic areas: computers, software, multimedia, Internet, advanced skills, and using technology for learning. Teacher confidence was high in all six areas with mean scores of 2.5 or higher, between "Somewhat" and "Very Easily" and very little discrepancy among their ratings ($SD=.05$ to $.38$). The teachers rated themselves highest in Computer Basics ($M=2.98$) and Software Basics ($M=2.96$). Remarkable is that of the 47 questions on the TSA, the teachers rated their confidence in 30 of the tasks very easily, which constitutes 63.8% of the tasks. Moreover, of the 47 questions, only 4 questions were rated below 2 ("Somewhat").

Focus Group Results

Two focus group interviews each were conducted with the four fifth grade teachers and approximately 8 to 10 of the fifth graders. Initial interviews were conducted in Fall 2003 and follow-up interviews in May 2004. Interview questions centered on three topic areas: (a) uses of technology, (b) expectations of the initiative and (c) reservations with the initiative. Verbatim comments are enclosed in quotation marks to represent most accurately the voice of the students and teachers.

Teacher Focus Group. The teachers primarily discussed two themes: (a) computer use and (b) pressures and concerns.

Computer use. The teachers identified online tests, publishing stories, information seeking and research on the Internet, word processing, electronic presentations, and draw/paint applications as the computer uses they had implemented. They also considered it their responsibility to teach the students about trustworthiness with the laptops and the “upkeep” for the laptops. The teachers were proud of the very few numbers of computers that had been “dropped” by the students. They also felt in order to leverage the use of the laptops, it was necessary to teach “saving,” “how to save” and management routines for using the laptops.

The teachers described that they would like to use the laptops for about “50%” of the time, about “two to three hours a day.” However, they felt some challenges prevented them from achieving this goal. Specifically, the scope of the curriculum, as well as state and district standards (i.e., “student performance indicators”), was difficult to achieve with and without using the laptops. Changes in the district curriculum also made it “difficult to schedule” and plan ahead for the next year.

Pressures and concerns. In the fall semester, the teachers were concerned about the keyboarding skills of the students, as well as “maintenance,” “upkeep” and “technical support” for using the laptops. However, in the spring semester, the teachers voiced that they were “confident” in the use of the laptops for instruction and that they could “figure out” most of the technical problems or questions that arose. They also noted that they depended on one another for expertise. Proximity to one another’s classrooms facilitated this learning community.

Similarly, in the fall semester, they described that their colleagues were “jealous” toward the fact that they have laptops; however, their colleagues were relieved they “did not have to deal with the responsibilities and/or tasks” that accompany using the laptops for learning. In the spring, this perception continued. One teacher described it as “laptop envy.” They felt that some teachers perceived the laptop program as an “extra burden.” Indicative of their growth and comfort levels, however, the teachers noted that colleagues “come to us for questions” about using computers or technical problems, demonstrating pride in their accomplishments.

In the fall semester, the teachers expressed “meeting expectations of the administration” as pressure toward using the laptops, and “meeting standards” defined by the school district and state as pressures they felt toward not using the laptops. It is simple to discern the conflict these pressures presented toward use and non-use. However, in the spring semester they seemed to have reconciled these. The teachers concurred that they did not feel “as much pressure as in the beginning.” Some pressure may have been intrinsic—applied by the teachers—in addition to the extrinsic pressures they identified. Again, pride in their endeavors seemed to have mitigated the former pressures.

In the fall semester, concerns about the laptop program centered on covering content and teaching skills and knowledge that specifically may not be revisited until later grades. The teachers were also concerned that they would be teaching computer skills that the students “will not use in other grade levels.” In the spring, concerns shifted to improvements for the following school year. For example, another teacher would be added to the fifth grade. Currently, the core subject areas (language arts, mathematics, science and social studies) were taught by one of each of the fifth grade teachers. So, all the fifth grade students rotated through each of the teachers. In fall 2004, another teacher will be added and she will most likely share teaching responsibilities for one or more content areas. Integrating this teacher into the learning community and “logistically figuring it out” how to use the laptops when the same subject matter is taught in two different classrooms were indicated as challenges and concerns. In addition, technical difficulties, such as reliability with internal network, external Internet and server access, continue to be concerns for the teachers. They do feel, however, that they are more sensitive to these challenges given their reliance on these resources.

Student Focus Group. Students’ discussions centered on two themes: (a) computer use and (b) students that benefit from using laptops.

Computer use. The students identified electronic presentations, writing “stories,” graphing such as an ordered pairs lesson in mathematics, draw/paint to create an original flower in science and visiting Internet sites for information seeking/research as ways they had used the laptop computers in class. They said in many

instances using the laptop computers was “easier,” “fun and faster” and required less “writing.” But they also recognized that in some cases, such as with the flower project in science, it was “harder” than completing the assignment on paper, where they previously used craft materials.

The students reported issues that they felt prevented from using them more in class. These related to technical and logistical topics as well as personal responsibility. Technical problems, such as system crashes, “freezing,” glitches in the application programs, system updates, as well as broken keypads and broken cords requiring “repair time,” continued to be challenges throughout the school year. Logistical issues primarily centered on lack of “battery power,” which sometimes caused delays in instruction and in a few instances resulted in lost work.

A very strong theme for the students’ use was personal responsibility for the laptops. This message as described by the teachers in their interviews appeared to have been respected by the students. Many students felt that they “had to be careful when using the laptops” so they would not damage them. They also felt that “not being responsible” would prevent them from being able to use them. Likewise, “dropping the laptops” was also a concern for the students. But, they also felt like they were “gaining responsibility” with using the laptops and taking care of them.

At the beginning of the school year, students thought typing, or keyboarding, skills were a problem for students, preventing use or slowing use. They even suggested requiring “a typing class.” However, at the end of the year, the students did not include this with their challenges to using the laptops or with the students they felt benefited most from the laptops’ use.

It is also interesting to note that a few students also felt that they “can’t work on [the laptops] all day.” They felt it was implausible. Similarly, students thought if they used the laptops “all day,” it “might get boring.”

Students that benefit from using laptops. The fifth graders felt that the types of students who benefited most from using the laptops were those that were fast learners or “students who learn more.” They also thought those peers that had prior knowledge about computers or were “into computers” also benefited. In the fall they felt that students who had “high IQs” benefited, but in the spring, students mentioned that “students who are not as smart” were the ones benefiting most.

The students agreed in the fall and spring that the type of students who did not benefit from using the laptops were those students who “don’t care” and those who “don’t listen” or do not pay attention. One student called these indifferent and lackadaisical students “goofers,” explaining that they “sit there and do nothing.” They also felt that the “smartest kids in class” benefited least, because “they already know” how to use the laptops and are confident with the content. Similarly, the “fast learners” they felt should have additional resources, because they are “held back” when skills are retaught.

Discussion

The discussion of the findings of this study is presented in association with each of the major research questions in the respective sections below. The limitations associated with this study are relative to all qualitative research. The small sample limits the ability to generalize these findings to larger populations. More specifically, this research represents the voices of students and teachers in a suburban city, so it is impossible to say if these findings would extrapolate to other populations. As such, these results should be interpreted with caution, and the extent to which these results can be applied in other contexts is situated with the reader.

In what ways has the effectiveness of instruction through the use of student laptop computer been impacted?

While it is difficult to determine increases without baseline, or beginning, data, SOM results indicate extensive uses of cooperative/collaborative learning, project-based learning and the teachers acting as coaches or facilitators. Results from the SCU indicate extensive uses of productivity tools, specifically draw/paint/graphics and electronic presentations, and Internet research with Internet browsers. SCU results also suggest wide use across the content areas. Finally, the overall meaningfulness of the computers was observed to be extensive in approximately one-third to fifty percent of the classroom visits. The results from the SOM coupled with results from the SCU point to activities that result in meaningful uses of computers that were based on problems, required critical thinking skills and used computer applications to locate, process and/or manipulate information. Despite the limited scope of technology tools, those tools observed were seen to meaningfully integrate technology to enhance student learning.

Moreover, data from the RSCA revealed that teachers used technology with over 40% of their student-centered learning activities. This finding is not surprising given that the observations were conducted with targeted lessons, where the teachers were asked to demonstrate technology integration. However, specifically

notable is that technology was observed in every instance with project-based learning. This is a significant accomplishment given the focus of the initiative on using technology to impact teaching and learning. Plus, technology for student use is often employed best during more ill-defined learning contexts such as project- and problem-based learning (Morrison & Lowther, 2005).

It is important to indicate that during two of the observations as noted in the SCU, the school network access was intermittent. As the laptop program continues and potentially expands, school network reliability will affect the effectiveness of instruction with the increased dependence on digital resources, such as the Internet, email and school servers. Other implementations (e.g., Edwards, 2003) have also experienced challenges with unstable or unreliable networks. While statistics may demonstrate promise for improving access to technology and digital resources (National Center for Educational Statistics, 2001), the reliability of school networks may impede or dissuade teachers from developing and implementing lessons that require Internet and intranet access.

To what degree and in what ways have teachers integrated technology with classroom instruction?

The proposed laptop program included comprehensive technology integration training for the fifth grade teachers; this was not implemented due to cost and lack of grants support. While no extensive training was conducted, the fifth grade teachers participated in a workshop on using Microsoft PowerPoint in Fall 2003 and informal discussions about classroom management with laptops during Spring 2003. Moreover, the teachers through focus group interviews indicated they had participated in professional development workshops offered through the local school district. They also relied heavily on one another to extend their expertise, creating an informal community of practice (Wenger, 1998) leveraged from their grade team. So, primarily the teachers used their educational philosophies and pedagogy to envision effective technology integration. Pierson (2001) suggests that pedagogical expertise and teacher epistemologies influence technology integration. Likewise, teachers' personal technology skills impact the meaningfulness of the technology integration activities as well as the instruction and assessment. While this evaluation did not seek to explore teacher epistemologies or pedagogical expertise, there is some evidence from observations and focus group interviews to suggest the fifth-grade teachers' visions for technology-enhanced teaching and learning represents the intersection of exemplary technological ability and exemplary teaching ability, Pierson's Category 4.

In the fall semester, both teachers and students mentioned keyboarding skills as impediments to technology-enhanced teaching and learning. As mentioned earlier, the students actually suggested requiring "a typing class." However, in the spring, keyboarding skills were not included as an obstacle to using the laptops computers more. SCU results reported keyboarding skills were very good in all classroom visits (100%). So student keyboarding skills seemed to have improved throughout the year and may be part of the learning curve for laptop initiatives.

To what degree do laptop teachers use methodologies that stress higher-order learning and student-centered learning activities?

In almost 90% (88.9%) of the targeted classroom visits, teachers were observed extensively to be acting as a coach or facilitator of learning. Other activities indicative of critical thinking and student engagement were seen in over 30% of the visits. Cooperative/collaborative learning, which was observed extensively in 33.3% of the visits, was observed to be a somewhat strong or strong application in over 40% of the observations (44.4%). Project-based learning, which was observed in 100% of the visits, was observed to be somewhat strong or strong application in over 75% of the visits (77.7%). Finally, independent inquiry/research, which was observed in over 40% of the visits (44.4%), was observed to be a somewhat strong or strong application in approximately 10% of the visits (11.1%). These data indicated some use of non-traditional, or more student-centered, instructional methods. Similar initiatives (e.g., Bickford et al., 2002) have reported challenges with teachers' uses of student-centered pedagogy. Pierson (2001) agreed that characterizations of exemplary technology-using teachers represent a combination of content knowledge, pedagogical knowledge and technological knowledge that few teachers may achieve.

The results from this research suggest the fifth-grade teachers have the pedagogical knowledge and skill to implement teaching methods that emphasize higher-order and critical thinking. While the observations used in this study were pre-arranged visits, it is impossible to determine the regularity of these strategies throughout the school year. In addition, with a lack of baseline comparative data, it is also impossible to discern whether the fifth-grade teachers employed these methods prior to the laptop initiative. However, professional development efforts or program goals focused more on these student-centered strategies may increase the frequency with which they are used.

To what degree has the laptop program impacted teacher attitudes toward technology?

The fifth grade teachers were enthusiastic about the laptop program. Succinctly, the teachers felt the

program had positively impacted their classroom instruction and positively impacted the fifth grade students. Moreover, the teachers felt they were ready to integrate technology into their instruction. This was corroborated by the focus group interviews as the teachers discussed their “confidence” with the laptops and reconciliation with previous intrinsic and extrinsic pressures. The TSA highlighted the teachers’ expertise in computer basics, software basics, multimedia basics, Internet basics, advanced skills and using technology to support learning. This corroborates previous research (e.g., Pierson, 2001; Silvernail & Lane, 2004) that suggests teacher technology skills positively impact technology integration.

Personal professional development objectives or grade level professional development goals should consider the few technology skills, such as Boolean strategy searches, electronic communications other than email and electronic teaching portfolios, that received mean scores below 2 (between “Not at All” and “Somewhat”). These skills should be evaluated for their value to the teachers, students and relevance to the program as the initiative continues.

Finally, the teachers felt they have the support of parents, the community, the administration and the technical support necessary to be effective with technology integration and improve student learning. Silvernail and Lane (2004) reported that success with technology integration also appeared to be influenced by key individuals to champion the program. The parents and school administration, while initially imposing extrinsic pressure on the teachers, may in fact have translated into the types of advocates necessary to support the laptop program.

Conclusion

From the formative results in this study, the school had positive teacher technology competence and confidence, used instructional strategies that centered on and facilitated student learning and employed classroom practices that engaged students in meaningful technology-supported activities. Pierson’s (2001) case studies emphasized content, pedagogical and technological knowledge as factors influencing technology integration. Windschitl and Sahl (2002) illuminated further this work by contending that teacher beliefs coupled with school culture and perceived support impact technology integration, specifically in laptop programs. In the present study, the fifth-grade teachers’ progress toward more student-centered activities, including project-based learning, cooperative/ collaborative learning and acting as a coach or facilitator, seems to support this. The interdependence with one another and community of practice established by the fifth grade teachers also appears to have created an informal culture of support and knowledge sharing (Wenger, 1998). While the teachers may have been novices at the beginning of the school year, clearly all the teachers felt they were skilled enough to use a variety of software applications for meaningful learning. These three factors — teacher pedagogical knowledge, technological knowledge and a supportive culture — seem to be strong indicators for impacting technology integration at this school.

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Using Human Performance Technology (HPT) to Identify Potential Barriers to Online High School Course Development

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Executive Summary

A suburban high school district in Arizona was recently named as a provider of Technology Assisted Project Based Instruction (TAPBI). The district's challenge was to create 20 effective, online high school courses in approximately nine months. Successful deployment depended in large measure on the ability of the teachers of those courses to effectively design and develop the instructional content. Therefore, the district had to train, prepare, and support the teachers in their work.

To help identify factors that might prevent teachers from meeting the challenge, a team of students from Arizona State University worked closely with the district during a two-month period as the TAPBI program began. This paper documents the data collection methods employed, findings, and subsequent recommendations for attaining success.

Project Purpose

The purpose of the project was to assist the district in identifying potential barriers to effective design and development of 20 online high school courses. The district had been named a provider of Technology Assisted Project Based Instruction (TAPBI), which required it to provide a "variety of educational methodologies employed by the school and the means of addressing the unique needs and learning styles of targeted pupil populations including computer assisted learning systems, virtual classrooms, virtual laboratories, electronic field trips, electronic mail, virtual tutoring, on-line help desk, group chat sessions and non-computer based activities performed under the direction of a certificated teacher." The district wanted to identify strategies leading to optimal implementation of the program.

Data Collection Methods

Data collection for the project employed four methods: analysis of a survey administered by the district to teachers, follow-up interviews with teachers who were interested in the project and who had completed the survey, observation of an informational meeting for interested teachers, and a review of relevant literature.

Survey

The district developed a survey instrument to be administered online to the teachers throughout the district. The instrument introduced the TAPBI program to the teachers and asked for responses from those who had an interest in participating as designers and developers of online courses. The items used for data collection focused primarily on the teachers' skill and experience in online environments. The district provided the project team with the data obtained from survey responses.

Interviews

Based on the survey responses, the project team divided teachers into three categories according to their skill and experience designing and delivering instruction in online environments. The project team then contacted each teacher via email in an effort to arrange a follow-up interview. The purpose of the interview was to understand teachers' perceptions of the TAPBI program, and to gauge their expectations regarding potential barriers to effective implementation. Select administrators were also contacted for similar reasons.

Informational Meeting

The project team attended an informational meeting held for teachers interested in participating in the program. Team members who attended the meeting were able to listen to teachers' questions and identify some

of their concerns regarding the program.

Literature Review

We anticipated that our task of identifying potential barriers to effective design and development could be aided by drawing upon the experiences of other organizations that had implemented similar programs and had published their experience in the literature. Therefore, we searched through relevant journals for cases in which organizations had implemented a program similar to TAPBI, and identified barriers to effective implementation.

Findings

Analysis of the data led to several findings with potential implications for action on the part of the district. Based on these findings, we generated recommendations for how to prevent performance barriers to the TAPBI program.

There are a wide variety of potential barriers to an effective rollout of the program. These barriers can be categorized into three general groups: Administrative / Strategic; Experience / Knowledge; and Motivational / Incentive. Our discussions with individual teachers revealed that they had several fears about their participation in the program, and that many lack experience as online teachers and designers. Our communication with administrators brought to light that the district is already grappling with issues such as marketing, teacher contracts, and copyright. The long-term success of the program rests on effectively dealing with many of these issues.

Teachers and administrators view lack of time as a potential barrier. Devising strategies to lessen encroachment of program responsibilities on the teachers' pre-existing classroom responsibilities should be a priority.

Many of the teachers lack critical experience and knowledge about designing online instructional content. This relates to using WebCT and supporting multimedia technology. The gap that exists between many teachers' knowledge of the technology necessary for development and the knowledge needed to effectively develop their courses must be bridged for the program to be successful. However, we felt that the teachers had a good understanding of how their online courses would differ, pedagogically, from their classroom courses.

Teachers expect and welcome peer review of their course designs. This strategy that the district is planning to implement can be a very effective method of ensuring sound pedagogical design, and standardization of technology, content, and designs. Enthusiasm for peer review, though, could become fragile, and could easily shatter if the reviews are not done constructively and meaningfully.

Implications and Recommendations

The implications for an optimal rollout of the TAPBI program depend on three key factors: time, training, and support.

Time

This is the most crucial factor for developing the TAPBI program. Although most teachers said they could complete their course by the deadline, time was the top concern for both teachers and administrators. At the time of this report, the courses to be developed had just been selected, but not yet approved for funding by the District Governing Board.

Training

The data clearly demonstrate that the teachers are experts in their content area, but they want multimedia/online course training. This is supported by the initial survey in which over half of the respondents indicated they had not developed course components for students using the online WebCT environment. Most feel that they need some kind of multimedia/online course training so they can develop classes that are going to meet the needs of their virtual students. Literature reviews also recognized that courses with text-heavy content are insufficient to retain student interest, and can lead to high attrition rates.

Support

The teachers must feel that this project is going to be supported by the district with IT resources, funding, and management. In addition, some instructors have been involved with similar programs that have never been brought to fruition, and they fear a lack of support could undermine their work developing the online

courses for the TAPBI program.

The following interventions are recommended for the TAPBI program rollout effort and to minimize potential barriers for optimal success.

Vision and Strategies Structure

Document the vision and strategy of the TAPBI program as it applies to the district to instill confidence in the teachers. This should include buy-in from the District Governing Board and pledged IT support for the program. A statement documenting the District's vision and strategies should be included in the development packet given to the teachers when they are selected to develop a course as proof of commitment to the program.

Multi-year Strategic Plan

Develop a schedule to keep course development on track, including a timetable of deadlines for each step in the process. This lets the teachers know what they are expected to have completed by when, and alerts the district to those teachers who may be having difficulties and are falling behind. This strategic plan also allows the district to see a problem as it arises and intervene in time to correct it.

Mentoring Program/Peer Coaching

Set up development groups with an experienced teacher as a mentor to help those with less experience. Provide time for them to meet in person to demonstrate "hands-on" procedures. Provide a Discussion Board for peer coaching and communication with administrators. Mentors should provide examples of both effective and less-effective online course designs as examples to the less-experienced teachers.

WebCT and/or Multimedia Training

Arrange for expert trainers to come to campus for "hands-on" training. Select one individual from each campus as a liaison between the teachers and trainers to stay current with software programs and techniques. The liaison will then share information at mentor meetings or through the Discussion Board. Again, training should provide both effective and less-effective examples of online design for the teachers to reference.

Feedback/Appraisal System

Schedule course material reviews at logical intervals (steps) throughout the development process as shown in the Strategic Plan. This should be an ongoing formative evaluation. By waiting until course completion for the jury review, it may be too late to meet the required deadline if course correction is required.

Table 1 *Results of Interviews with Teachers and Administrators*

1. What do you see as likely problems for you in the development of your online courses? (Arrange in the order of importance with 1 being the most important and 7 being the least important.)

| | Teacher Mean | Administrator Mean |
|---|-----------------|-----------------------|
| Lack of time | 1.50 | 1.00 |
| Lack of multimedia skills | 3.50 | 4.00 |
| Lack of District support | 3.50 | 5.00 |
| Lack of IT support. | 3.67 | 5.00 |
| Lack of instructional design skills | 3.83 | 2.50 |
| Lack of motivation after start of project | 5.17 | 3.50 |
| Lack of content expertise | 6.83 | 7.00 |

2. What do you feel is important to know before you begin creating your online course? (Arrange in the order of importance with 1 being the most important and 6 being the least important.)

| | Teacher Mean | Administrator Mean |
|-------------------------------------|-----------------|-----------------------|
| Experience teaching a course online | 2.83 | 4.50 |
| Subject matter | 3.00 | 1.00 |
| Instructional design | 3.33 | 2.50 |
| Multimedia programs | 3.50 | 4.50 |
| Experience taking a course online | 4.17 | 3.00 |
| More about computer technology | 4.67 | 5.50 |

3. What are your biggest fears in developing an online course? (Arrange in order with 1 being the biggest fear and 6 being the smallest or least fear.)

| | Teacher Mean | Administrator Mean |
|-----------------------------------|-----------------|-----------------------|
| Time | 1.67 | 2.00 |
| Multimedia skills | 2.50 | 3.00 |
| IT support | 3.67 | 4.00 |
| Computer skills | 4.00 | 2.00 |
| Submitting the course to the jury | 4.17 | 4.50 |
| Beta-testing the course | 5.00 | 5.00 |

4. What support/help will the District need to provide as you design and develop your course?

| | # of Teacher Responses |
|--|------------------------|
| Training/Workshop on WebCT | 3 |
| Real-time Technology Support | 3 |
| Training/Equipment on Multimedia Content | 1 |
| Documentation/Training Manual for WebCT (List of tips) | 1 |
| Reviewer of Course Material | 1 |

5. How will your online course be designed differently than your classroom course?

of Teacher Responses

| | |
|---|---|
| Online Quizzes | 1 |
| Multimedia Items (Audio and Visual) | 2 |
| Discussion Forums | 1 |
| Online Resources (Materials) | 2 |
| Student Centered Format | 1 |
| Independent Research | 2 |
| Critical Thinking | 1 |
| Reworking the content for assessment and motivational factors | 1 |
| Drill and Practice and Feedback on Quizzes | 1 |

6. What sort of evaluation procedures will you be following (if any) during the design and development of your course?

| | |
|------------------------|---|
| Evaluation by Peers | 3 |
| Field Test (Beta test) | 3 |

7. Are you aware of any standards that need to be met in the design and development of these courses?

| | |
|--|---|
| AIMS Standards | 1 |
| ISTE Standards | 1 |
| Local, State and National Standards | 4 |
| Self developed standards from online chats | 1 |
| Standards given by Project Coordinator | 1 |
| Good Instructional Design Principles | 1 |
| IT Standards | 1 |

8. What resources has the school has given you for this project?

| | |
|-------------------------------|---|
| Textbooks | 1 |
| Question banks | 1 |
| Teacher editions | 1 |
| Computer resources | 2 |
| Active Discussion Board | 1 |
| WebCT LMS and Tutorial Access | 1 |

9. What resources would help you?

| | |
|--|---|
| Training on WebCT | 2 |
| Training on IT (Integration of Technology) | 1 |
| Internet Access | 1 |
| Enough computers to beta test | 1 |
| CD Burner | 1 |
| Making Video Excerpts Available Online | 1 |

10. What was your primary motivation in getting involved in this project?

| | |
|---|---|
| Curiosity | 1 |
| Use of technology | 2 |
| Wish to become an online teacher later | 2 |
| Money | 1 |
| Helps Gifted Children and in home schooling | 1 |

11. What do you perceive as being the biggest obstacle for this project?

| | |
|---|---|
| Time involved in uploading the materials | 6 |
| Lack of knowledge of WebCT | 4 |
| Funding problems | 1 |
| Tech Support | 2 |
| Loosing face to face contact | 1 |
| Security issues online (students could cheat) | 1 |
| Training | 2 |
| Resources | 1 |
| Lack of Coordination | 1 |
| Skills | 1 |

12. Do you think that converting your classroom-based course to an online course will have the same effects on learning?

| | |
|---|---|
| Depends on the student (Discipline, Motivation, personality types) | 3 |
| Online courses are positive move forward in the educational system | 1 |
| Depends on the Challenge to overcome the lack of face-to-face contact | 1 |
| More successful for motivated students | 1 |

13. Would you be comfortable teaching an online course developed by someone else or would you let someone else teach the course you developed?

| | |
|--|---|
| Will let teach others courses | 1 |
| Prefer to teach my own course | 3 |
| Willing to let someone else teach my course | 2 |
| Will redesign and teach somebody else course | 3 |

14. If you have developed online course before, what do you know now that you wished you could have known then?

| | |
|---|---|
| Make lesson very explicit and complete | 1 |
| Provide feedback and positive reinforcement | 1 |
| More contact with students in an online setting | 1 |
| Be ready to handle technology issues | 1 |
| Course design takes more time than anticipated | 1 |
| The course design process | 1 |
| Teaching and learning in an online environment | 1 |
| School/districts expectations | 1 |

15. To what extent do you perceive this initiative to be of value to you and to the school where you teach?

| | |
|--|---|
| Will help the district to lead in cutting edge opportunities/efforts | 1 |
| School will be in forefront of this educational endeavor | 1 |
| Might end up re-inventing the wheel | 1 |
| Good challenge as we are moving into technology centered world | 1 |
| Great opportunity for personal growth | 1 |
| Good opportunity for students to be successful | 1 |
| Classes taught on one campus can be available for all the students | 1 |

Which Way for Which Teacher? Comparing Two Graduate Courses that Teach Technology Integration to Teachers

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Abstract

This brief paper describes a comparison of two different courses, both of which have been approved by the state of Georgia's Professional Standards Commission (PSC). These courses fulfill the PSC requirement that all teachers be competent with technology and know how to integrate technology into teaching and learning by the year 2006. The method of comparison was document analysis. Each of these courses has been approved to by the state as meeting the "Special Technology Requirement," but there are many contrasting elements. A description is given of how each course addresses the common topics taught by the courses and then a rating is assigned for each course on how thoroughly it addresses each topic. After the content analysis of each class was conducted, data from another study reporting the amount of time spent by students in the courses studied was incorporated to add depth to the comparison of the courses.

Study Rationale

In 2000 the Georgia state legislature passed House Bill 1187 which became the A+ Education Reform Act of 2000. A part of that act requires that all certified teachers in the state meet a technology requirement in order to keep their teaching certificates current. There are currently at least three different ways that in-service teachers – teachers that have previous certification and are currently teaching in Georgia schools – can meet that requirement at the University of Georgia. One way is a professional development model called InTech offered by the University's Educational Technology Training Center (ETTC). Another way is a class offered by the Department of Instructional Technology called EDIT 6150 – Introduction to Computer-based Education. The third option is EDIT 6150 offered as an online class rather than through a more traditional face-to-face method. The expressed purpose of each of these courses is to prepare teachers to be able to better use modern technologies in their teaching practices.

In the literature there are various examples of individual programs for training teachers how to integrate technology into their curriculum. The reports about these describe attributes of each program and why those involved view these programs as successful. For example, Norton and Gonzales (1998) describe a regional educational technology agency's attempt to meet the needs of the teachers in their service area. They point out in their report that there are several components that teachers being trained feel are key to the success of the course and are key to helping them to reach the course objectives. Some of those are the fact that other teachers teach the course and that integration is emphasized rather than skills. In the same report, instructors give input as to what they feel are significant components of the course. Similar to the opinions of the teachers taking the course, the instructors feel that the philosophy of curriculum integration of the technology is important. They also agree that having a team of teachers teaching the course is a significant feature.

Another article discusses teachers' levels of concern for using technology (Gonzales, Pikett, and Ruppert, 2002). In this article, the authors suggest a relationship between a teacher's level of concern for using technology and their skills and support to do so. The more skills and support that teachers have with dealing with technology, the higher their level of concern for using technology in their teaching will be. Another program (Moersch, 2001) takes the opposite approach and connects a teacher's current use of technology to his or her need for further professional development in technology. In other words, rather than suggesting that teachers need certain professional development to be able to integrate technology, their current level of technology integration determines what kind of professional development they might need.

In summary, there are examples of studies that describe individual programs or courses and then there are studies that describe levels of skills and experiences with technology of the people taking the classes. It is the researchers goal to take information from these studies and go further in an attempt to compare different programs in an attempt to discern which type of course is best for which type of teachers according to their nature, technical skills and past experiences.

Research Problem and Questions

There are many options for teachers who need to meet the technology requirement that the State of Georgia has mandated. A complete list of options can be found on the PSC's website at <http://www.gapsc.com/ApprovedPrograms/EducationProgram.asp?technology=yes>. There is a diversity of skills and previous experiences of teachers in those classes. Further, there are many people who are continuing to develop new courses to distribute and are modifying existing courses to meet this requirement.

This study seeks to compare two of the existing courses that teach technology integration to teachers in an attempt to inform instructors and potential course participants of which type of course is best for teachers of different skill levels and experiences. In doing so, the researchers must ask these questions: What key topics are covered by each individual course? How are different topics covered? Finally, what kinds of prerequisite skills are needed to be able to be successful with each topic?

Research Design

Site

The site for this study is the Department of Instructional Technology at the University of Georgia. The University of Georgia has one of the largest Colleges of Education in the country, and as such, serves not only a great many of the state's educators, but also educators that represent every demographic in the state. An impetus for this study is to become better informed of the variety of options teachers have for fulfilling the state technology recertification requirements.

In order to provide a richer context for the evaluation of student experience in each course, time-on-task data was also collected on the courses using a web-based log tool (Amiel, McClendon, & Orey, 2003). Students were asked to input the amount of time spend every week of class. The student log categories represent a comprehensive list of time consuming activities that are part of the course: class time, group time online, group time face-to-face, time spent working individually, technology problems, travel, message posting/boards, and other. Data from these logs were not collected for comparative purposes, but instead to provide another dimension for the analysis of in-class characteristics (for a discussion, see Clark, 1983, 1994; Ehrmann, 1995; Paulson, 2002).

Sample and Sample Selection

This study used as its sample one section of each of the two courses during the same semester. Time-on-task data was collected on both courses. Participants were self-selected and received extra credit for recording their time-on-task data using the web-based log tool once a week. The first course (online) had an enrollment of 21 and 11 participants; the second course (f2f) had an enrollment of 19 and 10 participants.

Data Analysis and Procedures

The course materials including syllabi, required texts, and assignment descriptions served as data and were analyzed according to the International Society for Technology in Education's National Educational Technology Standards (ISTE-NETS) categories. For a course to be approved by the PSC as meeting the special technology requirement, it must address the state's technology standards, which were adopted from the ISTE-NETS. In the ISTE-NETS there are twenty-three standards divided into six different topical areas. A complete, detailed list of these standards can be found on ISTE's website at http://cnets.iste.org/teachers/t_stands.html. After it was determined how each course addressed each topic, the primary researcher rated how well that topic was covered. She then consulted with the other researchers to confirm her findings. In order to rate how each course performed in addressing each topic, the researchers used a scale of one to five with descriptions of what would be seen as evidence of covering the topic at each level. The scale follows.

- 1 - Addressed only in an introductory nature such as by mentioning in lecture.
- 2 - Addressed mostly by discussion but with some practice or application.
- 3 - Addressed by an assignment that the student must complete. Often covered as a secondary objective to another assignment.

- 4 - Addressed by at least one assignment and one other method such as discussion, reading assignment, secondary objective of a lesson, etc.
- 5 - Directly and specifically addressed by multiple assignments on the topic.

Findings

Below is a description of each course including student demographics and information about the relationship of the researchers to the courses. The results of the analysis are then presented per ISTE-NETS topic for each course.

Descriptions of Each Course

EDIT 6150 Face-to-face

This course is offered as a traditional graduate level face-to-face class in 15 weekly meetings for 3-hours each over the span of a 15-week semester. Class discussions, technology skills, and software demonstrations are all a part of the course. A wide variety of students take this class including in-service and pre-service teachers, people who work in schools but not as teachers, and non-education majors.

EDIT 6150 Online

In this online course, the first class session has a face-to-face requirement. All 14 remaining sessions take place in a live online classroom. The online environment, HorizonLive, includes slides, live demonstrations and 2-way voice-over-IP audio. These live sessions last 2 hours each and take place over the course of the 15-week semester. In addition to the synchronous instruction, a variety of asynchronous requirements and supplements exist including required discussion threads, optional step-by-step software guides, professionally developed self-instructional software (from NetG), and other materials and activities. The student demographics of this course are similar to that of 6150 face-to-face.

Technology operations and concepts

Teachers demonstrate a sound understanding of technology operations and concepts. The face-to-face section of EDIT 6150 addresses technology operations and concepts through classroom activities and several of the course required activities such as a word processing assignment and a PowerPoint assignment. Time during class is devoted to technical assistance and certain individuals in the class are identified as technicians and tech tip teachers to help those that need personal assistance.

Rating: 5

EDIT 6150 Online uses several different web-based and print-based resources to help teachers with operations and concepts. Since the delivery of the course is online, there is no scheduled time that the students meet in person with others in the class or the instructor. However, the instructor does offer to be available to the students if they request a personal help session. The instructor also covers some of the concepts during class presentations delivered online.

Rating: 4

Planning and designing learning environments and experiences

Teachers plan and design effective learning environments and experiences supported by technology. Two of the six deliverable assignments for EDIT 6150 face-to-face are lessons that are to be designed for implementation with students. Those deliverables are a cognitive tool lesson and a final project that could be done in the form of a WebQuest, PowerPoint Game, or some other negotiated project. The course meetings provide a forum for discussion of these learning environments during the semester. Course readings that introduce ideas for technology supported learning environments and experiences are also included.

Rating: 5

EDIT 6150 online has students design three different learning environments. Those three assignments are a cognitive tool lesson, a WebQuest, and an open-ended project that is similar to the final project of the face-to-face class above. Each student's WebQuest and open-ended project idea is discussed via the discussion threads used as a part of the course.

Rating: 5

Teaching, learning, and the curriculum

Teachers implement curriculum plans that include methods and strategies for applying technology to

maximize student learning.

EDIT 6150 face-to-face requires that students develop their cognitive tool lesson and final project to be used with learners but does not require that they actually be implemented with the target audience. Again, class discussion and readings support the ideas needed to generate these products.

Rating: 3

EDIT 6150 online has its participants implement the WebQuest and the open-ended project with at least three learners from the target audience. Evidence of implementation is shown by photo documentation of the learners participating in the lesson. The cognitive tool lesson is planned so that it could be implemented, but evidence of implementation is not required.

Rating: 5

Assessment and evaluation

Teachers apply technology to facilitate a variety of effective assessment and evaluation strategies.

EDIT 6150 face-to-face uses rubrics for each required assignment. By having students in the class be assessed by a rubric, they can see the value of having a rubric for assessment. Also, they complete a software evaluation activity using a rubric, which further illustrates the value of a rubric. Additionally, the cognitive tools lesson focuses on how students can use technology to assess and evaluate information.

Rating: 4

EDIT 6150 online addresses this topic similarly to the face-to-face version of the course. Each assignment has a rubric to which the students in the class are held accountable. Also, the cognitive tools lesson has the students applying their knowledge of how different technologies can be used for assessing and evaluating information.

Rating: 4

Productivity and professional practice

Teachers use technology to enhance their productivity and professional practice. For both of the courses, the act of enrolling in the course to learn more about technology in education demonstrates their willingness to enhance their professional practice through the use of technology. However, each class also adds other components to this topic.

EDIT 6150 face-to-face has a journal requirement that students must keep and include in their web-based portfolio. Additionally, they include a description of how each activity that they complete as a student in class could be used by their own students in the classes that they teach.

Rating: 5

EDIT 6150 online makes use of the discussion thread in the online class room in order to facilitate a dialogue about how the course topics relate to their own practice. Also, participants are required to create a web-based portfolio for the course and in there must have a reflection on each activity that they have completed as a result of the course.

Rating: 5

Social, ethical, legal, and human issues

Teachers understand the social, ethical, legal, and human issues surrounding the use of technology in PK-12 schools and apply those principles in practice. Both sections of EDIT 6150 have a component to the cognitive tools lesson and the final/open-ended projects that asks students to reflect on affordances that are offered by technology to the learning activity. Both classes also cover the topics of social, ethical, legal and human issues in assigned readings and discussions.

Rating: 4

Time on task

Students were asked to log the amount of time spent on a comprehensive list of activities. Data entered by the students was saved into a database and exported into a spreadsheet program for analysis (Table 1). Each log entry was examined for consistency. The semester was composed of 15 weeks, so students who entered less than 12 logs were not considered for analysis. Since each class met once a week, it is reasonable to expect that students could miss a number of classes, or simply do no measurable work for class during a specific week.

Table 1. Average times on task per student per week by category

| Category | 6150 online (N=11) | | 6150 f2f (N=10) | |
|---------------------|--------------------|---------------|-----------------|---------------|
| | Average Minutes | Average Hours | Average Minutes | Average Hours |
| Class time | 93.73 | 1.56 | 132.43 | 2.21 |
| Groupwork online | 3.36 | 0.06 | 3.23 | 0.05 |
| Groupwork f2f | 0 | 0 | 10.97 | 0.18 |
| Individual work | 125.70 | 2.09 | 85.27 | 1.42 |
| Message posting | 28.11 | 0.47 | 16.15 | 0.27 |
| Technology problems | 18.38 | 0.47 | 8.50 | 0.14 |
| Travel | 13.88 | 0.31 | 42.62 | 0.71 |
| Other | 6.45 | 0.11 | 3.80 | 0.06 |
| Total | 289.61 | 4.83 | 302.97 | 5.05 |

Participants in this study were self-selected, and as such, a generalization to the whole class would seem difficult. Still the variance of data is so substantial (online, N=11, M = 4344.09, S = 2378.85; f2f, N=10, M = 4544.50, S = 1724.09) that a reasonable degree of confidence can be exercised when discussing the results as representative of the whole class. Were this a time comparison study, it would be easy to note that no significance differences exist between the courses in terms of total time-on-task per student (Table 2). Examining the specific categories provides a better context for the examination.

Table 2. Total time-on-task per student

| 6150 online | | 6150 f2f | |
|---------------|-------------|---------------|-------------|
| Total Minutes | Total Hours | Total Minutes | Total Hours |
| 1787 | 29.78 | 2110 | 35.17 |
| 2445 | 40.75 | 2542 | 42.37 |
| 2458 | 40.97 | 3313 | 55.22 |
| 2480 | 41.33 | 3665 | 61.08 |
| 3440 | 57.33 | 3980 | 66.33 |
| 3745 | 62.42 | 4755 | 79.25 |
| 3980 | 66.33 | 5465 | 91.08 |
| 4660 | 77.67 | 5970 | 99.50 |
| 5585 | 93.08 | 6150 | 102.50 |
| 8290 | 138.17 | 7495 | 124.92 |
| 8915 | 148.58 | | |

Data confirm some of the traditional assumptions regarding online courses. Students in the online classroom traveled less than those in the face-to-face class. It is not possible to ascertain whether travel time was a defining factor in choosing the course either of these courses. Still, since these courses were offered simultaneously, the data suggest that travel time might have been an important factor in choosing the session of 6150 a student would take. It is often assumed that more technology-related mishaps will occur in an online classroom, because the computer and an internet connection are needed for class time. Both classes made extensive use of computer-related technologies, but there were more technology-related problems reported by students in the online class. Though the time spent per week it is not in itself sizeable, it represents a little over 5-percent of the time students spent in the online class. Comments indicated some frustration with the audio connection, a common initial problem in the online classroom. Students are required to download a java-based plug-in in order to use the two-way audio, which often must be tweaked to work behind a firewall. As one student in the online classroom declared: "I find now that "problems with technology" are just part of the

work!”

Other observable differences in workload between the students in each course can be attributed to pedagogical decisions. Students reported spending less time in class because the online class rarely convened for more than two hours every week. Related to this observation is the finding that students spent more time on individual work in the online class. Time was incorporated into the classroom instruction in the face-to-face section of the class for completion of assignments whereas students’ only time to complete individual assignments in the online course was on their own time. Group work was not written into the curriculum of the online class and the time-on-task data confirmed that students spent little time cooperating in their projects. This finding suggests that students will likely not engage in group work unless encouraged by their instructor or demanded by the assignment (Hill, 2002).

Instructor reflection

Examining the workload of each student in the classroom provided for an interesting observation: some students dedicated as little as 30 hours to the course, while others set aside 150 hours, a five-fold difference! The low-end numbers are especially shocking when considering that class time alone (as reported by the students) would consume approximately 1.56 hours per week, for a total of 23.4 hours for class time alone during the full 15 weeks.

In order to examine some of the issues associated with such disparities, a follow up e-mail was sent to four students: the two who reported the lowest and highest time-on-task for each class.

Each student was asked to confirm that they had completed the logs correctly, and to provide an explanation for the higher/lower than average workload. The two students with the highest reported workload (online = 148.58 hours, and f2f = 124.92 hours) attributed the amount of workload to their general inexperience with computing and software used in his course (“It consumed my time because I am not computer savvy”). Both students with the lowest workload also confirmed the estimates. The responses indicate that both students were knowledgeable about the course content. One student added that she/he: “tried to budget my time very wisely”. The other responded indicated that she/he “basically knew everything covered in the class”.

Once the log data was compiled, it was taken to the course instructors. A semi-structured interview was used requesting that each instructor reflect on the time-on-task data. The most interesting aspect of the interview surrounded the large variance of reported workload. One instructor could not believe that anyone could have dedicated less than 30 hours to his whole course, while jotting down estimates of the number of hours a student would minimally have to dedicate to complete each project. The instructor estimated that a student would need at least *double* the time (60 hours) to complete the assignments in this course. Even though the log confirmed that the student devoted only 30 hours to the course, the instructor continued to affirm it to be impossible. The instructor was then told that the student had confirmed, via email, that indeed the 30 hours were approximately correct – moreover, the student had received an “A” (full grade”) in course. Even though substantial evidence was presented to confirm the validity of the data, the instructor did not shift his opinion regarding the minimum workload required for the course.

Conclusion

It is clear from the analysis above as would be expected that both of the courses address each topic area of the ISTE-NETS and therefore Georgia’s PSC standards. But the differences lie in the manner in which each is addressed described in the findings above. Additional distinguishing features of each individual course are based on the nature of its delivery and the structure of its curriculum.

EDIT 6150 face-to-face has the support of the instructors and classmates for students as they run into technical difficulties, which could be helpful for those who need personal attention when learning new skills and concepts. Not all of the skills that they learn in this course are directly tied to classroom application, and can be used more for teacher productivity, or even personal use. Since this course is not only offered to in-service teachers, this course allows for the opportunity of input from people who are new to the profession or in non-teaching roles.

While EDIT 6150 face-to-face could meet the needs of learners of all skill levels, the online version of EDIT 6150 does require some prerequisite technical ability. At the minimum, a student in this course should be comfortable with basic web navigation, sending and receiving of emails with attachments, and a functional knowledge of Windows (ability to change screen settings, etc.) Also, a student taking EDIT 6150 should have the ability to work independently and yet still contribute to the class as a whole.

In conclusion, we offer brief descriptions of the types of students who might be best served by each

class based on our findings. A student in EDIT 6150 face-to-face may come from various settings, but is usually best served by having some connection to education so that the examples and suggestions given in class have some significance. But since none of the lessons are required to be implemented with students, it is not essential that students in this course have a classroom connection. His or her level of skill will be irrelevant since plenty of in class support is given for those lacking skills. EDIT 6150 online requires more prerequisite skills than either of the other courses. Students who prefer a more self-directed environment would be best served by this course and should have an available classroom for implementing the required assignments.

The time-on-task analysis provided for valuable confirmation of pedagogical decisions by each instructor. It further supports some of the “truisms” of distance education as discussed above (travel preferences, technology problems). The results presented here further our belief that time-on-task data can be far more useful if it is not used for comparison purposes. The use of student reported data can fruitfully be used as a reflection tool for instructors, in analyzing the actual student-response (measure by workload) to pedagogical choices.

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Learning in 3D: Students' Experiences of Online Projects in NSW Schools

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Abstract

Student participation in online learning activities is a growing priority for Australian government schools. 'Online projects' have emerged as a new learning form, building on non-computer problem-based learning approaches. This paper reports on a study of online learning projects implemented in classes from year 2 to year 11. The purported benefits of online learning were explored through in-depth case studies of the selected projects. Results of the study are presented, providing a window onto the learning events as each project unfolded and highlighting the achievements of students. The study's findings have significant implications for education systems and teachers, in the design and implementation of online projects as part of an effective learning provision for students. The potential and limitations of an online project approach are placed in the context of online learning developments occurring in New South Wales and Australia.

Introduction

In the New South Wales (NSW) government school system (Australia's largest schooling authority), as in many other education systems, the incorporation of computer-based technologies has been a major priority for the last decade, with the familiar expectation that learning enhancements would be achieved. Also familiar are the disappointing outcomes of computer use, in terms of usage levels and evidence of effective learning or in changes to teaching practice (Audit Office, 2000; Hayes, Schuck, Segal, & Dwyer, 2001; Roberts Research Group, 2002).

The emphasis on hardware provision and connection of schools to the Internet needs to be matched with equal emphasis on demonstrating ways that computing technologies, particularly online technologies, can significantly add to teaching programs and student achievement. e-learning or online learning as an alternative to face-to-face lessons in particular school circumstances (small demand for subjects, teacher shortage, distance access) have become established as niche services. Yet when faced with an expectation that online learning will be part of all students' learning, we are still asking the question "What is online good for?" How online learning activities may provide new opportunities, and in what form, constitutes much of the current debate.

Online projects and the Australian online landscape

The Internet's characteristic feature is the ability to be 'connected' – to information, people and products. In NSW schools, currently most frequent use is made of connection to **information** (online encyclopaedia, web searching, WebQuests) and the associated learning activities (Audit Office, 2000; Cooper, Jamieson-Proctor, Crawford, & Nuyen, 2001; Wyld & Eklund, 1997). There is growing interest in educational **products** that will provide teaching and learning activities for direct use by students. The largest proportion of the investment by Australian education systems is going into the development of learning objects, which are expected to provide new opportunities and promote new ways of learning, as well as filling current resource gaps. Success will depend on the ability of objects to model complex concepts and events that are beyond the scope of school resources, and to provide self-paced pathways through sequences of materials (Australian Education Systems Officials Committee (AESOC), 2001). To date there is little product to show for this and even less evidence, worldwide, for significant learning changes.

The ability to connect to **people** provides a third area, with the promise of adding new dimensions to learning activities, particularly in mainstream, class-based environments. Potential activities include direct e-mail contact between students and with others, participation in online discussions or mailing lists, participation in projects with students in other places and contribution to real-world activities. Structured learning uses of online communications often fall into this latter group, presented in the form of 'online projects'.

All Australian education systems contribute to the *OzProjects* directory site administered by EdNA Online (Education Network Australia, 2003). The site provides a central registry of local and international projects, including some created by state education systems, with links to selected overseas collections. It is certainly not the only source of online projects being implemented in Australian schools. It does, however,

represent an endorsement of online projects as e-learning content for school use, although financial support of the site (and of online projects in general) is minimal, and hugely varied across state education systems.

The study on which this paper is based explores how online projects, as one form of class activity, can contribute to the learning outcomes of students and to the effective use of Internet technologies in K-12 school settings.

Activities describing themselves as online projects range from simple information sharing or web publishing activities; to those that bring together problem-based learning approaches and the promise of increased connection to and opportunities for collaboration with people and organisations beyond the school. Descriptions of project types or categories (including simulations) are provided in several contexts (Berenfeld, 1996; Ferrari, Taylor, & Vanlehn, 1999; Global SchoolNet, 2001; Harris, 2002), generally reflecting differences in the amount and nature of the interaction between participants and /or the complexity of the task. Different learning opportunities are promised as students move into a wider learning environment, and as communications facilities change the way activities are framed and undertaken. Online projects are currently implemented in pockets of schools and classes, both in Australia and elsewhere, with little consistent promotion or participation. The benefits of participation are expounded by project providers (Donlan, 1998 - heavily referenced in Education Network Australia, 2003; iEARN, 2003) and yet participation in projects remains relatively invisible in reports of school-based use of ICT in Australia and in the research literature around ICT integration.

Studies of online projects have focused on an 'overview' approach, mapping the occurrence and nature of projects (Harris, 2002) or documenting individual cases, with an emphasis on implementation issues and suggestions for their successful operation (Carr, 2001; Wyld & Eklund, 1997). While teachers recount their positive experiences of participation in online projects and the largely motivational benefits to students (for example, (Brunsdon, 2000; Clark, 2002; Roach, 2004; Robertson, 2000), anecdotal evidence of the value of online projects is not yet well supported by research into the experiences of learners or evidence of outcomes achieved. Concerted research is required that investigates and demonstrates how and what students are achieving through their participation in the online activities being advocated (Bennett & Lockyer, 1999; Windschitl, 1998).

The Study

The study reported here was conducted in four classes from Year 2 to Year 11, each participating in a project that moved beyond information gathering and sharing. The selected projects sought to introduce a complex, purposeful task (collaborative design, problem to solve) extending student activity beyond the school. In each case the project was implemented as an integral part of class activities. Use of online technologies was a pivotal part of each project, if not necessarily the aspect where most time was spent.

The purported benefits of online learning were explored through in-depth case studies, allowing the researcher to be part of the class for the duration of each project. A multi-method approach was taken to gain insights into the learning occurring through a variety of views, especially those of students. Data were collected through interviews with students and teachers, triangulated with extensive observations of class activities over the duration of each project.¹ Analysis of student products provides evidence of outcomes achieved, particularly related to syllabus requirements.

A significant feature of the study is the value placed on students' perspectives of the experience and learning achieved. Students' reflections on activities as they occurred, and in interviews at different stages of the project, are used as a primary focus of analysis; foregrounding students' perceptions of the project experience and the (sometimes less obvious) learning achieved. Class teachers described how they selected and implemented the projects. However, it is their knowledge of students, revealed through interviews and informal reflections, that contributes most to an understanding of the project learning experience: providing insights into what was occurring in the class and what was achieved as a result.

Online projects in action

In this paper I present two stories from the intensive case studies, one located in a primary (elementary) setting and one in a secondary setting. A detailed description of each project is provided, particularly highlighting the activities and responses of students, followed by analysis of some significant issues. The exploration of the particular contributes to a broader picture of online projects and their place in class-based learning.

Murder Under the Microscope: an eco-mystery for years 5-8

The tension is palpable. A final, collective decision needs to be made about the identity of the ecological criminal, drawing on the research, interpretation of clues and sometimes agonisingly difficult reasoning that has taken place over the last few weeks. A pair of students checks the latitude and longitude of the suspected crime site. Another group is arranging the issues summaries for the class' consideration, while the bulk of the class double-checks the reasons why most villains have been eliminated from suspicion. They are competing against some 2000 other teams from schools across Australia and beyond, and the deadline for making an accusation is looming.

All the ingredients of a murder mystery are here: a victim, dead in suspicious circumstances; a forensic scientist providing a complexity of test results; an array of suspects each with a possible 'modus operandi'; witnesses and bystanders ready to give contradictory accounts of events; all presented by a world-weary investigator in the field. The detective work was done by students in Class 4/5/6 (team name *Ecostars*), in their role as 'eco-detectives', struggling to piece together the information and clues to lead them to the solution: identifying the victim, the crime site, the villain and probable cause of the fatality. Information was revealed through weekly television broadcasts (also available online) and regular updates provided on the project web site. The second phase of the project involved students in the development of a rectification plan for the affected site, with the intention of preventing similar 'crimes' from occurring.

The project was implemented over a nine week period with three to five hours of class time spent each week. Outcomes in Science and Technology, English and Environmental Education were anticipated.

Capitalising on early enthusiasm for the project, the class spent the first weeks working in groups to explore the ten possible crime sites, two per group. They identified the information needed for each site, negotiating the fields of the database that became the enduring shared resource and reference point throughout the investigation. A similar process of distributed investigation was used a few weeks later, to develop understandings about the catchment issues that might be related to the crime. Each group selected and completed structured activities provided by the project.

The whole class eagerly awaited the first broadcast from Catchment HQ that revealed the crime scenario and the 20 potential victims and villains, and began the stream of information and clues to be sifted, interpreted and related to the background information they had compiled. Immediately, students were able to eliminate a number of victims, villains and sites. They debated the impact of the new information, providing evidence from their group investigations, with minimal intervention from the teacher. Subsequent broadcasts were characterised by absolute quiet in anticipation, followed by extraordinary levels of attention, even when frustration was expressed about other aspects of the investigation.

Interaction with the project web site was a defining feature of this project. Accumulated information was stored in various areas, games and activities were provided for enjoyment as well as providing additional clues, and the site provided direct access to reference materials, one-to-one communication with the scientist experts, and links to outside information sources. Information is deliberately delivered progressively throughout the investigation, allowing students time to gather ideas and build understanding, before each new set of data and clues arrived. New data acted as a learning reward, sustaining interest as predictions and decisions made by students were confirmed or refuted. The project itself guided the investigation, steering students' deductive efforts. Additional input was delivered via the Crime Scene Reports and daily Newsflashes, which were impatiently downloaded each morning. Disappointment was strong when they did not reveal something obviously useful.

Whole class discussion was used to share ideas across the groups. On some days this worked better than others, as children found it hard to make the connections between disparate sources and bites of information – a major difficulty identified by the teacher. By the middle of the investigative phase the class hit a trough in enthusiasm. A growing concern for the class teacher was the feeling that many students were not productively involved, in the group activities or in open discussions. Ongoing technical difficulties with the class computers, though relatively minor, caused added tensions as groups were delayed in pursuing their research or had to use computers located in other areas of the school.

The momentum picked up again with each broadcast, particularly as the deadline for accusations drew nearer. Gaps in understanding were being filled and more was revealed through the drama, enabling the class to make more confident assertions and narrow the scope of the follow up questions to be investigated. By this stage the difficulties of group operation had largely been resolved and the time spent on scaffolding group organisation was paying off. The class teacher, Hannah felt happy to leave the investigative work to the students, spending more of her time assisting the groups to keep functioning and structuring activities to

maintain involvement of individual children.

By week 5 the enthusiasm was tangible. The crimes site and victim lists were each narrowed down to two possibilities, with specific research questions being allocated to pairs of children to follow up. Questions were posted to the project scientists and while the answers were of limited value in resolving the issue, some of the questions posted by other teams provided useful additional ideas. Sifting through the hundreds of questions, however reduced this to a matter of luck rather than systematic analysis. Several students took the unexpected step of contacting the Department of Water Conservation by phone, and succeeded in getting an answer to their question.

Deadlines for individual tasks were used to keep groups on track and maintain the urgency. In a frenzy of activity on the day of the accusation, the class arrived at a tentative solution to the mystery. There was still uncertainty about the cause or 'issue' involved. The competitive aspect kicked in at this point and the class was divided about whether to submit their accusation immediately (only one accusation was allowed per team, and the first correct solution would 'win') or wait for the final broadcast to provide any final clues and confirmations.

The solution, and 'correct answer', was posted on the web site the next day. The *Ecostars* did not get all four elements correct, having made an error in locating the crime site latitude and longitude and in incorrectly identifying the environmental issue. Given the level of involvement throughout the project, it was surprising how rapidly the immediate let down of not getting the answer right, gave way to further thinking about the solution. There could have been recriminations over the error made by the pair who checked the grid references. While the teachers' distress was obvious as she felt responsible for not having made a final check, the children were surprisingly understanding. Attention quickly moved to the other error in their solution: the wrong issue. Rather than accept they'd 'just got it wrong', a lively debate ensued about the relative merits of the 'correct answer' in comparison to the class' decision. While this may be interpreted as justification (or just plain sour grapes) the insights and arguments put forward demonstrated a significant level of understanding of the both the issue that was suggested and the others that had been considered along the way. Several groups of children were able to outline and substantiate how their preferred solution reflected the clues they had been provided. A similar debate was played out on the teachers' forum of the project, with a number of dissenting arguments put forward. The outcome for both teachers and students was an acknowledgement of the interplay of influences and the cumulative effect of multiple environmental pressures – a sound learning outcome in itself.

Bring Modern History to life: the Middle East simulation

The room is full of variously dressed 'conference delegates'; passionately arguing their points, leaping out of seats; or slumped, resignedly feeling the frustration of impasse. A quickly scribbled note passes between delegates, framing up a response to an accusation or proposal. Microphone in hand, the press asks questions that make Arafat squirm, al-Assad leap to her(his) feet and George Bush defer to his co-delegates for support.

The Middle East simulation immerses Year 11 Modern History students in the issues and personalities of Arab-Israeli politics. Originally developed by the Macquarie University Centre for Middle East and North African Studies, for use by tertiary students studying the politics of the wider Middle East region (Macquarie University Centre for Middle East and North African Studies, 2003), the simulation has been adapted to meet the needs of high school participants focusing specifically on the Arab-Israeli conflict.

In groups of three, students take on roles of significant characters in contemporary Middle East affairs, using Internet technologies to interact and play out the action in a likely, if not real, political scenario. The participants were 60 students in three classes, across two Sydney high schools. Several 'control' roles were created to allow monitoring and assessment of activities by class teachers and 'controllers' from the Centre for Middle East and North African Studies. The controllers provided support and guidance to students, as required, allowing them to draw on the expertise of the participating university faculty members.

Following the release of a scenario which sets the scene for the simulation to follow, the action and reaction was driven by the ideas and decisions of students, unfolding over a three week period. The culmination of the project was a Conference Day where players came together, face-to-face, to negotiate around key issues in the conflict. All the lead up action took place online: messages were sent by e-mail, players used chat sessions to negotiate in real time and the simulation web site provided information and facilities to help students explore issues and plan their participation.

The overall response of students to this very different learning environment was unexpectedly varied. Problems with groups and difficulty feeling 'in role' made it less productive for some students, and the timing

of the project was the subject of frequent complaints. Yet in only a very few cases were these barriers sufficient to dampen enthusiasm or outweigh the benefits described by students.

Levels of involvement were extremely high, evidenced in all sorts of ways - from heated arguments on the school bus, or reassurances between friends after impassioned conference debates, to numbers of players who continued to log on to the site well after the simulation was finished. This is not to suggest that participation was easy. At times the challenge to existing ideas was difficult to deal with, particularly for those students who held strong views prior to the simulation.

Because I'm Jewish and I was playing Syria... when you went inside their views it gives a different perspective on the whole situation... I had never seen or even thought about other countries and what they are thinking..., another perspective, never thought about it before...

Overwhelmingly, interviewed students appreciated being able to direct the action themselves; having to weigh up ideas, think strategically and develop careful negotiating skills.

...it was great – not being checked all the time – do what you want in your character – you're in control of the character.

The project was time consuming, and the 'every night' commitment was problematic when other priorities were neglected. Several students described it as engrossing, addictive and themselves as 'becoming obsessed'. Strategies had to be developed by students to manage participation. Working to a team schedule, setting time limits and flexibly sharing the workload to accommodate other demands on team-members' time, were all used to deal with time pressures.

'Being the character' exerted a pressure to do the research and develop a deep understanding of the role being played. In order to take strategically consistent actions, students developed understandings of the range of characters, not just their own. The project shifted the emphasis from learning about events and consequences, to experiencing the processes of policy making, tactics and making difficult decisions at different levels of politics.

...there is like internal and external results of things – all the people who die, poor conditions and then the political side... thinking as the nation.... It's really hard to know which to do, because if you just go from the side of the civilians it's like giving up your nation's rights – like your beliefs ...

The conference day was characterised by strongly expressed positions, impassioned responses and heart-felt attempts to find solutions. The depth of knowledge and empathy with their character's position and outlook, developed through the online activities, allowed students to confidently argue their points and respond 'in character'. Students developed a strong sense of the complexity of the situation and reasons behind it, all the while maintaining a remarkable optimism.

Discussion of findings from the two cases

Variations on a theme

I have chosen to present accounts of these two online projects because they are so very different: in learning area, in nature of project approach, in technologies used and in age of participants. This selection of cases is not proposed as representative in any way nor do I want to suggest that they represent polar opposites or even points on a continuum. They do demonstrate the variation that exists in the range of projects that can conceivably be developed. There is value in exploring different settings, ages and learning area contexts as well as the different types of project on offer. Multiple cases assist in building a more extensive view of the attributes, value and difficulties that online projects offer.

What unites them (and the others in the study) is their existence as constructed learning environments. They are 'packaged' as complete units of work, offering complex, problem-solving challenges. They each do more than simply 'connecting' students in order to communicate per se. They reflect commonly described characteristics of project-based learning approaches (Katz, 2000; Moursund, 2002; Stepien & Gallagher, 1993; Thomas, 2000): being implemented as a central part of the class curriculum, promoting increased student autonomy, engaging students in constructive investigation around concepts of significance through realistic, non

school-like topics, tasks or challenges.

The experience of being part of these vibrant learning spaces is highly seductive - even second hand as I observed online the daily performances in the Middle East simulation and recorded the student's accounts of their experience. It would be easy to take away a glorified view of the project experience. The purpose of this paper is to make a more critical examination of the nature of the learning achieved and the role played by online presentation of the projects.

Reflecting on the learning experience

At the heart of each project is the expectation that students will develop disciplinary knowledge. In both cases the teachers' decisions to take part was dependent on the project providing a learning challenge that fitted their existing intentions, directly related to the required learning outcomes. Analysis of activities and work products provided substantial evidence for attainment of subject-based knowledge that clearly met the required course or syllabus outcomes. Teachers in both projects highlighted that the students did much more than simply reach these outcomes.

The history students themselves were keen to talk about their wider learning, highlighting an appreciation of both sides of the conflict as perhaps the most valuable outcome of their involvement. New depths of understanding of the complexity of issues were described, with an awareness of motivations and the different points of view that are inevitably present in any conflict. Building empathy with the ordinary, as well as not-so-ordinary people on both sides of the conflict was a surprising result for some. One girl described her realisation that "this isn't about countries - they were people" in terms of it being a revelation.

So it's like learning in 3D – because it's not just like this is this and this is that, it's like 'maybe' - and there is also this side – different ways of looking at it! (Student interview, Middle East simulation)

The most significant feature of both projects was the change in the way the learning was achieved. The projects set up learning spaces, physical and conceptual, that differed markedly from those usually encountered by the classes. Activity shifted from 'finding out' about events and consequences in a more traditional content driven approach, to one that required students to participate in the processes of investigating, making decisions and developing solutions. The range of outcomes was extended, providing a greater emphasis than usual on the learning processes of the respective disciplines.

... obviously we learnt about the conflict - but more. You know it's so easy to stand back and criticise the way that politics work. Everyone is so stubborn... it's so much harder to be so neat about it now – to criticise when you've been there... so I think it made us realise it's not that easy – these feelings have been held for years. You can't just change it

It was an experience, not just a lesson, or an essay... (Student interviews, Middle East simulation)

A major aim of the Middle East simulation (subsequently referred to as ME simulation) was to connect students' experiences to real events in the outside world; engaging them in the processes of international politics as well as historical inquiry. The simulation necessarily required students to 'find out' but with an increased depth of inquiry because they need to take action – they need to do something meaningful with the information.

In solving the *Murder* mystery, students engaged in an investigative process that required them to gather and share information, think carefully about relationships between pieces of data, make links and see casual relationships, and substantiate ideas through reference to data provided or information gathered. This represented a significant challenge to the students' usual ways of demonstrating learning and produced some of the greatest tensions in the project. Outside the project context, the students were (and are) most commonly required to locate and select information relevant to a question or topic, with repackaging of the information sufficing as a demonstration of learning. The messy process of looking for evidence and then testing it against established understandings and other information sources, was new and difficult for many students. The contribution, however, to achievement of learning processes outcomes of Science and Technology², particularly investigation, was a major benefit of the project.

Really useful learning problems are not easy to solve. Significance relies on the problem reflecting real world conditions: in these cases, being contentious, complicated by multiple viewpoints and vested interests. Both projects created learning environments, one online the other in the classroom, conducive to knowledge building: problematising the topics, relying on students to do the intellectual work, while supporting them in

learning how to do this (Engle & Conant, 2002).

Much more was demanded of students; they could not rely on information retrieval or simple, literal readings of reference materials. They were compelled to identify what they needed to know and the questions they needed to ask in order to be able make the next move toward the solution. The project structures supported the teachers in shifting cognitive responsibility to students (Scardamalia, 2002), changing their own roles and those of students. The ME simulation places all responsibility of the collective learning on the students. Teachers provided support only when specifically sought out by students, or in extreme, and rare instances where they need to intervene (although this was not required during the 2003 implementation). Such enhanced agency is particularly rare in senior secondary classes, where examination pressure often causes teachers to revert to highly transmissive pedagogies in order to 'cover the content', but where it might be most urgently required (Heath, 2003).

Not knowing 'the answer' was also particularly significant. It was critical to present an open-ended scenario, allowing students to work through the processes of decision making, negotiation and compromise without a predetermined solution available. To truly engage in the processes of diplomacy, the characters had to have options, make choices and take risks - and deal with the uncertainty of how others might respond.

In *Murder* the teacher remained a necessary part of the learning collective, taking a shared role, assisting regularly as needed. The difference in teacher role was again assisted by not knowing the answer. She was unable to shape the direction of the investigation, even inadvertently. Groups were held accountable for contributing to the success of the investigation and were required to make the knowledge generated available and accessible to the rest of the class. Hannah was more than a just a co-learner, being responsive to students cognitive and social learning needs. The more challenging nature of the task revealed skill gaps that had previously been hidden, exposing assumptions the teacher had made about individual and group competence.

...[needed to] plan lessons for the kids, for those that need them. The others can sort through but some need more directed activities to get them to be able to deal with it - some are suffering from info overload and are opting out. (Teacher comment during lesson observation)

In addition to scaffolding group operation Hannah realised she needed to provide targeted lessons, such as guided deconstructions of texts, modelling of question generation and even basic information skills.

The importance of group activity and the difficulties it presented strongly influenced the experiences of individuals in both projects. Worthwhile skills and strategies for working in groups were developed by many in the ME simulation, to manage workload and organise collective contributions. Where the groups worked well, they added to the building of understanding and confidence in the subject matter. The group helped individuals to work through challenging new ideas, to utilise or develop different strengths and specialised knowledge areas, and to collaborate in the construction of responses. These effects were reliant on the effective functioning of the group. Students were quick to point out when others 'could hide behind the group'. While the variation in contribution to the shared task was noted and reflected in the final assessments, there was little way of alleviating the added burden felt by those whose groups did not function well.

The amount of research required and the complexity of the information to be digested throughout the *Murder* investigation necessitated a division of labour and the pooling of ideas and knowledge acquired or created. It was clear that the class was not used to working in this way. Early on, some students openly discussed how hard it was, but equally how enjoyable they found it. Others were less enthusiastic, and because of the group work structure, they found it relatively easy to hang back, providing minimal input to group tasks and avoiding contribution to broader discussions. Over time a balancing effect was noticed. Students had to trust that information being provided by other groups was accurate, with the reciprocal effect of creating an imperative for groups to produce worthwhile contributions to the shared information pool. As the project progressed this process was taken more seriously. The pressure to make a contribution, in the knowledge that it might be the pivotal piece of information, resulted in a greater willingness to complete activities and share findings. Improved learning relationships involving trust in, and respect for other class members, developed during the project. For Hannah, the nagging doubt persisted, however, about how much had been achieved by a (small) number of class members.

Scardamalia and Bereiter (1991) remind us not to romanticise the idea of students as independent learners, acknowledging the role of authoritative sources of various types. The role that the projects played in supporting students in this way is also linked to ideas about authenticity.

Enhancing authenticity is a claim often made by advocates of ICT in learning, particularly online projects (Bransford, Brown, & Cocking, 2000; Donlan, 1998; GLOBE, 2004; Stepien & Gallagher, 1993).

While there is considerable diversity in the ways that authenticity is conceptualised in educational research, there was an underlying assumption on the part of teachers in the study that the projects themselves were 'authentic' or true to the situation they purport to represent, providing students with valid insights and understanding of the wider world.

As occurs in many online projects (Childnet International, 2002; CIESE, 1998-2001; Global SchoolNet, 2001) the ME simulation and *Murder* both offered students access to experts. Expert involvement, however, was not limited to answering individual questions. The projects gained authority by their very design, being developed by specialists in the field who ensured that 'the science was right' or that the 'likely if not real' scenario of the ME simulation was authentic to contemporary events. As one designer involved in *Murder* commented, "it may be fiction but it can never be fictional".

Students' construction of knowledge was guided throughout the *Murder* investigation via the progressive revelation of information, all of which was subsequently available on-demand on the web site. The questions posed by all participating teams were available to all as a further resource.

The university-based controllers in the ME simulation performed a dual function: providing direct responses to student-initiated questions, and endorsing proposed 'major' actions before they happened (offensive strikes, dismantling of a refugee camp). Their advice assisted students in understanding and interpreting their character's actions and reactions and helped them to think through alternative types of action they may take, without diminishing students' decision making ability.

Control's reply to a request from the CIA to leak a false report regarding the death of Sheikh Nasrallah, in the hope of driving people to the negotiating table:

George,

Put down the matches and the petrol... Attacks tend to move parties away from the negotiating table rather than towards it (thus the I-P peace process is constantly derailed by attacks) - you'll find that talks are most likely when both sides are exhausted by violence.

If you like, you can still mail Fox News and make up a false report, but it may be counter-productive... As Director of the CIA, you have vast resources and experience in force management so get out there and start managing these parties by improving security on all sides.

Teachers were enormously appreciative of the addition to their resource repertoire and valued highly the opportunity for their students to learn from external specialists. Students not only benefited from the direct input provided, but saw the involvement of real scientists and real academics as validating the work they were doing. They knew their learning mattered.

In both cases the projects were developed for school use through partnerships between the disciplinary experts (government departments and university academics) and educationalists. This also works as quality assurance for teachers considering embarking on a project-based activity. The ongoing partnerships have worked to make the projects more than one-off events, being open to an ever-expanding number of schools and classes and elevating them to a level beyond many of the information-sharing projects that dominate the online project landscape.

The two projects discussed here had particular strengths in adding authenticity in terms of processes and content. In the other cases in my study, those not elaborated in this paper, the tasks were not as reflective of real-world activities. However they provided a greater level of authenticity and value to students because of the audience for whom they were completed.

The audience for activity in both *Murder* and ME simulation was also extended beyond the class teacher. Participation in ME was assessed by the project controllers, as well as the class teachers, based on how 'true to character' students were in their interpretation of the scenario and the actions proposed. Working with another school added to the effectiveness of the simulation. Submitting the solution to the *Murder* mystery to 'Catchment Headquarters' provided an acute motivating effect and significant value to the learning. In both projects, students talked of connections made to their own interaction with and enhanced understanding of current events.

However, in neither of these situations did the activities and products of the projects have a real impact on events or people outside the class. This is the obvious limitation of simulations, which by definition are imitations of real events. But it may help to explain the disappointing participation on the second phase of *Murder*. For the majority of teams, including my case study class, the solution to the crime is the culminating

event of the project. The second phase involves the development of the catchment plan, that brings together the understanding students have developed through the investigation and asks that they put their knowledge into practice. Consistently, only around 10-15% of teams continue to phase two (Interview with project designer) despite the promotion of this as the most important aspect, deserving of the “highest honour” (Teachers’ Handbook, p.4).

How much of these effects were the result of the projects being presented online?

Examination of the impact of online presentation of the projects yielded some expected benefits, consistent with the experience in other web-based activities. Working in the online space created in the ME simulation increased participation of all students (Sherry & Bilig, 2002), access to expertise beyond the school and extended audience for student activity.

The motivating effects, so frequently attributed to online activities was of less intrinsic value than the other aspects of the project environments already discussed. For most students in the study computer use is not a novelty to be valued for its own sake. On the contrary, Hannah encountered continuing resistance by a few class members to the computer-based activities, that was barely altered by participation in the project. Once again the group work focus enabled students to opt out of this aspect of the tasks.

Even in the ME simulation, where most of the action took place online, the learning was not primarily about using the computers. For some it was the first time they’d really used e-mail, but this was rare. The online environment of the simulation was significant for several students who for the first time saw some purpose in computer use for school. Others were critical of the interface because of their extensive personal experiences.

While the projects certainly put the technologies to use in meaningful ways, they were not identified as significantly improving students’ computing skills, except in a few isolated cases. Rather, they shifted the role of the technology, making it secondary or ancillary to the purpose and intention of the learning. Presenting the projects online not only adds to the realism of the experience but extends students’ technology activities to higher order uses.

A strong message came from the teachers. Several were tentative computers users prior to implementing the project. The experience has demonstrated a more meaningful use of ICT in their classes and provided suggestions for new ways of working. While this doesn’t mean they are instant converts, they are now looking for other times, places and ways of creating similar learning spaces.

... it gave me another view on how to do it and how to use the Internet... I wouldn’t have done it that way, it wouldn’t have occurred to me. (Teacher interview – Murder Under the Microscope)

Unexpected effects also emerged, related to the unfolding of events, the learning supports provided through the project infrastructure, and the positioning of students that enhanced the authenticity of the task.

The murder-mystery metaphor of *Murder Under the Microscope* creates the drama and excitement of the project. The importance of the unknown result has already been discussed. The progressive unfolding of events was only possible through the delivery of the materials online and through the broadcasts. Daily and weekly inputs not only maintained the momentum of the investigation over several weeks, but also helped students cope with the amount and complexity of the information being provided. The ongoing availability of the accumulated materials allowed students to retrieve and review them as required. Even so, it seemed a little overwhelming at times.

...the fact that they added [ideas] as they learnt them means you’ve got to ask ‘Well where does that fit into this?’ So that forces them to make those links. (Teacher interview – Murder Under the Microscope)

It is in this way that online projects also differ significantly from other online activities. A partnership developed between the online component of the project and the necessary activities that took place in other spheres of the class’ work - both on and off computer. Student activities take centre stage; the construction of ideas takes place between students. The technologies themselves (the computer and the network) recede into the background of complex learning tasks, perhaps more so than in other styles of online activity.

The *Murder* project provided a wealth of support materials: appropriately pitched reference materials, formats for organising and presenting information and lists of web resources for students; planning and scheduling advice, suggested sequences of lessons, assessment formats for teachers. Support materials are intended to assist where and when needed. They are neither prescriptive nor exhaustive. They do however, provide much needed supports for teachers, elaborating possible implementation strategies and ways to manage

the knowledge building processes.

While the online interaction was the dominant function of the ME simulation, the final face-to-face meeting was highly valued by all involved. Again, the balance of virtual and real interaction was a major benefit of the experience. The depth of learning that occurred during the three weeks of online interaction prepared students for the often confronting task of arguing the points face-to-face.

I learnt it so well. I found when I finished - I don't know why that stuck... you've had all this lead up to it . You actually believe what you are saying. (Student interview, Middle East simulation)

It is certainly conceivable to suggest that the activity could have taken place entirely in a face-to-face classroom environment. However, being online added several significant dimensions. Shifting the major activity away from a face-to-face interaction increased students' ability to construct arguments in considered ways, working collaboratively to explore ideas, plan actions and respond to the initiatives of other characters, without being interrupted (Wills & Ip, 2002). An immediate comparison was possible.

...it let everyone get a say. In the conference you don't have time to search for that perfect word that would just fit in - it's hard to be articulate – in e-mails you can think about it... (Student interview, Middle East simulation)

Events unfolded on a daily basis, sustaining the momentum while maintaining the depth of responses. As for *Murder*, the online environment contributed to the pace of the action and interaction.

Working electronically, interactions between group members did not have to occur synchronously. The workload was frequently divided, with group members taking the load on different days, while maintaining shared responsibility through systems of individual drafting and group review, amendment or endorsement. The simulation environment provided a 'diary' area where character group members could privately communicate with each other. Not all groups made use of this, preferring to use instant messaging or the telephone, or even discussing and planning at school. The intensity of the project often led to combinations of these being used simultaneously. The project made it imperative that students plan and manage their participation, at the same time as providing support structures to do so.

In the ME simulation, involvement of another school was only made possible by working online. Students commented that this enhanced the realness of the situation, adding new perspectives and a greater range of ideas and unpredictable responses. As they did not know the others, they communicated entirely in role. Wills and Ip, (2002) suggest such anonymity makes participation more comfortable, especially for adult learners. For the school students being online also meant that existing relationships were minimised; the action was 'unable to be influenced' by existing friendships. Most importantly it added to the authenticity of the action; communication occurred between the 'characters' rather than friends and classmates.

It didn't feel like just talking to kids!

Conclusions

There is no revolution happening here and perhaps we should stop expecting one. I have learnt, as have the teachers in my study, that online projects have a deal to offer in creating authentic, problem-based learning experiences for students and in making effective use of online technologies, although not without sizeable concerns to be addressed.

Students were asked if they would recommend the project to others. An overwhelmingly positive response was tempered by similar issues identified by students in both projects: the amount of time it took away from other set tasks and the difficulty found by some in working in their allocated groups.

More experienced computer users in both age groups were most vocally critical of any online aspects that didn't measure up to their (outside school) experiences: the relatively limited 'flashiness' of the *Murder* graphics, 'cripplingly' slow speed of the simulation chat facility. This sets immediate challenges for schools, 'to be in the game' both in terms of quality of functionality and interface design that supports the purposes of the sites. This is not easy. We know that graphics, functions and interface design of recreational software are the result of a multi-billion dollar, cut-throat industry built on rapid updating and expanding repertoires of effects and features. It is impossible for the resource-poor education sector to keep up technically. Students' further comments were somewhat reassuring. They suggested that 'bells and whistles' are not critical, but reliable,

efficient function is, with a style of presentation that supports the purpose without attempting to be more than it is. The greatest criticism was of 'try hard' failures.

The teachers would all do it again, too... "but not all the time!" They acknowledged that the projects created a style of learning that is rewarding and adds tangible benefits to children: realism, purpose, authentic process and valuable content, emphasis on student knowledge building. But it requires a balance. Projects are time consuming (if not all-consuming) and have more than just the potential to take time away from other, equally important learning activities of the class.

Ways of resolving the tension between the time taken and the value gained, requires further investigation. Can we accept that the time it takes, is the time it takes and therefore is worth it? Or should the projects be scaled back so they more manageably become an 'ordinary' part of class activities. At what point in scaling is the value lost? Is it sufficient to implement projects only periodically, particularly if the models of changed pedagogy can be incorporated in teachers' design of other learning activities?

Teachers certainly did not want to have to create projects themselves. They have neither the time or expertise. Definite value lay in the projects being available for teachers to participate in, as convenient.

The continued existence (individually and collectively) of online projects relies on teachers and students finding the experiences useful, both in delivering learning benefits and providing support for changed pedagogy. The evidence from these two cases suggests that, with support, this can be achieved.

The study has significant implications for education systems in the design and implementation of online projects as part an effective online learning provision for schools. While they are enthusiastically implemented by teachers who value the student learning achieved and the support provided within the project environments, wider implementation remains sporadic, at best. Complex problem-solving projects require time and expertise to develop and maintain, far beyond the capacity of individuals or even groups of teachers to sustain. Both these issues suggest the increased need for systemic development and support for projects, particularly in partnership with other organisations. Yet in NSW and most other states of Australia, they remain the 'poor relation' of online activities: underfunded and outside priority e-learning development areas.

In this highly conflicted area of investment in ICT and the search for purposeful learning uses of the Internet, online projects present a teaching and learning approach that can deliver on some of the much-acclaimed potential – primarily because they promote changes in practice that are concerned with much more than just the technology.

¹The Middle East simulation, described later in this paper, was conducted predominantly in the virtual project environment. Student activity took place outside class time and locations included students' homes, the school library and other venues where Internet access was available. In place of direct observations, descriptions of the learning activity and students' perceptions were obtained through interviews with six groups of students (two from each of the three participating classes) at three points during the project, and diaries of participation completed by four volunteers, two from each school.

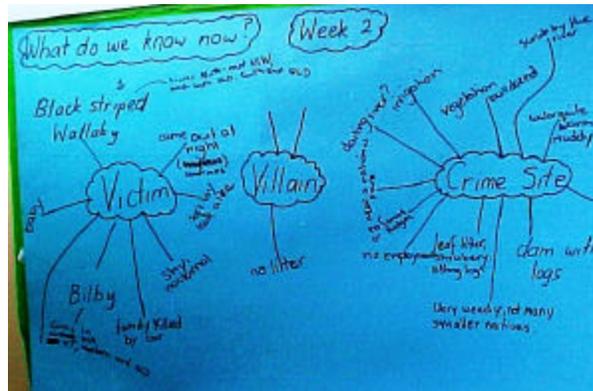
²The NSW primary curriculum brings science and technology subjects together in a single syllabus, *Science & Technology K-6*. The three learning processes of Investigating, Designing and making and Using technology underpin all learning in the area.

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Past Technologies, Practice and Applications: A Discussion on How the Major Developments in Instructional Technology in the 20th Century Affect the Following Qualities – Access, Efficiency, Effectiveness, and Humaneness

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Introduction

The Association for Educational Communications and Technology defines Instructional Technology as the “theory and practice of design, development, utilization, management, and evaluation of processes and resources for learning” (Seels & Richley, 1994). From the above definition, it can be seen that Instructional Technology can be considered in terms of the use of media (or resources) and the use of “systematic instructional design procedures” (Reiser, 2002, p. 28) that includes the processes such as design, development, utilization, management, and evaluation. For the purpose of this article, I shall refer the latter to *instructional design* for instructional purposes. I summarize the history of Instructional Technology in the 20th century using these two qualities – media and instructional design. Also included in this article is a discussion on how these two qualities affect the following four qualities of instructional technology: access, efficiency, effectiveness, and humaneness.

History of Media Developments in Instructional Technology

According to Clark (1996), there are five possible perspectives on media: (a) media as machines, (b) media as tutors, (c) media as socializing agents, (d) media as motivators for learning, and (e) media as mental tools for thinking and problem solving. For the purpose of this article, the first perspective is taken. Drawing upon Dale’s (1969) and Reiser’s (2002) work, I have classified the history of media in Instructional Technology into the following six main periods – Silent visual media, Audiovisual materials, Instructional television, Personal computers, Internet, and wireless tools.

Silent Visual Media

Media developments in instructional technology essentially began with silent visual media that were housed in school museums (Saettler, 1990). These silent media includes stereographs, slides, study prints, charts, and photographs (Saettler, 1968; Dale, 1969). With the advent of the motion picture projector, silent visual instructional films soon appeared in the educational landscape. In 1910, the public school system of Rochester, NY, became the first to adopt silent instructional films for instructional purposes (Reiser, 2002). That same year also saw the publication of the first catalog of instructional films (Reiser, 2001).

Audiovisual Materials

With the advent of media incorporating sound, the silent visual era soon gave way to what is known as the audiovisual instruction movement. As a result, sound incorporated motion pictures became a reality, which led to increased interest in the use of media to enhance learning. Dale (1969), for example, summarized twelve benefits of motion pictures, which include the ability to create reality or reveal the invisibility, compel attention, and promote an understanding of abstract relationships.

In the 1920s, the radio was invented, and soon it was used in carrying on various types of educational activities. Some of its characteristics that made it educationally valuable were its low cost, its ability to bring dramatic feeling into the classroom, and the fact that listening can foster imagination on the part of the listener (Dale, 1969).

Instructional Television

The advent of television soon followed in the 1950s. There was much interest in the use of instructional television then, so much so that by 1955, there were 17 instructional television channels in the U.S., and by 1960, had increased to more than 50 (Blakey, 1979). Distinguishing between the terms “educational television” and “instructional television”, Dale highlighted some major characteristics of the latter:

(a) instructor-guided, (b) systematic with objectives of the course and planned learning experiences, (c) ordered and sequential, and (d) integrated to other learning experiences such as practice, reading, laboratory, and writing. Central to the great interest in the use of instructional television was the belief that this particular medium has the potential to bring demonstrations to the classroom, handles films and other changes from straight classroom presentation with a minimum of transitional difficulty, concentrates attention, and provides a change of pace, often a lift, for the classroom (Schramm cited in Da le, 1969, p. 356).

The interest, however, did not prevail long and by mid-1960s it had abated (Reiser, 2001) due to reasons such as the inability of television alone to adequately present the various conditions necessary for student learning (Tyler, 1975).

Personal Computers

The next media to grab the attention of educators was the personal computer in the 1980s. The use of personal computers for instructional purposes has since increased and by 2003, virtually all U.S. schools have some personal computers and the most recent ratio of students to computers was fewer than four to one (Market Data Retrieval, 2003).

Internet

The explosion of the Internet and world-wide web (WWW) soon followed in the wake of the advent of personal computers. In 1991, Tim Berners-Lee completed the original software for the WWW, the hypertext system he had first proposed in 1989. He had envisioned the WWW as a shared information space, a web of hypertext documents, within which people can communicate with each other and with computers (Moschovitis, Poole, Schuyler, & Senft, 1999). The use of the Internet and WWW is now ubiquitous, with 98% of U.S public schools already connected to the Internet in Fall 2001 (Cattagni & Farris, 2001). The student-per-Internet-connected computer ratio was now 4.3:1 (Education Week, cited in Molenda & Bichelmeyer, in press).

Wireless Tools

Currently, the use of wireless tools such as pocket PCs or personal digital assistants (PDA) is increasingly widespread within K-12 and higher education. According to Park and Staresina (2004), about 8% of schools nationwide provide PDAs for their teachers and 4% provide them for their students. For teachers, the PDAs are useful for lesson preparation and classroom management, such as taking attendance. For students, the PDAs are used as digital readers and graphing calculators, for word processing, and other specific instructional activities such as concept mapping (ISTE, cited in Molenda & Bichelmeyer, in press).

Effects of the Major Media Developments on Access, Efficiency, Effectiveness and Humaneness

One very interesting recurrent pattern can be seen throughout the development of media for instructional purposes, which is the comparison between the anticipated and real effect of media on instructional practices (Reiser, 2001). From Thomas Edison's 1913 famous prediction that films will replace every other media, or the advent of computer instructional programs to the hype created every time a new instructional media is discovered, expectations have been usually greater than outcomes. Many of the media research studies show that students learn equally and effectively well regardless of the types of media used (Clark, 1994; Russell, 1999), leading some researchers to believe that it is the instructional methods rather than media that can influence the effectiveness of student learning (Clark, 1994).

It seems then that the effects of media *per se* on instructional technology are geared more towards the access, efficiency, and humaneness rather than the effectiveness aspect. Media helps increase access to learning by giving students opportunities that never existed before. The use of the Internet and teleconferencing, for example, enables students to sign up for courses from virtually all sorts of geographical locations. Students from far-flung, hard-to-reach places can now have easy access to learning. So do students who have physical disabilities that rendered them immobile.

Closely related to the idea of access is efficiency, which can include concepts such as cost efficiency, time efficiency, energy efficiency, and "delivery-of-information" efficiency. The use of the Internet is a good example of "delivery-of-information" efficiency because information can now be easily structured and presented to many learners at one time. It is also cost efficient to design and develop courses over the Internet because as the number of students taking an online course increased, the development costs were spread across a large student body, making the development cost per student low (Shearer, 2003). Meanwhile, the use of

management tools such as WebCT, and BlackBoard allows instructors a greater degree of flexibility and ease in terms of updating and revising courses (Shearer, 2003). This has brought about time and energy efficiency for the instructors.

The development of certain media has also improved the humaneness aspect by providing rich sensory experiences and individualized learning to students. Television and computers, for example, provide students with vivid three-dimensional images that may help them remember information better, than printed materials can.

Major Instructional Design Developments in Instructional Technology

Besides the major media developments, there were also major instructional design developments that shaped the field of instructional technology. Many authors have classified these instructional design developments into various categories; these have typically been done in more or less a chronological fashion (e.g. Reiser, 2001, 2002). In this article, however, I chose to succinctly divide the periods of instructional design developments in terms of its design paradigms, ontological, and epistemological perspectives drawing mainly upon the work of Wilson (1997, 2004), Driscoll (2000), and Mertens (1998); yielding the following three categories – (a) behaviorist paradigm, (b) conditions-of-learning paradigm, and (c) constructivist paradigm. I decided to do this because I felt that such a move would better capture the real essence of instructional design developments compared to a chronological method *per se*. Table 1 shows these paradigms as well as the ontological and epistemological perspectives associated with them.

| Design paradigm | Ontological perspective | Epistemological perspective |
|---------------------------------|--|----------------------------------|
| Behaviorist paradigm | Positivism | Objectivism |
| Conditions-of-learning paradigm | Positivism | Objectivism |
| Constructivism | Interpretivism and sometimes Postmodernism | Contextualism/situated knowledge |

Table 1. *Design paradigm, ontological and epistemological perspectives*

Behaviorist paradigm

One of the major concepts that appeared in the 1910s was the claim by John Watson that human and animal behaviors were the *only* legitimate areas of study for psychologists. This signaled the birth of behaviorism as an approach to psychology and learning that emphasizes observable and measurable behavior but ignores mental processes. Watson’s idea was in essence a “descriptive S-R psychology whose goal was to predict and/or control behavior” (Saettler, 1990, p. 287). Edward Thorndike soon followed with his theory of connectionism, which is a descriptive learning theory made up of three laws – the law of effect, the law of exercise, and the law of readiness. These laws are founded on the stimulus-response notion – “a neutral bond would be established between the stimulus and the response when a particular stimulus produced a satisfying response with a given environment” (Saettler, 1990, p. 55). Learning takes place when these bonds formed into patterns of behavior. Building on Thorndike’s and Watson’s ideas, B. F. Skinner came up with the theory of operant conditioning, which basically states that “if the occurrence of an operant is followed by presentation of a reinforcing stimulus, the strength probability is increased” (Saettler, 1990, p. 71). This led to a science of instruction with systematic methods of modifying behaviors, and determining the types of response patterns associated with different reinforcement schedules (Ferster & Skinner, 1957).

Central to the behaviorist paradigm is the notion of using experimental approaches in the study of learning. The works of Hermann Ebbinghaus Edward Thorndike, and Ivan Pavlov, for instance, bore testimony to it. This notion of using experimental approaches as a method of study resonates with the positivist ontological perspective. According to Mertens (1998), the underlying assumptions of positivism include the belief that the social world can be analyzed in the same way as the natural way, that there is a technique for studying the social world which is value-free, and that explanations of a causal nature can be given. In positivist thinking, objectivity is important, whereby the researcher simply manipulates and observes in a dispassionate manner.

Conditions-of-learning paradigm

B. F. Skinner’s behaviorism work on contingencies of reinforcement and programmed instruction was the antecedent to the next paradigm- the conditions-of-learning. As noted clearly by Wilson (2004):

In the days of programmed instruction, researchers held to a few general principles of learning, based on behavioral psychology, which were thought to apply universally to all settings and

organisms. Results of programmed instruction, however, showed that some strategies worked better than others, depending on conditions. This led Lumsdaine (cited in Wilson, 2004) and others to articulate a vision for an emerging science of instruction: through factorial experiments, instructional scientists would develop a sophisticated series of rules, sub-rules, and meta-rules for employing instructional strategies to teach different kinds of content in different settings.

The belief that certain strategies would be more appropriate for certain context led to the notion of the conditions-of-learning paradigm. In essence, this paradigm posits that there exists a hierarchy of learning outcomes, and for each desired outcome, there exists a set of conditions which leads to learning (Wilson, 1997). Some of the noted authors and thinkers of this paradigm include Benjamin Bloom (who developed the taxonomy of educational objectives for the cognitive domain), Robert Gagne (who introduced five domains of learning and the conditions necessary for each of them, as well as the nine events of instruction to promote the attainment of any type of learning outcome), and Charles Reigeluth (who discussed the various conditions in his Green books).

In addition to the belief of a rule set that links conditions, instructional methods, and learning outcomes, there were two other important ideas that emerged during this paradigm: (a) the systems approach in instructional design, and (b) the cognitive information-processing theory. In the systems approach, the design of instruction is divided into small manageable components or procedures, where the output of one procedure becomes the input of the next one. A good example would be the ADDIE systems approach which is made up of five procedures: Analysis, Design, Development, Implementation, and Evaluation. The design of instruction proceeds more or less in a linear fashion, beginning with the Analysis phase, and ending with Evaluation. The burgeoning interest in the systems approach spawned many instructional design models (e.g. the Dick & Carey's, 1978), as well as methodologies and concepts (e.g. Mager's 1962 behavioral objectives, Glaser's 1963 criterion-referenced testing, and Scriven's 1967 formative evaluation).

The second important emerging idea in this paradigm was the cognitive information-processing theory which posits that information is transformed as it passes through three main stages of memory: sensory memory, short-term memory, and long-term memory (Atkinson & Shiffrin, 1968). As this idea gained acceptance and popularity, many researchers began to incorporate it in their studies. One of the most notable works based on the cognitive information-processing theory is the nine events of instruction, developed by Robert Gagne.

The conditions-of-learning paradigm also appeared to resonate with the positivist ontological perspective. This is because many researchers in this period still used the experimental design as the main research tool in trying to isolate instructional methods most appropriate for certain contexts. As noted by Driscoll (2000), both Skinnerian Behaviorism, and Gagne's instructional theory rest on objectivist assumptions.

Constructivist paradigm

Constructivism, which states that learning is a process of knowledge construction, rather than acquisition, began to rise in prominence beginning in the early 90s. Duffy and Cunningham (1996) postulated that some of the assumptions that are adopted by constructivists include the following: (1) all knowledge is constructed (i.e., learners construct understanding of the world for themselves (Winn, 2003)), (2) many world views can be constructed, hence there will be multiple perspectives, (3) knowledge is context dependent, thus learning should occur in contexts to which it is relevant, (4) learning is mediated by tools and signs, (5) learning is an inherently social-dialogical activity, (6) learners are distributed, multidimensional participants in a socio-cultural process, and (7) knowing how we know (reflexivity) is the ultimate human accomplishment.

In contrast to the previous conditions-of-learning paradigm which is based on a reductionist view (e.g. the use of task analysis to decompose a subject into various sub-subjects according to its learning outcomes; then instruction is ordered from simple to complex), the constructivist paradigm celebrates complex, authentic tasks that are not broken into smaller components. It emphasizes the creation of rich learning environments and the use of scaffolding to help learners gain the knowledge and skills of a practitioner.

The constructivist paradigm is most aligned with the interpretive ontological perspective. According to Mertens (1998), the basic assumptions guiding the interpretive ontological position are that knowledge is socially constructed by people, and that perceptions of reality may change throughout the process of study. It rejects the notion of objectivism. Constructivism is also consistent with the postmodern perspective. Although I agree with Wilson's (1997) observation that not all constructivists are postmodern in their orientation, I would, however, argue that *most* of the concepts of constructivism appear to be founded on the key ideas of postmodernism. For example, postmodernism posits that knowledge is constructed by people, reality is multiperspectival, and thinking is an interpretive act (Wilson, 1997). These key ideas are congruent with

those held by constructivists.

Effects of the Major Instructional Design Paradigms on Access, Efficiency, Effectiveness and Humaneness

I believe the developments of the major instructional design paradigms primarily influenced the effectiveness and humaneness aspects of instructional technology. For example, design concepts based on the behaviorist, conditions-of-learning, and constructivism paradigms all strive to improve the effectiveness of instruction, with each camp advocating its own advantages, sometimes to unproductive arguments. Nonetheless, there has been a consensus in recent years among educators that the design concepts based on different paradigm each has its own place and value best effective for certain types of learning outcomes such as:

For *discrimination* (recalling facts), *generalizations* (defining and illustrating concepts), *associations* (applying explanations), and *chaining* (automatically performing a specified procedure) types of learning outcome, design concepts based on the behaviorist paradigm would be a good choice (Ertmer & Newby, 1993).

For *advanced knowledge acquisition* and *problem-solving in ill-structured domains* types of learning, design concepts based on the constructivist paradigm would work best (Jonassen, 1991).

However, in terms of humane benefits, there are certain design concepts that lend themselves better than others in providing rich authentic experiences. Design concepts associated with constructivist paradigm, which require learners to solve realistic problems, and take ownership of the learning process (Driscoll, 2000), is a good example.

Summary

There have been many developments both in the media and design process aspects of instructional technology in the 20th century. These have in turn affected each of the four instructional technology qualities: access, efficiency, effectiveness, and humaneness. The developments of film, radio, television, and computers in the have each increased the access, efficiency, and humaneness aspects. I believe that media *per se*, however, do not directly affect the effectiveness of learning because it is the method or process that determines it. Design concepts such as behaviorist paradigm, conditions of learning, as well as constructivism, have also affected the effectiveness and humaneness of instructional technology through the provision of rich experiences and individualized learning for students.

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Igniting the SPARK: Supporting the Technology Needs of Online Learners

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Abstract

Students taking hybrid or online classes are often unprepared for the kinds of skills that are needed to be successful in this environment. This report provides an overview of one approach, an interactive CD-ROM (SPARK), that faculty can use to assist students in narrowing the gap between needed online learning skills and their current technical knowledge.

Igniting the SPARK: Supporting the Technology Needs of Online Learners

The popularity of online learning continues to transform the educational landscape. As more faculty redesign courses to meet the demands of education in the 21st Century, some students can be left behind. Students who have not used information technology in previous school experiences and those who are returning to school after a long hiatus from higher education are of particular concern. Even those students who consider themselves to be technically proficient may have developed bad habits over the years that create barriers for them in the online context. Faculty should recognize this potential “digital divide” and assure their students have the tools they need to be successful in online learning experiences.

Online courses suffer from high attrition rates. A possible explanation is that students are not adequately prepared. According to Rowntree (1995), one of the key skills areas that students identify as requiring a “steep learning curve” for online learning includes computing skills (p. 212). The Student Preparation and Resource Kit (SPARK) was created to address gaps in knowledge between needed online learning skills and students’ knowledge deficits. SPARK has been piloted with two groups of nursing students: 19 undergraduates and 18 graduate students. Following is a description of SPARK, related definitions, a brief review of usability literature and a report of student evaluations of the CD-ROM.

Description of SPARK

SPARK was created through a partnership of the College of Nursing and MediaKube, LLC, a digital solutions provider and funded by the Arizona Regents University. The CD-ROM was planned to be easy to navigate, entertaining, and conversational. The decision to use this instructional style had two positive implications. First, students who considered themselves computer novices would be more likely to retain information presented in a non-threatening manner. Second, students who felt they already were familiar with the material would be enticed to explore the content for the entertainment value.

A significant challenge was that the program had to effectively present items of a technical nature in a way that was not daunting for the user. Wherever possible, real-world analogies were used to relate terminology to something with which the student was likely to be familiar. For example, a flatbed scanner is compared to a traditional copy machine with the noted exception that the scanner output is sent to a computer via a digital signal instead of printed onto a piece of paper. Humor was injected throughout to make the content less intimidating and to facilitate the description of complex subjects. Remediation for wrong answers was provided in a helpful and friendly manner. The scripting allows students to repeat a question just to find out how the software reacts to the wrong answers. Learning why an answer is wrong can often be more educational than simply knowing the correct response.

SPARK is an appealing visual experience with plenty of motion and imagery. This delivery style helps direct the immediate attention of the student, while at the same time giving them a mental image to recall at a

later date when they need to apply the information they have learned. Where appropriate, animated simulations demonstrate the appropriate steps in a particular task prior to requiring the user to perform the task.

For ease of use, SPARK is configured to launch automatically when the CD is inserted into a PC. The navigation in SPARK is designed to be as unobtrusive as possible, while still providing a substantial degree of control for the student. The replay and skip buttons allow the student to quickly maneuver within a topic, while a click of the map button offers them a hierarchical view of the entire content tree. The student can navigate to any other program topic with just three or four clicks.

SPARK Configuration and Navigation

The program begins with an animated series of credits and title screens. The voice-over narrator starts by asking, “Is this the first time you’ve sat down to go through this CD or have we already met?”. A click of *button A* “*First time for me.*” takes the user through a full introductory sequence, while clicking *button B* “*We’ve already met.*” directs them directly to the SPARK Topic Map. Similar branching occurs throughout much of the introductory section of the program for each main topic. The Topic Map displays the main categories of information followed by a layer of main topics. Below the main level is a set of sub-topics for each major category. The following table shows the overall layout of SPARK.

Table 1. *SPARK Category and Topic Layout*

| Categories | Main Topics |
|-----------------|---|
| Hardware | Introduction, CPU, Memory, Storage, Input, Output, Connectivity |
| Software | Introduction, OS Software, Applications, Viruses |
| Internet | Networks, LAN vs. WAN, World Wide Web |
| Skills | Keyboard Shortcuts, File Formats, Using Adobe Reader, Using a Web Browser, Sending Email, Searching, Downloading, File Management |
| Navigation Help | A detailed explanation of each navigation button and feature is displayed on the Topic Map screen. |

Definitions and Usability Literature

The following definitions are provided to clarify the meaning of various terms used in this study:

1. *Multimedia is the convergence of computers with motion, sound, graphics, and text (Azarmsa, 1996, p. 2).*
2. *Hypertext is the presentation of information as a linked network of nodes which readers are free to navigate in a non-linear fashion (Keep, McLaughlin, & Parmar, 1993-2000).*
3. *Hypermedia is a special case of hypertext that employs multimedia and describes linked information presentations that contain many forms of media (Azarmsa, 1996) that include sound, video, and so on (Keep et al., 1993-2000).*
4. *Hyperlinks are the connections among units of information (nodes) in hypermedia. This arrangement can be described as a three-dimensional web of information (Dede & Palumbo, 1991, pp. 2-3).*
5. Computer literacy level refers to the ease with which a learner is able to operate the system controlling the hypermedia program. For example, a person with a low level of computer literacy may need assistance operating the mouse or keyboard commands necessary to navigate within the program.

Hypermedia Usability

The term “hypermedia usability” refers to the ability to use a piece of hypermedia software for the intended audience. It pertains to the ease with which a learner can perform a specific search task for a particular piece of information. “Usability is the combination of fitness for purpose, ease of use, and ease of learning that makes a product effective” (Kushner, 2003). Usability has been applied to ‘the Web’ (the Internet) for a number of years; however, it is not specific to ‘the Web’. “Since the early 1980s....researchers have been investigating the usability and usefulness of hypermedia across a wide spectrum of domains” (Buckingham-Shum, 1996, pp. 1-2).

Two main factors influence usability: content and design. Critchfield (1998) asserted that a well-designed website appears more credible regardless of the information provided. The usability of instructional multimedia (hypermedia) is vital for the success and satisfaction of its users because confusion resulting from poorly designed programs can be detrimental to learning performance.

The process of assessing and evaluating online content is subjective and internal (Krug, 2000). Several

approaches for expert-based evaluation of usability have been proposed over the past few years. According to Dimitrova, Sharp, and Wilson (2001) there is little evidence in the literature regarding the effectiveness of these approaches. Although expert evaluators are somewhat successful predicting usability problems, they still have difficulties identifying certain types of learner problems such as comprehension. Expert evaluations do not eliminate the need for tests with actual learners. To that end, an evaluation by the end-user was deemed appropriate.

Pilot Study and Evaluation

SPARK was piloted at Arizona State University's College of Nursing in the fall of 2004. The CD-ROM containing SPARK was distributed to nineteen members of an accelerated RN to BSN program and eighteen members of a graduate level neonatal nursing program. All participants were allowed to keep the CD for their future use. Undergraduate participants received extra credit in their course; graduate students volunteered to complete the evaluation survey. The students were shown how to launch the CD in class and then asked to take it home to review it on their own time. They returned evaluation data via a seven-item survey (described below) the following week.

Evaluation data were collected using a six item survey addressing level of confidence after viewing SPARK, its pace, ease of use, ability to keep participants' attention, newness of material, and its usefulness. Participants ranked their responses to each of these questions on a five-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree". A comment area was provided for each question. Finally, participants were asked what else should be included in SPARK as well as how long it took them to review the CD.

Results of Evaluation

An analysis of the data was used to determine what improvements and modifications should be made to the program. 100% of students from the undergraduate class and 51% from the graduate class responded to the survey. Means were calculated for responses to the Likert-type scale items; qualitative data were analyzed for themes.

Table 2. SPARK Survey Items and Comparison of Means between Undergraduate and Graduate Students

| Item | Undergraduate | Graduate | Overall |
|--|---------------|----------|---------|
| | Mean | Mean | Mean |
| SPARK was easy to use. | 4.53 | 4.89 | 4.70 |
| The topics covered in SPARK were new to me. | 3.11 | 2.50 | 2.81 |
| The topics covered in SPARK were useful to me. | 4.11 | 3.77 | 3.95 |
| How (narration, self-paced units) topics were covered in SPARK kept my attention. | 3.84 | 3.94 | 3.89 |
| The pace in which topics were covered in SPARK was just right. | 3.63 | 3.94 | 3.78 |
| I feel more confident about my computer skills after using SPARK. | 3.58 | 3.61 | 3.59 |
| How much time did it take for you to review the materials of interest to you? (time in minutes). | 45.79 | 29.64 | 38.94 |

Note. Undergraduate ($n = 19$), Graduate ($n = 18$)

Response scale (1 = Strongly Disagree, 5 = Strongly Agree)

Comments were analyzed for further insights into participants' experience with SPARK. However, comments tended to mirror each groups' rating of the evaluation items. Of the ten comments provided by graduate students, three students felt that the pace of the program was too slow to meet their needs and two students indicated that only some of the content was new to them. The undergraduate students provided many more comments ($n = 86$) and were more positive in their evaluation. The two most frequent comments had to do with ease of use ($n = 6$) and enhancement of current knowledge ($n = 6$). Five comments indicated that not all of the content was new to the student. However, it appeared that SPARK was able to either reinforce information that students were unsure about or that it corrected misinformation.

The amount of time spent in SPARK by undergraduate students as compared to graduate students was significantly higher. Several circumstances may account for the difference. The undergraduate students were taking a class from one of the investigators (Hrabe); they also received extra credit for taking the time to

complete an online survey. The graduate students completed a paper and pencil survey voluntarily (i.e., no extra credit) and the investigators were unknown to this group. The positive evaluations could also reflect participants' gratitude for receiving a free copy of a CD and faculty concern for the students' success in school.

Discussion and Summary

Overall, data suggest a positive experience with SPARK. Ratings indicate that students' felt the CD was easy to use, kept their attention and enhanced their confidence in learning the skills necessary to navigate online courses. While the lowest rankings indicated that much of the content was not new to the participants, having the information readily available helped to refresh and reinforce what they already knew and increased their confidence.

Using SPARK or similar approaches highlights the importance of helping students acquire the technical expertise they need to be successful in hybrid or totally online courses. These endeavors should assist faculty in narrowing the gap between the skills students bring versus those they need. Future work will focus on improving assessment of skill and matching results to targeted remediation.

Table 3. Selected Screens from SPARK, copyright and patent pending 2004.

Figure 1.

SPARK Title Screen

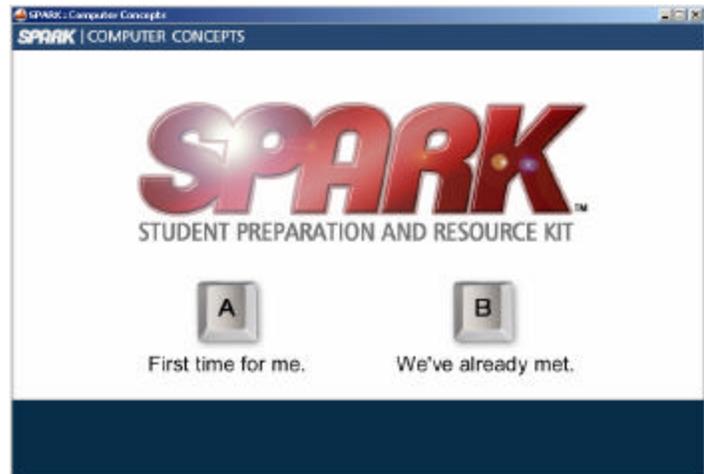


Figure 2.

Introductory screen asks user to rate his or her computer skills. Narrated voice-over feedback is individualized according to response.

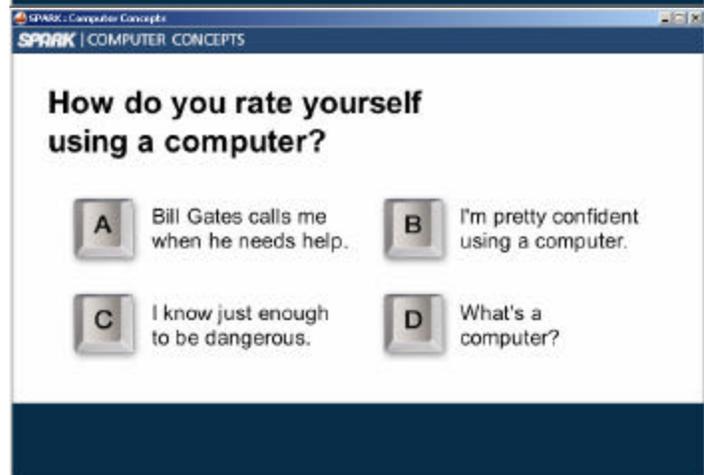


Figure 3.

Program Navigation Instructions includes voice-over narration.

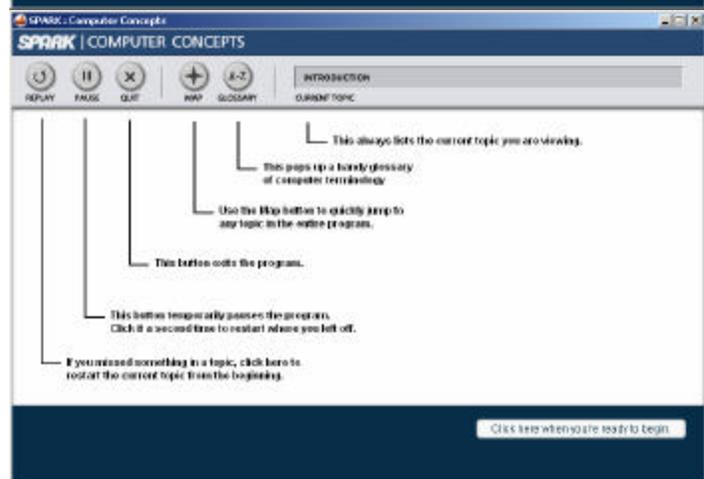


Figure 4.

SPARK Topic Map allows random navigation to any topic or sub-topic.

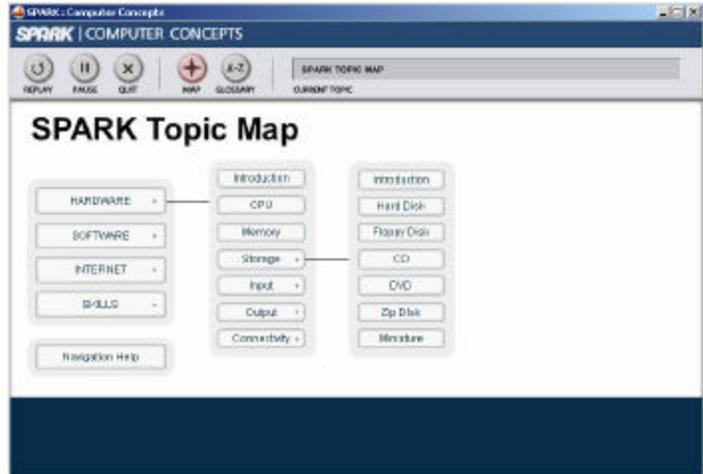
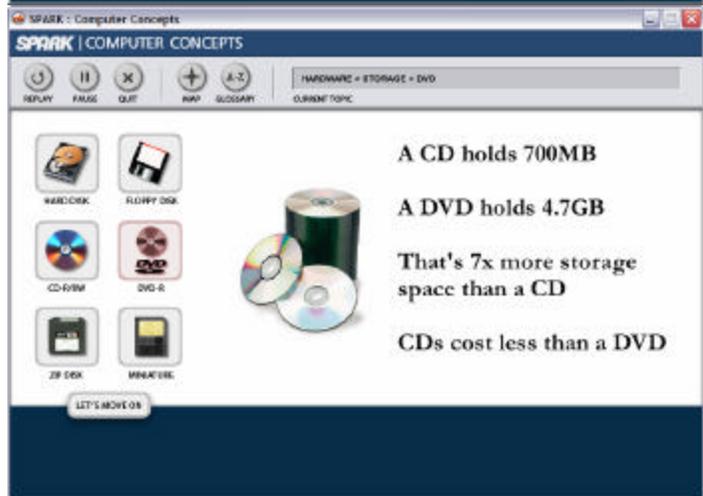


Figure 5.

This instruction screen from the Hardware category is about DVD storage capacity versus CD capacity. Additional sub-topics are offered on the left.



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It Is More about Telling Interesting Stories: Use Explicit Hints in Storytelling to Help College Students Solve Ill-defined Problems

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Abstract

A team consisting of three faculty members from Agricultural Economics, Agribusiness management, and Food Science with two research assistants at Penn State University has been working for three years on creating a food product case library for a problem-based learning and case-based instruction course. With the assistance of experts from the food manufacturing and retailing industries we collected approximately 110 stories related to food product development. These stories were organized and stored into a database (a Case Library) for faculty and students to use in a case-based instruction course.

An earlier research study conducted by our team members found evidence that a Case Library with stories did affect students' decisions of making multiple-choice tests concerning ill structured problems (Hernandez-Serrano, 2001). Then, we encountered that students had difficulty making on-point connections between stories and target problems at hand. Our goal is to help learners better understand the stories while enhancing their abilities to make analogies. This has raised the following questions: What should we do to achieve this goal? What kind of story-indexing strategies will help students understand the stories better? Will surface level indices (such as company name, product category, product name, and development process) help students recall similar features easier? Will a deeper level of indices (such as theme, goal, plan, results, and lesson) help students understand the stories better?

Problem Statement and Research Question

Given the importance of ill-structured/ill-defined problem solving in the workplace, instructional materials and activities should be situated in a contextual learning environment. An ill-structured problem may lack a clear initial state, a set of permissible operators, or a clear goal state (Chi & Glaser, 1985). In addition, there are no absolute correct answers, so this type of problem lends itself to multiple viable solutions making it difficult to teach students how to solve ill-structured problems. Research has shown that stories are more memorable, promote elaboration to personal experiences, and help in solving ill-structured problems (Swap, Leonard, Shields, and Abrams, 2001; Hernandez-Serrano, et al. 2002). However, research has not shown whether academic achievement of solving ill-structured problems is improved by using stories with pre-generated story indices developed by experts in the representative field.

Based on the research purpose stated above, answers to the following questions are sought:

- Q₁: What are the effects of using different story-indexing strategies within a Case Library on college students' (novice learners') ability to solve ill-structured problems?
- Q₂: How do novice learners make analogies between stories and targeted problems when they solve ill-structured problems? What processes are used when novice learners read, encode, retrieve, and adapt the source stories to the targeted problems?
- Q₃: How do pre-selected indices help novice learners see similar features between the stories and the targeted problems?

Literature Review

Problem Solving: Experts classify/ index problems differently from novices

Chi & Glaser (1985) describe two factors influencing people's problem solving abilities: *the kind of knowledge brought to the problem by the solver* and *the nature of the task*. The knowledge brought to the problem by the solvers varies depending on the amount of their knowledge of specific domain content.

Identifying differences between experts and novices offers a key to understanding problem solving processes. Some studies show that novices tend to classify problems by their *surface structure*, focusing on the

words or subjects that are prominent in the problem statements; some studies indicate that experts appear to base their perceptions of problem relatedness upon problems' *deep structure*.

Case-based Reasoning and Story Index

The application of storytelling to problem-solving skill is supported by case-based reasoning (CBR), a learning theory focused on analogy in the context of solving real-world problems "... by encoding, retrieval, and adaptation in analogical reasoning process (Kolodner, 1997, p.57)." Suggested by CBR, a Case Library is built to provide the resources of cases by collecting stories from experts. A Case Library is a systematic collection and organization of a number of experts' experiences presented in the form of stories to the learner as they interact with a task environment (Edelson, 1993). See Figure 1 for an example of the Food Product Case Library.

Indexing is the process of assigning labels to stories based on specific rules or interpretations when putting stories into a Case Library (Kolodner 1993). Indexing consists of "labeling" an experience with the appropriate "title" and then "filing" it in the right place in memory, which is the process of organizing experiences so that people know where they can find relevant information when needed (Schank, Berman, and Macpherson, 1999).

Figure 1: Food Product Case Library

Verdelli - Defining the Idea and Concept
Hi, daisy

[Defining the Idea and Concept](#)
[The Market](#)
[Organizing for Product Development](#)
[Raw Material Supply](#)
[Research and Development](#)
[Quality Assurance](#)
[Processing](#)

A New Opportunity - Defining the Idea and Concept

In the early 80's, Giant Food, a regional supermarket chain, commissioned surveys and focus groups that revealed a demand for home meal replacement items in their produce departments. As a result, they introduced a vegetable platter prepared in-store that was marketed as a holiday item.

In the early 90's, they began to look for similar alternatives in the fruit category. Concomitantly, supermarkets were seeking ways to market fruit that was damaged or overripe. As a way to salvage the bruised fruit and satisfy consumer demand, the stores began peeling and cutting the fruit, putting it in deli cups and selling it within 24 hours. At the time fruit cups retailed for \$1.50

Records 1 to 2 of 2

[Previous](#) [Next](#)

Performing the Symphony
[View](#)

Coca-Cola's Share of the Stomach
[View](#)

Explicit Story Indices and Problem Solving

Novices lack experience to draw on; even if they do have experience, they may have difficulties using these experiences well because they lack a good understanding of how to encode their experiences, are unable to make retrieval at appropriate times, and cannot reuse experiences (Kolodner, 1997). In contrast to novices, experts have many experiences in their areas of expertise stored in their "library" of memory, and they can retrieve the right story to solve new problems (Schank, Berman, and Macpherson, 1999). An expert is someone who has a great many stories to tell in one particular area of knowledge and who has those stories indexed well enough to find the right one at the right time (Schank, 1995). Schank (1995) tried three different methods of extracting stories from an expert who proved to be a repository of stories about various episodes in military history. He can see military stories in a variety of different ways because he has created for himself a set of complex indices about military history.

In the experimental study of Gick and Holyoak (1980, 1983) and Holyoak (1990), college students were asked to use the fortress problem to help solve an ill-defined radiation problem. The desired goal of the radiation problem is specified at an abstract level and the strategies used to achieve the goal are open ended.

Without the fortress problem as source analog, very few students proposed the idea of using low intensity rays. For those who received fortress problems as a resource analogy, they performed differently in generating solutions. When a hint to use the story is provided, most of the students came up with the idea of using convergent low intensity rays; when students are not told to apply the prior fortress story to help solve the radiation problem, their transfer performance of generating analogous solutions declined. Why did most of the subjects fail to notice the relevance of a story analogy to a target problem? It was concluded that the difficulty may be related to the problem of identifying the optimal level of abstraction for representing the similar features.

Novices without enough domain knowledge and cases stored in memory only see the surface features when asked to solve problems and interpret problems but experts classify problems by principles and specific rules. How do we gather and organize expert stories to help novices learn? The application of storytelling to problem-solving skills is supported by case-based reasoning (CBR) and a Case Library is built to provide the resources of cases by collecting stories from experts.

If using cases as a resource analogy is such a natural and efficient way to help novice learners understand problem situations and propose solutions, how do we help novice learners see the relevance? How do we help them see more than surface features?

Our hypothesis is that using stories collected from experts and indexing them by deeper features/thematic features can make these connections explicit for novice learners.

Method

This research is a mixed-method design with a quantitative design (control, comparable, and experimental group) and a qualitative design (think-aloud protocol). The different treatments for the three groups are listed below.

1. Control group: stories are not indexed with any labels or hints.
2. Comparable group: stories are indexed with surface indices (factual information, such as the name of the product, the name of the company, the category of the product, and the process of the product development).
3. Experimental group: stories are indexed with belief-based indices according to Schank's (1990). Belief-based indices include theme, goal, plan, result, and lesson.

See Figure 2 for an example of story with surface indices and Figure 3 for an example of story with thematic indices.

Figure 2: Story with surface indices

| | |
|-------------------------|-------------------------------|
| Company | PepsiCo |
| Product Category | Beverage |
| Product Name | AquaFina |
| Processes | Generate Product Idea/Concept |



Just "bottled water"

Just a few years ago, when most people wanted to have a drink of water, most likely they turned to a water fountain in the school, work or home. Nowadays it is more common to see the upscale crowd carrying bottled water. This phenomenon seems to be driven by demographics. People are becoming more health conscious. The attitude seems to be "I don't drink tap water because is chlorinated and I don't trust it. It's not good for my health."

Trying to cash in on this craze around bottled water, the PepsiCo corporation launched its popular water product AquaFina. The marketing managers behind this product knew that this demographic group would be willing to pay a certain price for this product if it matched consumers' notions and expectations of health. That has been paired to powerful images of spring waters from Colorado and France further highlighting notions about health, freshness and purity. The product has been a success.

The AquaFina product has been well positioned against a demographic group. The PepsiCo corporation

has been successful by correctly applying demographic data to position a product in the consumer's mind, thus meeting the expectations of the more health conscious consumer of today.

Figure 3: Story with thematic indices

| | |
|---------------|--|
| Theme | Generate Product Idea/ Concept |
| Goal | Generate and evaluate retail product concepts |
| Plan | Gather qualitative/ quantitative data on retail product concepts |
| Result | Successfully applying demographic data to position a product |
| Lesson | Evaluating demographic trends can develop new product concepts |



Just "bottled water"

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The AquaFina product has been well positioned against a demographic group. The PepsiCo corporation has been successful by correctly applying demographic data to position a product in the consumer's mind, thus meeting the expectations of the more health conscious consumer of today.

The main purpose of this quantitative design is to demonstrate the effect of using different story-indexing strategies within a Case Library on novice learners' abilities of solving ill-structured problems. By manipulating the variable of story-indexing strategy (grouping participants into control, comparable, and experimental groups and by allowing each group access to a Case Library with either no indices, surface indices, or thematic indices), we can gauge the effect on learners' performance scores on solving ill-structured problems. The main purpose of the qualitative design is to gather verbal reports from the novice learners when they are taking the open-ended test in order to investigate and understand the process of problem solving and analogy making.

All subjects were selected from university junior or senior students taking related courses in marketing management, food marketing management, or agriculture business. They took one training session and one open-ended test session in this study. Those participating in the think-aloud activity attended both sessions. The main difference is they have to talk aloud their thinking process while solve problems. The entire think-aloud process is video- and audio-taped and used as qualitative data. See Figure 4 for the flow chart of quantitative design; see Figure 5 for the flow chart of qualitative design.

For the open-ended test, a rubric with scoring rules was created by the first author and a professor of Agricultural Economics. Two raters used the rubric to assign scores for students' answers on those open-ended questions. The scores were treated as quantitative data. Therefore, each student has two scores from two raters. Average of the scores was used to see if there is any significant difference due to the treatment. For the qualitative data, the data were coded, categorized, and analyzed by following the method of verbal data analysis from Chi (1997).

Anticipated Outcomes

It is expected that the group with access to a number of stories with thematic-indexing strategy in a Case Library, will perform better on an open-ended test evaluating high-order thinking skills of solving ill-structured problems than a comparable group who have access to stories with surface-indexing strategy and a control group who has access to stories without indexing strategy. It is also expected that through the careful analysis of learners' verbal reports, the nature and process of analogical problem solving, the transferring process from experts' experiences/stories to novice learners, and the construction and function of personal indexing schema will be revealed.

Figure 4: A flow chart of the quantitative design

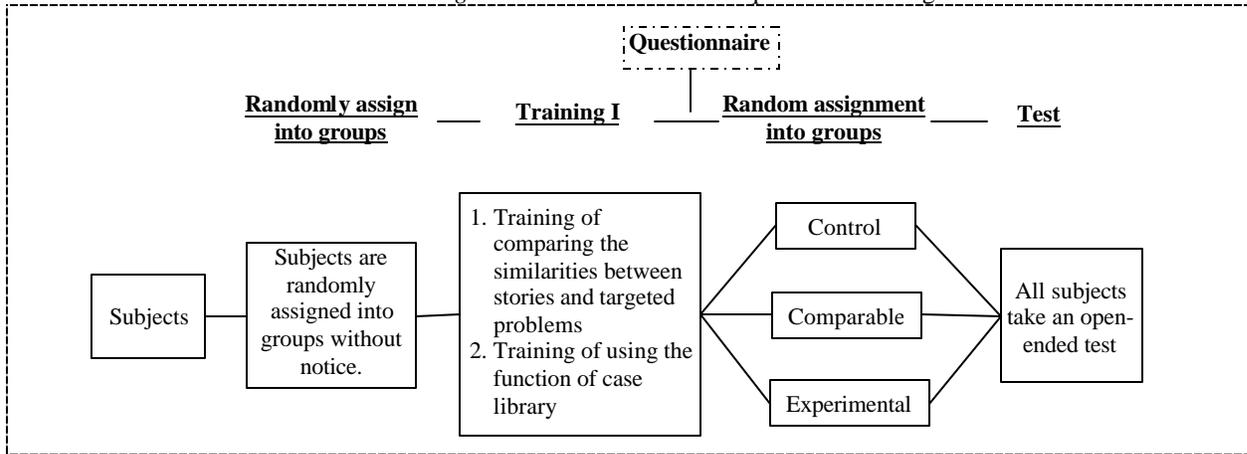
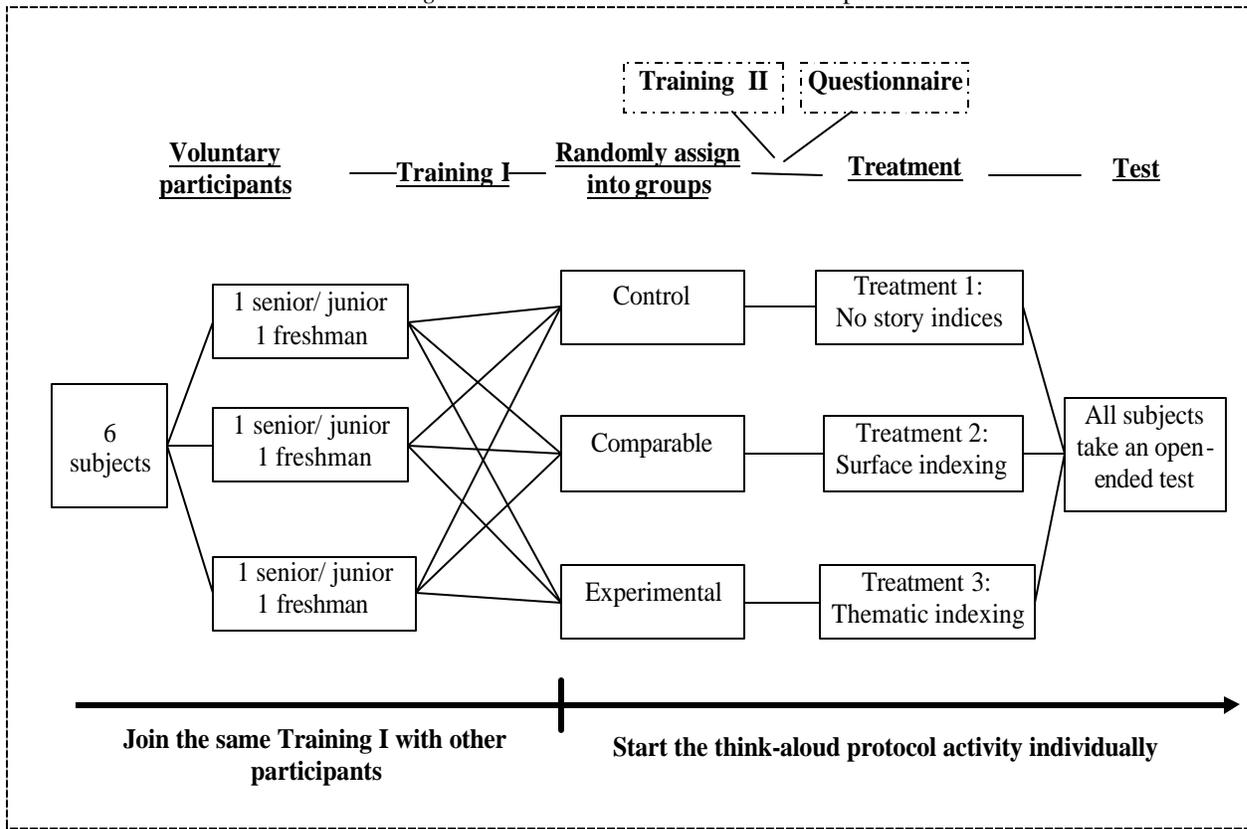


Figure 5: A flow chart of the think-aloud protocol



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Impact of Cognitive-based Instructional Intervention on Learning Motivation: The Implementation of Student-made Glossary in a Programming-oriented Engineering Problem-solving Course and Its Impact on Learning Motivation

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Abstract

This article describes the purpose, development, and implementation of a cognitive-based instructional intervention and its impact on learning motivation. The study was conducted in a programming-based problem-solving course for first-year engineering students. The results suggest that the instructional intervention developed based on the hierarchical analysis of intellectual skills development and partial-to-whole learning task approach has significant correlation with the Satisfaction component of ARCS Motivational Design Model.

Introduction

Problems with current approaches to study of motivation

Motivation is a critical factor in learning (Linnenbrink & Pintrich, 2002) and many researchers have examined the subject from various perspectives (Gonzalez-Pienda, *et al.*, 2002; Hancock, 2002; Cokley, *et al.*, 2001). Three issues trouble current studies of learning motivation: the lack of a systematic approach, neglect of other aspects of learning, and the inability to separate different aspects of motivation.

The affective and complex nature of motivation makes it difficult to study, resulting in many motivational studies that lack a systematic approach. This lack of systematicity limits reproduction of the effect and makes application difficult in practical situations. A review of motivational studies based on various aspects of learning (e.g. cognitive, social, and attitudinal) reveals that there is no sound systematic approach applied to them; most are solely based on motivational theories (Harlen & Crick, 2004) and frameworks to establish a broad, inductive goal without identifying a motivational problem. Identifying the motivational problem can clarify the motivational analysis and intervention. For example, Bandura's Self-Regulation theory is well received in the learning motivation field and efforts are being made to identify the measurable variables affecting levels of Self-Regulation (Miller & Brickman, 2004). However, there is no suggestion as to how those variables or components can be practically applied to resolve specific problems.

In other words, one problem with learning motivation studies is a lack of linkage between theories and practical instructional practices. Many theorists have proposed theories on how people get motivated and what behaviors can be stimulated by motivation (Weiner, 1985; Ames, 1992; Anderman & Maehr, 1994; Bandura, 1997). However, educators are still in search of practical and applicable guidelines that would enable them to convert motivation-enhancing theories into practical instructional practices with confidence (Hancock, 2002).

Another problem with current studies of learning motivation is their narrow approach. Given the complexity of investigating and measuring learning motivation in any instructional setting, various aspects of learning should be considered when trying to address motivational issues holistically. Aspects ranging from internal factors like student learning styles to external factors like the learning environment and applied instructional strategies should be considered.

Finally, the other learning components, such as instructional strategies, along with affective components traditionally associated with motivation such as enthusiasm and understanding of content, need to be separated and their effects on each other evaluated. This poses the concern of how reliable and valid motivational studies are if multiple issues are addressed simultaneously. Because factors affecting learning do interact with each other, a confounding effect can occur. Motivation does not occur in a vacuum, and the effects other factors in learning have on motivation are traditionally neglected (Astleitner & Wiesner, 2004).

A Systematic Approach: Selection of the ARCS Model

In order for the results of motivational studies to be more practical in addressing known instructional

or learning problems, perhaps a problem-solving process should accompany the investigation process. A generic instructional design process whose components are found in many instructional design models (e.g. Dick, 1996; Smith & Ragan, 1993; Gentry, 1994, Gustafson & Branch, 1997) may be an appropriate tool. The ADDIE process is geared towards solving instructional problems in five general steps: (A) analysis of the instructional problem, (D) design and (D) development of the instructional intervention, (I) implementation of the intervention, and (E) evaluation of the outcome(s). These systematic steps can be applied to the investigation of learning motivation due to their generalizability.

A motivational model with practical instruments should be used along with a problem-solving process to address specific aspects of motivation that a broad instructional design model like ADDIE cannot. The ARCS model, a motivational design model (Keller, 1987a, b), provides both a theoretical framework and a tool for assessing motivational levels by following the steps of ADDIE. The ARCS model suggests that learning motivation is influenced by four components: Attention, Relevance, Confidence, and Satisfaction. By enhancing an individual component using specific motivational strategies and instructional methods, students' learning motivation can be improved. Keller (1987b) suggested a systematic approach to first identify motivational problems and then prescribe motivational strategies to solve them. A pre-motivational survey is needed to establish students' initial motivational level. Keller's (1993) Instructional Materials Motivational Survey (IMMS) was developed as a situated measuring instrument to gauge the learning motivation of specific instructional materials. From the survey, motivational strategies can be prescribed according to identified motivational objectives. A post-motivational survey should be conducted to examine the effectiveness of the motivational strategies applied.

Motivational Studies Focusing on Cognitive Information Processing

Another way to make motivational studies more widely applicable is to focus on the cognitive side of learning. Studies on the cognitive aspects of learning, including cognition development, have established a scientific methodology to empirically investigate the human learning process from an information processing viewpoint. This deductive approach makes the studies more replicable, the focus of research questions more clear, and the outcomes more reliable and easier to identify.

In addition to the measurable outcomes these scientific research designs can produce, various studies have suggested a possible relationship between cognitive information processing and learning motivation (Wolters, 2004; Chalupa, Chen, & Charles, 2001). For example, Malone and Lepper (1987) proposed four components to establish learning motivation, all derived from human mental cognition. The association between motivation and cognition is also supported by the Expectancy Theory (Vroom, 1964) and the Control Theory (Klein, 1989) in which the learner's goal setting behaviors and perceived control are emphasized. Astleitner and Wiesner (2004) further proposed an integrated model of multimedia learning and motivation that describes the relationship between memory capacity and resource management, and their effect on learning motivation.

From an instructional design viewpoint, the systematic process to approach motivational problems and the relationship between cognitive processing and motivation means it is possible to design and develop interventions for motivational problems based on a cognitively based instructional strategy.

Purpose of the Study

The purposes of this study are to examine the feasibility of adopting a systematic and instructional design-oriented research design for the investigation of learning motivation, and to investigate the relationship between a cognitively based intervention and learners' motivation. This study employed (1) a procedure to diagnose, analyze, and develop instructional interventions for better motivational outcomes, (2) a hierarchical analysis of intellectual skills to better understand the complexity of the subject's cognitive learning tasks, and (3) the cognitive load theory (Sweller, 1994) as the foundation for developing the intervention in response to the identified motivational problems.

Methodology

Setting and Participants

Our focus in this study was on how subjects used a computer-based tutorial called M-Tutor™. M-Tutor was designed to help students learn MATLAB® syntax. MATLAB® is a computational software package that integrates mathematical computing, visualization, and a powerful computer programming language to provide a flexible environment for technical computing (Mathworks, 2003).

In the Fall semester of 2002, first-year engineering students who enrolled in ENGR 106, Engineering Problem-Solving and Computer Tools, were instructed to use M-Tutor as their primary means of learning MATLAB syntax. This 2 credit-hour, required course is designed to develop first-year engineering students' abilities to solve engineering problems with appropriate computer tools. In order to accomplish the course objectives, the instructor needed to create an active learning environment in the lecture, which emphasizes fundamental engineering concepts and problem-solving strategies. However, the students needed to simultaneously learn to be efficient and effective users of computer tools and use those tools to solve engineering problems. The instructor struggled with devoting class time to simply telling students about computer tools and how they worked versus covering fundamental engineering concepts and how to use these computer tools to solve realistic problems. Thus the instructor adopted M-Tutor to help students learn MATLAB syntax outside of class. Students' motivation for using M-Tutor to learn MATLAB was the focus of this study.

Keller's ARCS Model of Motivational Design and Instructional Materials Motivational Survey (IMMS) were adopted as the theoretical framework of learning motivation as well as the basis for quantitative and qualitative data collection. The study employed the one group pre and post-tests design. Three surveys were implemented: Pre-motivational survey, post-motivational survey, and an additional survey on the use of student-made glossary. The treatment was having students complete instructor-guided glossary items. The last survey focused on the glossary itself was implemented in order to associate students' perception towards the use of the glossary with their learning motivation levels. The pre-motivational survey based on the ARCS Model indicated that students gave a relatively low rating on the Satisfaction component. Students' qualitative responses also suggested that they felt frustrated when using the computer-based tutorial. The main reason for that reaction is the lack of connection between isolated coding tasks and their application to engineering problems. Thus the motivational strategy was developed based on the pre-motivational survey with specific emphasis on the Satisfaction component of ARCS Model.

The strategy for enhancing students' Satisfaction level is to provide students with more opportunities to gain a sense of accomplishment on course assignments by using M-Tutor™. Providing immediate feedback is also considered a crucial element for better motivational outcome. Thus the student-made glossary assignment was developed as the intervention to carry out the motivational strategy, which allows students to receive meaningful feedback as well as obtain a sense of accomplishment prior to solving application problems. The feeling of accomplishment is obtained by allowing students to go through smaller parts of the learning task (i.e. individual syntax as opposed to a chunk of coding). There are five columns on the glossary form: (1) syntax, (2) overview of the syntax, (3) student developed test case(s) based on instructor guidelines, (4) hand computations to predict results of test cases, and (5) MATLAB results. The complexity level of each column is increased by following the hierarchical analysis of intellectual skills (i.e. discrimination, concepts, and rules). By accomplishing the lower levels allows students to build a schema and tie the ideas together, so that when they are presented with a problem, they can relate the problem to their new schema.

Each glossary item was designed by the instructor according to immediate assignments since it helps students to better transfer newly acquired programming skills (composing with syntax) to application problems. Students were asked to complete the glossary before they worked on application problems.

Research Design

This study included all five steps of the generic instructional design process discussed earlier (i.e. ADDIE).

- (1) The analysis of the pre-motivational survey and examining its data.
- (2) The design of motivational intervention based on the pre-motivational data.
- (3) The development of a motivational intervention based on previous relevant research and theories as well as subject matter experts' input.
- (4) The implementation of the developed motivational intervention (instructional strategy) to the actual instructional setting.
- (5) The evaluation of the motivational strategy by a post-motivational survey and an intervention-specific survey.

Development of Motivational Strategies and Data Processing

Pre- and Post-Motivational Survey and Data Analysis The first motivational survey was conducted in the week after the first M-Tutor assignment while the post-motivational survey was given after the implementation of intervention. The survey instrument collected students' Pre- and Post- reactions towards the

tutorial. Keller's IMMS survey was adapted in order to accommodate the computer-based study setting. It consisted of 36 rating questions (Cronbach's Alpha= 0.917). The Instructional Materials Motivational Survey (IMMS) (Keller, 1993) was developed based on the ARCS Model. The IMMS consists of 36 statements that are rated using Likert-type scales (1 = Not True; 5 = Very True). Each item is mapped to an individual ARCS component and provides a measure of the respondent's perception of that particular component. Quantitative data are composed of ratings from the IMMS. It is important to remember that responses to a Likert-type scale item generate categorical data that cannot be averaged to provide a mean response for an individual survey item. Therefore, the frequency with which students responded "Mostly True" and "Very True" on individual survey items were computed. For all items mapped to a particular ARCS component, the frequency with which students responded "Mostly True" (4) and "Very True" (5) was used to provide a single quantitative measure of that ARCS component. Qualitative data was also collected by open-ended questions attached to the survey. The main purpose of collecting qualitative data was to better identify design issues within each instructional component.

Studies indicate that the ARCS Model is applicable in the computer-based or web-based instructional environment (Keller, 1999; Keller & Song, 1999; Knowlton, Shellnut & Savage, 1999; Park & Hannifin, 1993) although it was originally designed for developing motivating instructional materials in traditional face-to-face, classroom settings. For this pilot study, the IMMS was modified to assess the motivational effectiveness of M-Tutor. Each survey item was revisited and, as needed, re-focused on the research question, which was to diagnose students' motivational level in using the tutorial as a learning tool, with the expectation that students would effectively learn MATLAB syntax and effectively use MATLAB as a tool for solving engineering problems.

Design, Development, Implementation, and Evaluation of Motivational Strategies After the pre-motivational survey, we analyzed the quantitative as well qualitative data to determine which aspect of motivation to address. A coding system (Table 1) was developed for analyzing qualitative data based on design principles of multimedia courseware (Szabo & Kanuka, 1998; Evans & Edwards, 1999; Coscarelli & Shrock, 2000). The instructional coding system categorizes qualitative responses from each mapped ARCS Model open-ended question into various instructional components. The instructional components involved were coded as interface design, content, learning support, and implementation. Each qualitative response could be coded in one or more categories. The research direction was revisited repeatedly during the development of the coding system to insure the validity of items (Coscarelli & Shrock, 2000).

By triangulating the quantitative and qualitative data, valuable information can be gained. First, the research team can identify which instructional component(s) are most influential on students' motivational levels. Second, the research team can map the instructional components of the tutorial (interface, content, learning support, and implementation) to the ARCS Model components (Attention, Relevance, Confidence, and Satisfaction).

Also to explicitly evaluate the instructional intervention, a ten-question survey was developed to measure students' reactions towards the intervention independently of its effectiveness in enhancing their motivational level. (Cronbach's Alpha =0.926, N=957).

Table 1. *EXAMPLES OF CODES AND INTERPRETATIONS*

| Instructional Component Code | Keyword Examples |
|-------------------------------------|---|
| Interface Design | Text, graphs, navigational system, interactivity menu |
| Content | Relevance, easiness and difficulty of information |
| Learning Support | Textbook, assistance, Help session, feedback, exercises |
| Implementation | Course structure, technical infrastructure |

Results

Pre-motivational survey analysis

Table 2 indicates that students initially provided the least of amount of positive response towards the Satisfaction component of ARCS model based on the frequencies of “Mostly True” and “Very True” that were selected for each component. Additionally, the qualitative data suggested a considerable amount of students did not perceive using the tutorial as a satisfactory experience. Therefore the objective, based on the pre- analysis, was to increase students’ satisfaction level towards the tutorial with a feasible instructional intervention.

TABLE 2. Comparison of frequencies of “Very True” selected by participants among ARCS components

| Pre-Motivational Survey | Attention | Relevance | Confidence | Satisfaction |
|---|-----------|-----------|------------|--------------|
| Frequency of response indicating “Mostly True” and “Very True” combined | 2692 | 3568 | 2749 | 711 |

Identifying Motivational Strategies

The qualitative data analysis from the pre-motivational survey indicated that the main issue influencing students’ motivation was the transfer between learning programming syntax and using the syntax in problem-solving scenarios. The problem of transferability is common in abstract cognitive skill instruction such as programming or mathematics. Quilici and Mayer (2002) conducted a study on the transferability of statistical skills to word problems, which suggests the transfer of knowledge can be facilitated by providing systematic and frequent training. Renkl *et al.* (2002) also suggests that by providing problem-solving examples with gradually increasing levels of difficulty students were able to develop complete problem-solving skills by themselves. The low ratings on the Satisfaction component provided further support for designing corresponding motivational strategies. In order to enhance the Satisfaction level, students should have more opportunities to receive feedback and have feelings of accomplishment by exercising newly -learned knowledge (Keller, 1987b). As a result, a student-made glossary was developed (Table 3), which allowed students to define and practice MATLAB syntax prior to being given engineering problems to solve.

TABLE 3. Example of student-made glossary

| MATLAB Syntax | Overview of Syntax | Test Case(s) | Expected Result for Each Test Case | MATLAB Command Used for Each Test Case and Result |
|---------------|--|---|---|---|
| who | <p>Description: Displays a list of all the variables available in the workspace.</p> <p>Input Arguments: none</p> <p>General Format: >> who</p> | <p>Enter these MATLAB commands:</p> <pre>>> C = 0 >> x = 3 >> who</pre> | <p>Lists the variables C and x (and anything else previously created) as being available in the workspace</p> | <p>As given under Test Cases.</p> <p>Result: Your variables are: C x</p> |
| save | <p>Description: Saves all results, or specified results, to a MAT file</p> <p>Input Arguments: filename and specific variables (optional)</p> <p>General Format: >>save filename >>save filename var1</p> | <ol style="list-style-type: none"> 1. Create three variables. 2. Save all of the variables you've created in a filename called vars_all. 3. Save two of the three variables you | <p>Saves variables to a MAT file</p> <p>Where are the files saved? Give the exact path name. To the current directory which should be h:My</p> | <pre>X = 1 Y = 2 Z = 3 save vars_all save vars_two X Y</pre> |

| MATLAB Syntax | Overview of Syntax | Test Case(s) | Expected Result for Each Test Case | MATLAB Command Used for Each Test Case and Result |
|----------------------|---------------------------|---|---|--|
| | var2 ... | created in a filename called vars_two. | Documents/m-tutor | |

Implementation of Motivational Strategy: The Student-Made Glossary

The student-made glossary was implemented as a homework assignment towards the end of the semester. The glossary items came from the last M-Tutor learning unit assigned and included syntax needed to complete problem-solving assignments for the remainder of the semester. Students were asked to fill out all four columns as the first part of the assignment. Later the commands seen in the glossary were applied to other homework problems. The columns conform to Renkl's idea (Renkl, *et al.*, 2002) of increasing difficulty. In the first column, the student describes the programming syntax in terms of how and why to use it. In the next column, the student must generate a small sample case using the syntax. In the next two columns, the student generates an answer without the computer, then feeds their sample code into the MATLAB program and records its response.

Post-Motivational Survey Data Analysis

The same instrument (IMMS) used in the pre-motivational survey was administered to conduct the post-motivational survey to make a valid comparison, as shown in Table 4.

A one-way ANOVA was applied to data analysis to investigate the significance of variance between pre- and post-motivational surveys as the result of implementing the motivational intervention, that is, the student-made glossary.

The analysis indicated that the use of the glossary significantly lowered students' satisfaction as shown in Table 4 based on the aforementioned frequency method, which contradicts our hypothesis that the satisfaction level would increase when students were provided with opportunities to practice newly acquired skills and to gain meaningful feedback. Possible reasons contributing to the result will be addressed in the Discussion section.

TABLE 4. *One-way ANOVA on students' satisfaction towards M-Tutor between Pre- and Post-motivational surveys*

| | Pre Mean | Post Mean | F | Significance level |
|--------|----------|-----------|--------|--------------------|
| N= 957 | 0.75 | 0.57 | 10.717 | 0.001 |

Post-Motivational Survey and Glossary Survey

The purpose of implementing the glossary survey (Cronbach's Alpha= 0.926) was to collect data on students' reactions to using it as a supplementary learning tool and its relation to students' satisfaction level on the post-motivational survey. To thoroughly evaluate the implemented motivational strategy (i.e. student-made glossary), it is important to measure students' initial reaction towards the glossary as the first level of evaluation (Kirkpatrick, 1998). Interestingly the linear regression analysis suggests there is a significant relationship between students' reactions towards the glossary and the post-satisfaction response frequencies as shown in Table 5. Students' reactions towards the glossary, which was developed based on the different levels of intellectual skill hierarchical analysis, had a statistically significant relationship with students' post-satisfaction level as defined by Keller's ARCS Model.

TABLE 5. *Linear regression analysis between students' reaction towards glossary and Post-satisfaction responses frequencies*

| Y=aX+b | Coefficient | t statistic | P value | R Square |
|-----------------------|-------------|-------------|----------|----------|
| a(Glossary Reaction) | 0.1103 | 9.2985 | 9.42E-20 | 0.083 |

The study suggests that the cognitively based instructional intervention (i.e. student-made glossary) is influential on the variance of students' Satisfaction level in a computer-based instructional setting, though the

effect is considered negative towards students' overall motivational gain. Further discussion will explore the underlying reasons as to how the construction of their problem-solving schema affects students' perceived motivational levels during the development of higher cognitive skills. As the result of evaluation for the implemented intervention, the significant linear regression relationship between students' positive reaction to glossary and their post-satisfaction level suggests, interestingly, the possibility of other factors affecting the motivational gain induced by the glossary, which also will be discussed in the next section.

Discussion

Traditionally motivational studies have not been conducted very systematically, perhaps due to the complex nature of motivation and the difficulty in measuring it. This study uses a generic systematic model, ADDIE, often used in instructional design, with the following steps: analysis, design, development, implementation, and evaluation. The ADDIE model is general enough to approach most problems, including motivation. The appearance of each component of ADDIE in most of the accepted instructional design models today is a sign of its theoretical grounding.

This study focused primarily on the Satisfaction component after the pre-motivational survey, and showed significant change after the intervention. Students felt less satisfied towards M-Tutor after the use of the glossary. However, the regressive relationship between students' positive reaction to the glossary (i.e. how they like the intervention) and their post-satisfaction level suggests otherwise. Before we delve into the reasons as to why the loss of motivational gain, it is necessary to first to understand the function of student-made glossary and how it is compatible with Keller's definition of the Satisfaction component. Keller breaks Satisfaction up into three parts: natural consequences, positive consequences, and equity (Keller, 1987).

It could be that either positive consequences or equity relate to this study. The design and development of student-made glossary, however, focused on natural consequences mainly because it can give students a meaningful way to transfer the information they have learned. The student-made glossary is a cognitive advance organizer that addresses that aspect of satisfaction by helping student create a glossary of terms, leading them from knowing what the term is to practicing how to use it. The organizer categorizes students' knowledge, then provides a way for students to use it in a meaningful way in context and therefore meeting the "natural consequences" requirement of satisfaction.

Given the pedagogically-sound theoretical foundation and rationale of designing and developing the student-made glossary derived from either cognitive loading theory (e.g. worked example) (Sweller, 1994) or the ARCS motivational design model (Keller, 1987a,b), the negative effect on motivational gain induced by the glossary raises issues not only associated with the developmental portion of instructional intervention, but redirects our attention to the overall research design, especially in the implementation part of the study.

The pre-motivational survey was administered in the first quarter of the semester while the instructional intervention (i.e. student-made glossary) was not in place until the last quarter due to time needed for the pre-motivational survey data analysis and the design and development of the glossary. This temporal gap is typical in the developmental research (Richey & Nelson, 1996). Additionally the study was conducted simultaneously with the progression of the course. Therefore it is very likely that the glossary is not the cause of the motivational loss. Various factors such as course structure, complexity of learning tasks, interaction between teaching staff (i.e. professors and teaching assistants) and students, and the utilization of M-Tutor could have influenced students' motivation levels. It is questionable whether the student-made glossary could overcome the interactions among the aforementioned factors in terms of students' motivational gain or loss. In order to better measure any instructional intervention's effectiveness especially on perceived motivation, a more controlled study setting (e.g. smaller sample size) with a much shorter time gap between pre- and post-motivational surveys needs to be applied.

Conclusion

This study presents the concept and feasibility of using a generic instructional design process (ADDIE model) to motivational evaluation. It also demonstrates the use of the ARCS Model of Motivational Design for analysis and evaluation of students' learning motivation when using an existing computer-based tutorial. Triangulation of quantitative and qualitative data provided insight on the impact of instructional components on students' learning motivation as represented by four motivational components, which is also helpful for future revision of the computer-based tutorial. Finally the issue of effective implementation of an instructional intervention for motivational studies poses important considerations when migrating from the realm of

developmental research to a more replicable research design.

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A Case Study on the Development and Implementation of a Graduate Level Human Performance Technology Course

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Abstract

Given the emerging trend of innovating Instructional Design process (ID) for Human Performance Technology (HPT) related application in order to more effectively addressing organizational performance problems in industries, it is necessary to prepare students majoring in Instructional Design or Educational Technology in terms of how they can apply and further develop the concepts and skills learned from the field of ID to a more complicated and challenging HPT setting for the increasing demand seen in job markets. This paper presents a case study on the design, development, and implementation of a graduate level HPT course for the purpose of better developing ID students for future HPT related tasks. Issues such as (1) locating potential HPT client in an academic setting, (2) the dynamic interaction among stakeholders, (3) Tools used to facilitate the communication (i.e. visual modeling method, WebCT), and (4) effectiveness of project-base learning for HPT courses are discussed.

What is HPT

Application of HPT in Education Settings

Human Performance Technology (HPT) is defined as “a systematic approach to improving productivity and competence, through a process of analysis, intervention selection and design, development, implementation and evaluation, designed to of programs to most-cost-effectively influence human behavior and accomplishment” (ISPI, 2000). It is usually applied in business or industrial settings to address performance problems, but is increasingly applied in public sectors and community settings (Schaffer & Richardson, 2004). The International Society for Performance Improvement also provides a job description for a human performance technologist: “HP technologist’s are those who adopt a systems view of performance gaps, systematically analyze both gap and system, and design cost-effective and efficient interventions that are based on analysis data, scientific knowledge, and documented procedures” (Stolovich & Keeps, 1992).

The infrastructural knowledge (i.e. organizational behavior, employer and employee relationship, incentives for better organizational performance) for facilitating the solution design decision-making process for HPT is also more complicated and dynamic in nature as compared to an instructional problem. Though the concept of developing value-added and cost-effective non-instructional interventions (Reiser & Dempsey, 2002) to solve HPT problems is somewhat novel for many instructional designers, it is clear to see the compatibility between the task of instructional designer and human performance technologist in terms of using a systematic and analytical approach to solve performance problems. While both ISD and HPT use a similar problem-solving approach, the level of organizational impact and the measurability of results that is a hallmark of HPT requires a much stronger emphasis on analysis.

Given that there is an increasing need for human performance solutions in either for-profit industries or educational settings, the venues for developing capable human performance technologist are in demand. Actually many existing graduate level instructional technology, instructional design, and educational technology programs have begun to establish a solid foundation to support the growing demand for performance improvement education.

This paper presents a case study on the design, development, and implementation of a graduate level HPT course in order to share the instructor’s as well as students’ experiences. The process and tools employed to conduct the human performance project are also discussed in order to establish instructionally practical and pragmatic guidelines for others interested in creating similar learning experiences for students.

Process

The first challenge for the instructor was to introduce the fundamental knowledge, from concept definitions to theory and research of HPT, to novice graduate students in a constrained time frame. It was critical to provide the students with both the broad view in a wide range of topics on HPT, and the specific systems and models to prepare them for the solutions of real HPT problems. This was achieved following a step-by-step learning process through which students were guided to: 1) compare their personal definitions of the field against the textbook and supplementary readings; 2) create a system model and describe its interdependence with other systems, 3) review articles from Performance Improvement Quarterly or Performance Improvement to identify the theoretical framework and discuss the research support for the performance intervention; and 4) compare and contrast three different HPT process models. After they gained enough understanding on the topic, students completed an Individual Performance Analysis Report in which they integrated the concept, theory and system models to address a problem in which they were interested. It also served as practice in using analysis tools for their more complex HPT project in the next phase of the course.

HPT Performance Analysis Process

The second challenge was to locate projects that not only could provide practical experiences for students, but were also achievable within the semester timeframe. Since students were novice to the HPT field, the instructor took the initiative to select the project topics and group the students accordingly. At the beginning of the course, the instructor invited and introduced the “clients”, the on-campus Information Technology (IT) division in-charge persons to the class, to help students better understand the expectations and identify the possible problem scopes. Once the general problem areas for projects were identified, the instructor’s role became more like a consultant, providing necessary guidance to the students who actually took the responsibility to apply HPT to address real world problems.

Tools

Turing Research into Results—a Guide to Selecting the Right Performance Solutions (Clark & Estes, 2002) and *Performance Consulting* (Robinson, & Robinson, 1995) were selected as the textbooks for this course. Robinson, & Robinson’s (1995) Performance Model and Performance Relationship Map offered a good starting point for students to take a systems view of identified performance problems. Students collaborated in developing their own system models and relationship maps for different performance problems, which lay the foundation for later cause analysis and intervention selection.

The instructor also helped students to focus the analysis on the top three causes of performance problem: Knowledge and Skill, Motivation, and Organizational Causes (Clark & Estes, 2002). In the case of one identified problem, P2P file sharing, illegal file sharing was more likely to be caused by motivation and organizational culture than a lack of knowledge or skill. In addition, the instructor introduced the Performance Pyramid (Wedman & Graham, 1998), which visually laid out the possible performance problem causes into building blocks. It provided a particularly useful instrument to ground the design and development of the investigation questionnaire, a major tool for the project teams to collect information.

Project Management

Communication Tools Both project teams used private discussion forums in WebCT to archive team files, chat rooms, and the university web mail to communicate with clients, the instructor and one another. Effective communication was important to keep the project on track and the effort focused in the right areas. WebCT discussion was used among the instructor and the students to clarify questions and concerns, generate ideas, explore solutions and offer in-time assistance. E-mails were frequently utilized to exchange information, update progress and report results. Finally the online survey results were put into MS Excel spread sheets and visual charts were created to present and interpret data to the clients. In doing so students not only learned how to apply HPT theory and principles into specific context, but also practiced consulting skills such as how to “ask the right question right” (Robinson, & Robinson, 1995) and how to visualize the presentation of collected data to help the clients reach conclusions.

Client Involvement As in any successful HPT project, it was critical to involve the client throughout the process of performance analysis. In both projects, the students conducted structured meetings with the clients before, during and after the performance analysis to define the problem, report progress, and obtain feedback. At each crucial stage of the performance analysis, the students would acquire approval from the clients before taking further actions. The client-oriented approach helped to build solid support for the HPT

project as well as ensure customer satisfaction and buy-in to the process and results.

P-Based Learning: Project, Process, People, Problem

This course was offered from a graduate level Educational Technology program at Purdue University. A "P-based" approach to course development was used including project, problem, process, and people-based methods. Project selection for this course was mainly conducted by the instructor due to students' lack of experience and contacts on campus. The most time consuming part of project selection process was to explain the concept of human performance to potential clients.

The first key requirement for project selection is that the gap between current state of identified performance and desired state of performance was quantifiable in terms of dollar value, hours of manpower consumed, numbers of filed customer complaints, etc. In certain cases especially within educational settings the measurable outcome initially cannot easily be identified, for example, attitude changes. Therefore the clients, course instructor, and students have to work closely to identify projects with measurable outcome. The second concern is the constrained timeframe and resources of the course (i.e. eight weeks from project initiation and final reporting). The scope and depth of projects both were considered in relation to students' novice level of analysis and problem-solving skills within the HPT context.

Although it is not fair to use a dichotomous method to categorize all human performance problems into inductive and deductive ones, this approach did help students in the course to initiate their problem-solving process. Two topics were selected from an on-campus Information Technology division. One project focused on student's awareness of available information security (IS) resources provided by university. The other focused on student's awareness of the detrimental consequences of using the campus network to illegally download copyrighted files via Peer-to-Peer (P2P) file sharing.

The objective of IS project was to identify student behaviors related to securing his or her computer with virus protection software, for example; whereas the P2P project was geared toward trying to understand why students use the campus network to execute illegal transactions. The IS project eventually converged all data into a set of awareness procedures that could be implemented immediately while the data from P2P project produced a number questions requiring further investigation.

It was obvious in the initial stage of project development that each team (IS and P2P) should approach their specific problem with different mindsets. The IS team was looking for an incremental, relatively short term intervention. The P2P was developing a data-driven rationale for further investigation of the problem as the result of HPT process. Students in this course were fortunate enough to encounter both types of HPT problems (i.e. inductive and deductive) in one semester and consequently adjusted certain analysis process (e.g. gap analysis, performance map analysis) in order to accommodate project objectives.

Conclusion and Implication

The HPT course discussed in this paper offered students inductive and deductive types of problems to solve over the course of the semester. By continuing to dissect and learn about the many facets of human performance theory it was clear that many things other than knowledge and skill cause poor performance. The ability to quickly apply theory provided students with the opportunity to facilitate problem solving in a complex setting with real time lines. In the future, students will be introduced to HPT frameworks and processes in much the same way as in the current course. However, future courses will allow students to select their own projects rather than rely only on instructor-selected projects. Due to the amount of work and time needed to complete the semester-long project, students in current and future classes will be given a longer timeline for completion. Additional online discussions will be available to support learners through peer feedback, and a web-based performance support tool will be used to provide student analysts with process support, tools, and report templates.

A significant change in the course is conducted is the introduction of methods to promote reflective inquiry. Learners reflect upon each of the major analysis processes: define, analyze and select, by writing brief statements about their experiences while completing processes. Learners also self-assess their confidence in completing processes by rating the quality of each deliverable. It is hoped that using action research methods to explore the processes of novice analysts will support deeper learning and better understanding of the analysis process in general.

Sidebar: One Student's Application of the HPT Model

HPT is a meaningful model for a technology coordinator. With the emphasis of the job on the staff

development of K-12 teachers, results showed that the training the teachers completed was not being implemented into their classrooms. Having completed the course has provided a foundation of the HPT to analyze this situation. The model will be incorporated in current and future plans of the school district. For example, performance concerns that exist were being fixed by issuing additional training. Of course, this was the incorrect method of dealing with the issues because performance was not modified.

As a result before trainings are organized, performance is looked upon as what is occurring compared to the ideal performance. Beginning from this point has brought about change and performance improvement. Issues of expectations and feedback as well as desire to perform have been identified. This has provided a starting point for improvement.

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Understanding Performance Improvement Teams: A Case Study Investigating the Relationship between Team Efficacy and Team Performance

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Abstract

Team efficacy is a group-level motivational construct, which is the extension of self-efficacy. It has been argued that teams with higher team efficacy perform more efficiently than the teams with lower team efficacy. The purpose of this study is to examine the relationship between team efficacy and team performance in Personnel Qualification Standards (PQS) book development and revision teams in the U.S. Navy. The results of the study will be reported and discussed.

Introduction

Recent years have seen an increasingly widespread use of teams in organizations. Many organizations rely on teams to accomplish important goals. However, teams are not always effective. Some teams perform better than the others. It is suggested that processes that occur within a team may help account for real differences in team effectiveness (Brannick, et al., 1997). Several team process variables have been investigated in relation to team performance, such as team cooperation (Mathieu, et al., 2000), team coordination (Stout et al., 1990; Entin & Serfaty, 1999), and team communication (Mathieu et al., 2000). For some time, there has been a fair amount of research on these team variables. However, only a few studies investigated the relationship between the motivational process of team efficacy (collective efficacy) and team performance.

Team efficacy (Bandura 1982) is a motivational group-level construct that originates with Bandura's concept of self-efficacy (1977). It refers to "a group's shared belief in its conjoint capabilities to organize and execute the courses of action required to produce given levels of attainment" (Bandura, 1997, p477). A couple of studies have reported positive results regarding the relationship between team efficacy and team performance (Gibson, 1999, Knight et al, 2001, Little et al. 1997; Spink, 1992). Nevertheless, most of these studies are conducted with short-term artificial teams in the laboratory settings (Gibson, 1999; Knight et al, 2001), with sports teams (Spink, 1992), or manufacturing work teams (Little et al., 1997). Few studies have been conducted to examine the relationship between team efficacy and team performance with performance improvement teams in a real work setting.

The purpose of this study is to examine the relationship between team efficacy and team performance in Personnel Qualification Standards (PQS) development teams in the U.S. Navy. More specifically, it is intended to investigate if teams with higher team efficacy perform better than teams with lower team efficacy.

Method

Participants

The participants of the study were Navy personnel and civilians who worked in teams to revise U.S. Navy PQS books. 32 participants in four teams participated in this study. Each of them worked in teams during a few-day-long workshop to discuss and revise a particular PQS book. The teams were formed between 8 and 2 weeks before the workshop. Some team members had already known each other before attending the workshop, while others had no prior contact. Each team consisted of 4 to 17 members (comprised of one facilitator, one model manager, and the remaining were subject matter experts (SME)). During the workshops, SMEs discussed and made suggestions on book revision, while the role of the facilitators was to manage the discussion process,

record the changes to be made, and keep the team on track. The model manager was also a SME, but had an overall assignment of keeping the books current. The workshops lasted from 2 to 4 days.

Material

A PQS contains minimum knowledge and skills that navy personnel must demonstrate in order to qualify to stand watches or perform other specific routine duties necessary for the safety, security, or proper operation of a ship, aircraft, or support system. The book presents performance requirements that the Navy personnel are required to demonstrate a reasonable amount of knowledge comprehension or skill proficiency. All PQS books consisted of three sections: 100 section (Fundamentals) contained the fundamental knowledge necessary to understand the watchstation/workstation books, 200 section (Systems) contained the information on the systems that will be required to operate at watchstation/workstation, 300 section (Watchstations) contained the tasks that will be required to satisfactorily perform in order to achieve final PQS qualification for a particular watchstation/workstation.

Measures

Team efficacy

Team efficacy was measured with a 14-item questionnaire developed by the researchers. It is a 10-point Likert scale questionnaire, with 0 representing '*not confident at all*' and 10 representing '*extremely confident*'. The instrument items were identified based on a task analysis conducted with a panel of 3 subject matter experts. The instrument asked the participants to indicate the degree of confidence in his/her team's ability in performing tasks involved in the PQS book revision process (e.g. *Your confidence (0-10) in your team's ability to verify references in the PQS book*). Each team member completed the questionnaire independently. Then, each individual's rating of each question was aggregated and the mean rating was calculated indicating the rating of team efficacy. Bandura (2000) claims the aggregation method is useful for teams of high interdependence.

Team performance

Team performance was measured by the number of revisions made to the PQS book per hour. As the study was conducted in a real setting, we had no control of the amount of time each team would spend on the tasks. The number of revisions per hour should be a reasonable measure of performance across the teams.

Procedure

Immediately before each team started the workshop on the first day, the workshop observer gave a copy of the team efficacy questionnaire to each participant. It was stressed that each participant read each question carefully and that for each particular task listed, he/she needed to rate his/her confidence level on his/her team's confidence in performing the task. After each participant independently completed the questionnaire, copies were collected. Then the observer observed the workshop process and took field notes including the time each team started discussing a revision, the process of the discussion, and the time that the team reached a consensus and completed the revision.

The same procedures were repeated for each team on the last day of the workshop when the second-time questionnaire was administered to the participants. Team efficacy was measured twice because previous research indicated that efficacy beliefs formed before task performance can be different from those formed afterward (Gibson, 1999). We chose to measure the construct twice to see their relationship to team performance respectively.

Data Analysis

For each team, the original PQS book before the workshop (Start Book) and the final PQS book after the workshop (End Book) were collected for comparison. One researcher compared the Start Book and End Book for all the four teams following a coding system that was developed by the researchers. The coding system was developed based on researchers' experiences with previous PQS workshops as well as observations of all the four workshops. Every single change in the books was coded using notations in the coding system. The parts that remained intact were also marked. After all the books were coded, the revisions made to each PQS book were categorized and the total number of revisions was counted. In addition, the observer's field notes were analyzed and the total number of hours spent on the book revision process for each team was counted. The number of total revisions divided by the number of total hours spent on the revision process was

then calculated as the performance measure of the teams.

Pearson's *r* correlation was computed to determine the relationship between team efficacy measured at two times (at the beginning of the workshop and at the end of the workshop) and team performance.

Results and Discussion

The purpose of the study is to seek the relationship between team efficacy and team performance. Pearson's *r* correlation showed that team-efficacy as measured both at Time 1 and Time 2 was positively correlated to team performance, but the results were not significant (Time 1: $r=.14$, Time 2: $r=.03$). Table 1 displays the correlation data.

Table 1: *Correlations between team efficacy and team performance*

| | Team-efficacy (Time 1) | Team-efficacy (Time 2) | Performance |
|------------------------|------------------------|------------------------|-------------|
| Team-efficacy (Time 1) | 1 | -- | -- |
| Team-efficacy (Time 2) | .478** | 1 | -- |
| Performance | .14 | .03 | 1 |

Note: **Correlation is significant at 0.01 level (two-tailed)

One limitation of the study is the small sample size. A larger sample size needs to be gathered in order to more accurately measure the relationship between team-efficacy and team-performance. Another issue of concern is that the teams studied were of different sizes. For example, one team consisted of only four members; while another team consisted of fourteen members. Team size might have played a role in team efficacy and performance. These two issues of concern may have influenced the results of the study. However, the strength of the research is that it studied real performance improvement teams, which is rarely available in the current literature.

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Use of an Innovation Component Configuration Map to Measure Technology Integration Practices of Higher Education Faculty

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Abstract

This presentation will focus on the use of a custom developed Innovation Component Configuration Map (ICCM) to measure technology integration practices of faculty in Schools, Colleges, and Departments of Education (SCDEs). This study investigated the relationship between the level of technology integration fidelity (high, moderate or low) by SCDE faculty and a) access to adequate support from technological infrastructure, b) access to adequate support from human infrastructure, and c) personal attitude toward computer use.

Introduction

The primary goal of this study was to explore and identify best practices in technology integration by higher education faculty, specifically higher education faculty in Schools, Colleges, and Departments of Education (SCDEs). This research study grew out of a perceived need to identify and contribute to the sparse knowledge base in current literature related to concrete classroom practices in technology integration by higher education faculty in SCDEs (Tharp, 1997; Willis, Thompson & Sadera, 1999). This population is of particular concern given the inherent responsibility and expectation for these faculty to model effective technology integration within their instruction in the preparation of preservice teachers.

Theoretical Background

The literature documents that the preparation for preservice teachers in the area of technology integration is inadequate (e.g., Garcia, 1998; Hannafin, 1999; Moursund & Bielefeldt, 1999; Poole, 1998; Schrum, 1999). There are isolated examples of excellence in technology integration (e.g., Eakin, 1997; Michael, 1998; Persichitte, Caffarella & Tharp, 1999; Studler & Wetzel, 1999). Much of the research literature in technology integration is limited to use of technology rather than on integration of technology in education. Also very little of the technology integration literature focuses on higher education faculty. Previous research (Persichitte et al., 1999) documents the importance of variables that influence technology integration: technological infrastructure, human support infrastructure, and attitude toward computer use. The work of change theorists and diffusion of innovation scholars such as Rogers (1995), Hall and Hord (2001), and Fullan (1993) offers a sound theoretical foundation for further research in the area of technology integration. However, the diffusion rate of technology integration practices among SCDE faculty is very low and hence, the focal point of this research was an investigation of the process of change and diffusion of instructional technology among teacher education faculty. The literature also suggests that although many K-12 schools and higher education settings have established benchmarks or standards for the integration of technology into classrooms, no model or methodology exists for substantiating technology standards with actual classroom practices (Mills, 2001).

Research Questions

The following research questions guided this study.

- RQ 1. To what extent do SCDE faculty report examples of technology integration that parallel examples of best practices in the current literature?

- RQ 2. To what extent do SCDE faculty report high fidelity, moderate fidelity, or low fidelity technology integration practices in their teaching?
- RQ 3. Is there a relationship between level of technology integration fidelity (high, moderate or low) by SCDE faculty and access to adequate support from technological infrastructure?
- RQ 4. Is there a relationship between level of technology integration fidelity (high, moderate or low) by SCDE faculty and access to adequate support from human infrastructure?
- RQ 5. Is there a relationship between level of technology integration fidelity (high, moderate or low) by SCDE faculty and their personal attitude toward computer use?

Methodology

Instruments

The variables of primary interest in this research study were: technology integration practices, implementation fidelity of technology integration by higher education faculty, attitudes of faculty toward computers, and technological and human infrastructure in support of technology integration. Technology integration practices and implementation fidelity by faculty were measured by an Innovation Component Configuration Map (ICCM) that was custom developed, field tested, and reviewed by experts in the area of technology integration. The Attitudes Toward Computer Usage Scale (ATCUS) (Popovich, Hyde, Zakrajsek, & Blumer, 1987) was utilized to collect data related to computer attitudes of SCDE faculty participants. Information about technological and human infrastructure was obtained from open ended and multiple choice questions included as a part of the Demographic Questionnaire.

Participants and Data Collection Procedures

The focus of this research was higher education faculty members associated with SCDEs. Hence the representative population selected for this study was individual members of the American Association of Colleges of Teacher Education (AACTE). AACTE is the principal professional association for college and university leaders with responsibility for educator preparation. The AACTE 2002 membership list included 5,323 individual members. From the individual membership, 600 faculty were randomly sampled and asked to participate in this study.

To answer the research questions addressed in this study, 600 instrumentation packets (ICCM, ATCUS, and Demographics) were disseminated to members of the American Association of Colleges of Teacher Education (AACTE), via a multi-mode (paper-based, online and e-mail) method. After two follow-up reminders, completed surveys were received from 208 participants resulting in a response rate of 36%. Interestingly, of the 208 participants, 53 responded to the online version, 154 via the paper-based version, and only one participant responded via the e-mail attachment. Of the AACTE members returning completed surveys, 56.7% were female, 91.4% were Assistant, Associate, and Professors with 89.9% holding a doctorate degree, 99% reported full time employment status, and 95.8% were affiliated with a college or a university. The age group of participant faculty ranged from 20 to 72 years ($M = 50.74$, $SD = 11.57$) with teaching experience ranging from 0 to 48 years ($M = 25$, $SD = 8.96$).

Results

Research question 1 focused on the technology integration practices of higher education faculty for which the ICCM served as the primary data collection instrument. Results of the analysis indicate that, on an average, 79.1% of the SCDE faculty participants were close to demonstrating best practices in technology integration, and that this mean for ICCM scores was significantly different from the best practice score of 75. The responses on the ICCM were fairly normally distributed with a large variance ($M = 79.1$, $SD = 19.51$).

Research question 2 explored the classification of the SCDE faculty into three distinct groups of technology integration fidelity levels. The ICCM allowed for the categorization into three distinct groups, resulting in 56.7% in the high fidelity, 38% in the moderate fidelity, and 5.3% in the low fidelity group. The chi-squared goodness of fit test determined that there were significant differences in the proportions of the three fidelity groups favoring high fidelity.

Research questions 3, 4, and 5 explored the relationships between six predictor variables (four factors

of the ATCUS, technological and human support available to faculty) and technology integration fidelity levels (dependent variable). A multinomial logistic regression analysis predicted the relationship among the set of predictor variables and the dependent variables to be significant. Slightly over 58% of the participants were correctly classified by fidelity. However, ATCUS factor 2 (Positive Reactions to Computers) and ATCUS factor 4 (Comfort with Familiar Computer-Related Mechanisms) were the only individual significant factors in differentiating between high and low fidelity groups. ATCUS factor 4 (Comfort with Familiar Computer-Related Mechanisms) was the only significant factor that differentiated between moderate and high fidelity groups.

The results of an ANOVA indicated a statistically significant difference between faculty who reported adequate technological infrastructure and faculty who reported inadequate technological infrastructure. There was also a significant interaction between human infrastructure support and computer anxiety. Faculty with high computer anxiety improved on their technology integration skills when provided with adequate support from human infrastructure.

Conclusion

This research study investigated the complex relationships among these constructs: technological infrastructure, human infrastructure, attitudes toward computers, and technology integration fidelity with a random sample of higher education faculty representing SCDEs. This study contributes to the technology integration literature in the following ways: (1) provides evidence of tangible classroom practices in technology integration for teaching and learning in higher education, (2) offers a contemporary ICCM to measure technology integration among higher education faculty, (3) provides an updated description of faculty characteristics for SCDE faculty who integrate technology in their teaching, and (4) supports Roger's (1995) theoretical framework and the change literature associated with the Concerns-Based Adoption Model (CBAM) (Hall & Hord, 2001).

Note: The detailed instruments (ICCM, ATCUS and the Demographic Questionnaire) used in this study would be provided to the conference participants at the presentation.

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The Effects of Communication Style and Message Function in Triggering Responses and Critical Discussion in Computer-Supported Collaborative Argumentation

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Abstract

This study examined how differences in communication style affect how likely particular types of messages (e.g. arguments, evidence, critiques, explanations) were able to elicit critical responses during four online debates. Event sequence analysis was used to compare the response probabilities for each type of message across messages that used expository versus epistolary styles of communication observed in the four asynchronous threaded discussions. The results suggests that when a message is posted to challenge an opposing viewpoint, that message is significantly less likely to elicit a return response from the opposition when the message acknowledges individuals by name or presents a direct reference to an individual's preceding statements. A more detailed and exploratory analysis of the interactions revealed that this style of communication might have contributed to a decrease in the frequency of evidence and subsequent discussion of supporting explanations needed to defend the challenged viewpoints and arguments.

Introduction

Computer-mediated communication (CMC) provides opportunities for learner-to-learner interaction and enables learning communities to engage in more reflective critical thinking. Argumentation is one of the fundamental collaborative inquiry-based learning strategies for increasing critical thinking skills in online settings. These skills involve the processes of building arguments to support a position, and considering and weighing evidence and counter-evidence in developing supporting arguments. Innovative approaches to facilitating student participation in collaborative argumentation have been developed in computer-supported collaborative learning (CSCL) and computer-supported collaborative argumentation (CSCA). One approach to scaffolding and facilitating collaborative argumentation is to structure the discussions such that constraints are placed on when and what types of functional moves and messages can be posted to discussions (Cho & Jonassen, 2002; Duffy et al., 1998; Jonassen & Remidez, 2001; McAlister, 2001). The other approach incorporates intelligent systems and pedagogical agents that use formalized models of argumentation to actively diagnose students' performance and suggest immediate courses of action (Eleuterio, Barthes & Bartolozzi, 2002; Jacques, Oliveira, & Vicari, 2002a; Jacques et. Al, 2002b; Karacapilidis & Papadias, 2001).

Despite these technical advances to support the functions students perform during online discussions and regardless of what technology is used to facilitate discussion, a growing body of research now suggests that student participation in online discussions can be influenced by the communication styles of its participants. When and how often a student responds to a message may depend not just on what is said in the message (in terms of function of the message), but also by how the message was delivered in terms of communication style. Significant differences in communication styles have been found between males and females. For example, men tend to assert opinions strongly as facts, place more value on presenting information using an expository style, are more likely to use crude language, violate online rules of conduct, engage in more adversarial exchanges, and terminate exchanges when there are disagreements (Fahy, 2002; Herring, 1993; Savicki et al., 1996). In contrast, females are more likely to qualify and justify their assertions, use expressions that convey more epistolary roles, make apologies, and in general, manifest a more consensus-making orientation and epistolary style. Furthermore, females are more upset by violations of politeness and are more likely to challenge participants that violate rules of conduct and (Smith, McLaughlin & Osborne, 1997). Although each gender may have a tendency towards one communication style, groups have also been found to modify their communication styles in the direction of the majority gender (Baym, 1996; Herring, 1996).

However, the impact of communication styles on when and how often messages are able to elicit responses that generate more critical and more substantive discussions has yet to be examined and empirically investigated. The lack of empirical research can be attributed to the absence of appropriate theories, methods and tools capable of operationalizing and producing precise measurements, descriptions and assessments of group interactions and processes in online discussions (Fahy, 2001 & 2002; Garrison, 2000). The main problems lie in the coding and analysis of computer conference messages (Rourke, Anderson, Garrison, Archer, 2001) and the sequential nature of messages and responses (Gunawardena, Lowe & Anderson, 1997). The difficulty in coding message content is in establishing the unit of analysis because messages often contain multiple ideas that serve multiple functions. As a result, the contents of a message must be classified into multiple codes, making it nearly impossible to map message-response sequences in terms of pre-defined message categories (Levin, Kim & Riel, 1990; Newman, Johnson, Cochrane & Webb, 1996; Gunawardena, Lowe & Anderson, 1997). These methodological problems have prevented researchers from conducting a closer and more detailed examination of the relationships between messages and responses - particularly the functional, temporal, social and semantic relationships between exchanged messages and responses (Jeong, 2004a).

One solution to this problem is to require students to pre-classify their contributions to discussions using a pre-determined set of message/response categories. This constrains each message to serve only one function at a time, and establishes a clear unit of analysis. This approach has been used in a number of computer-supported collaborative argumentation (CSCA) systems (Cho & Jonassen, 2002; Duffy et al., 1998; Jonassen & Remidez, 2001; McAlister, 2001). The ACT system (Sloffer, Dueber & Duffy, 1999), for example, is a threaded discussion board that is designed to scaffold online debates by requiring students to pre-classify each posting to one of six response categories - proposal, counter-proposal, supporting reasons, detracting reasons, supporting evidence and detracting evidence. McAlister (2003) proposed a synchronous chat tool to support collaborative argumentation by requiring students to pre-classify messages to inform, question, challenge, reason, support or maintain chat discussions. Within each of these response categories, students are able to choose a specific sentence opener (e.g. "A counter-argument is...") to channel students' thoughts by the process of completing the sentence in a way that fits with the opener.

Purpose

Using the methods described above, the purpose of this study was to determine the precise probabilities in which messages with a given function (e.g. arguments, supporting evidence, critiques and explanations) and communication style (epistolary vs. expository) are able to successfully elicit responses that contribute to discussions that critically examine claims and alternative viewpoints. The research questions that were specifically addressed in this study were the following:

1. *Level of Interaction Between Opposing Viewpoints.* When conducting discussions to critically examine alternative viewpoints, how does the use of epistolary styles of communication affect how likely students will respond back to students who challenge their claims with counter-arguments and supporting explanations?
2. *Impact on Level of Critical Discussion.* What are the implications of using versus not using these specific styles of communication on the level and depth of discussion across all presented arguments and claims?

Method

Participants

The participants ($n = 17$) were graduate students from a major university in the Southeast region of the U.S., consisting of 11 female and 6 male students, and ranging from 20 to 40 years in age. The students were enrolled in a 16-week online graduate introductory course to distance learning required to complete a Master's program in instructional systems with a major in distance learning. The gender of each student was determined at the beginning of the online course through personal introductions and posted biographies.

Debate procedures

Students were required to participate in a series of four highly structured debates using threaded discussion forums in Blackboard, a web-based course management system. The discussions were highly

structured given that: a) student participation in the debates and other scheduled discussions throughout the course contributed to 20% of the course grade; b) for each debate, students were required to post at least four messages to receive full credit for each debate; c) prior to each debate, students were randomly assigned to one of two teams (but balanced by gender) to either support or oppose a given position; and d) students were required to vote on the team that presented the strongest arguments after each debate.

The purpose of each debate was to critically examine design issues, concepts and principle in distance learning covered during the week of the debate. For example, students debated over the following claims: “The Dick & Carey ISD model is an effective model for designing the instructional materials for this course”, “The role of the instructor should change when teaching at a distance”, “Type of media does not make any significant contributions to student learning”, and “Given the data and needs assessment, the fictitious country of NED should not develop a distance learning system”. Students were instructed to support and refute presented claims and viewpoints with arguments, evidence, explanations, and critiques.

Online debate messages and message labels

Students were presented a list of four response categories during the debates designed to scaffold argumentation. The response categories were based loosely on Toulmin’s (1958) model of argumentation. The response categories and their definitions were presented to students prior to participating in the debates. Each student was required to classify each posted message by response category by inserting the corresponding label into the subject headings of every message. Students were required to limit the content of their messages to address one and only one response category at a time. The experimenter occasionally checked the message labels to determine if students had appropriately labeled their messages according to the described procedures. No participation points were awarded for a given debate if a student failed to properly label one or more posted messages. However, students were able to return to a message at any time to correct for errors in their labels.

| Symbol | Description of symbol |
|--------|---|
| + | Identifies a message posted by a student assigned to the team <u>supporting</u> the given claim/statement |
| - | Identifies a message posted by a student assigned to the team <u>opposing</u> the given claim/statement |
| ARG# | Identifies a message that presents <u>one and only one</u> argument or reason for using or not using chats (instead of threaded discussion forums). Number each posted argument by counting the number of arguments already presented by your team. Sub-arguments need not be numbered. ARG = "argument". |
| EXPL | Identifies a reply/message that provides additional support, explanation, clarification, elaboration of an argument or challenge. |
| BUT | Identifies a reply/message that questions or challenges the merits, logic, relevancy, validity, accuracy or plausibility of a presented argument (ARG) or challenge (BUT). |
| EVID | Identifies a reply/message that provides proof or evidence to establish the validity of an argument or challenge. |

Figure 1 – Example instructions on how to label messages during the online debates

The purpose of labeling and constraining each message to a specific function was to make the inter-relationships between students’ contributions explicit and to enable students to visualize the structure of their arguments (Jeong & Juong, 2004b). The second reason for using these procedures is that they enabled the experimenter to clearly establish each message as a unit of analysis. With each message assigned to a specific response category, the types of message-response sequences observed in the debates could be clearly identified and counted to determine their relative frequencies. Previous studies on group interaction in CMC did not succeed in measuring message-response sequences (Gunawardena, Lowe, & Anderson, 1997; Newman,

Johnson, Cochrane, & Webb, 1996) because students' messages and responses often addressed multiple functions or response categories at the same time. As a result, mapping the relationships between messages and responses was a difficult if not impossible task. In this study, however, the use of student-labeled messages was found to be an adequate solution to resolving some of the previous problems by establishing a clear unit of analysis. Although these procedures appear at first sight to be artificial and perhaps intrusive, this method has been implemented in a number of computer-supported collaborative argumentation (CSCA) systems for scaffolding argumentation and problem solving (Carr & Anderson, 2001; Cho & Jonassen, 2002; McAlister, 2003; Sloffer, Dueber, & Duffy, 1999; Veerman, Andriessen, & Kanselaar, 1999).

In addition, students were also instructed to identify each message by team membership by adding an “-” for opposing or a “+” for supporting team at the end of each label (e.g. +ARG, -ARG). These tags allowed the students to easily locate the exchanges between the opposing and supporting teams within the discussion threads (e.g. +ARG→-BUT) and respond to the exchanges to advance or defend their team's position. An example discussion thread from a debate is illustrated in Figure 2.

Figure 2. Example of online debate with labeled messages

| | | | |
|--------------------------|---|---------------|---------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> SUPPORT statement because... | Student names | Sat Oct 2, 2004 11:18 am |
| <input type="checkbox"/> | <input type="checkbox"/> +ARG#1 MedialsButAMereVehicle | Student names | Mon Oct 4, 2004 8:47 pm |
| <input type="checkbox"/> | <input type="checkbox"/> -EVID MedialsButAMereVeh... | Student names | Tue Oct 5, 2004 7:09 pm |
| <input type="checkbox"/> | <input type="checkbox"/> +But RelativityTheory... | Student names | Tue Oct 5, 2004 9:43 pm |
| <input type="checkbox"/> | <input type="checkbox"/> -But RelativityThe... | Student names | Sat Oct 9, 2004 10:12 am |
| <input type="checkbox"/> | <input type="checkbox"/> -BUT Whataboutemotions? | Student names | Tue Oct 5, 2004 9:53 pm |
| <input type="checkbox"/> | <input type="checkbox"/> +EVID DistEdEffectiveAsF2F | Student names | Tue Oct 5, 2004 10:40 pm |
| <input type="checkbox"/> | <input type="checkbox"/> -BUTMediaamerevehicle | Student names | Wed Oct 6, 2004 8:19 pm |
| <input type="checkbox"/> | <input type="checkbox"/> +EVID MooreConcurs | Student names | Wed Oct 6, 2004 10:07 pm |
| <input type="checkbox"/> | <input type="checkbox"/> +EXPLMediaSelectionCo... | Student names | Sun Oct 10, 2004 12:35 am |
| <input type="checkbox"/> | <input type="checkbox"/> -BUT WellChosenEffect... | Student names | Sun Oct 10, 2004 4:31 pm |
| <input type="checkbox"/> | <input type="checkbox"/> +But SupportingRes... | Student names | Sun Oct 10, 2004 5:37 pm |
| <input type="checkbox"/> | <input type="checkbox"/> -BUTMediaismorethanamere... | Student names | Fri Oct 8, 2004 5:30 pm |
| <input type="checkbox"/> | <input type="checkbox"/> +BUT SupportingEviden... | Student names | Sat Oct 9, 2004 8:51 am |
| <input type="checkbox"/> | <input type="checkbox"/> -BUT LearningNotSimplyAP... | Student names | Mon Oct 11, 2004 9:54 am |
| <input type="checkbox"/> | <input type="checkbox"/> +ARG2 Standards for teaching | Student names | Wed Oct 6, 2004 1:48 pm |
| <input type="checkbox"/> | <input type="checkbox"/> +But Clarification? | Student names | Sun Oct 10, 2004 5:39 pm |
| <input type="checkbox"/> | <input type="checkbox"/> +ARG3 MediaUnrelatedtoLearn... | Student names | Wed Oct 6, 2004 3:12 pm |
| <input type="checkbox"/> | <input type="checkbox"/> -BUTMediaUnrelatedtoLear... | Student names | Wed Oct 6, 2004 8:26 pm |
| <input type="checkbox"/> | <input type="checkbox"/> +BUT MediaSelection | Student names | Thu Oct 7, 2004 9:20 am |
| <input type="checkbox"/> | <input type="checkbox"/> -BUT MediaSelection | Student names | Sun Oct 10, 2004 11:21 am |
| <input type="checkbox"/> | <input type="checkbox"/> +EVID MethodNotMedia | Student names | Wed Oct 6, 2004 11:04 pm |
| <input type="checkbox"/> | <input type="checkbox"/> -BUT MediaUnrelatedtoLea... | Student names | Sat Oct 9, 2004 10:59 am |

Data analysis

Inter-rater reliability. To determine the extent in which the messages were labeled correctly by students, two of the four debates were randomly selected and coded by the experimenter to determine inter-rater reliability (work in progress).

Data preparation prior to analysis. To prepare the data for analysis, computer software was written by the experimenter to download, tabulate and compile the student-labeled messages from the Blackboard discussion forums into Microsoft Excel. The experimenter reviewed all the messages to identify and tag any messages that contained expressions that reflected more conversational and epistolary exchanges. The expressions that were

found to exhibit the epistolary style were direct references to previous statements (e.g. “I agree when you say that...”), and references to individual’s names (e.g. “Hi Bob”). All messages that contained these expressions were tagged with an “s” (e.g. BUTs). As a result, a total of eight message categories (ARG, ARGs, BUT, BUTs, EVID, EVIDs, EXPL, EXPLs) were used to code the messages.

Event sequence analysis. Event sequence analysis (Bakeman & Gottman, 1997) was used to identify and quantify the observed interaction patterns between messages that exhibited different communication styles. Sometimes referred to as lag analysis or Markovian chain analysis, the purpose of event sequence analysis is to determine: a) the probability in which a given event is able to elicit one or more subsequent events; and b) the probabilities in which specific types of events are likely to follow a given event. Event sequence analysis has effectively been used in communications research to study, for example, communication patterns in the conversations and interactions between married couples (Bakeman & Gottman, 1997 pp. 184-193; Gottman, 1979), children at play (Bakeman & Brownlee, 1982), mother and infant at play (Stern, 1974), and humans and computer-interfaces (Olson, Herbsleb, & Rueter, 1994).

A computer program (Jeong, 2003), the Discussion Analysis Tool (DAT), was developed by the experimenter to perform the event sequence analysis. DAT tallied the frequency of each message-response interaction. The response frequencies for each target message were then converted into relative frequencies, or *transitional probabilities* (Bakeman & Gottman; 1997). The transitional probabilities measured how likely a particular type of response was posted in reply to a particular type of message relative to all the other types of responses elicited by the given message.

Transitional state diagrams. The observed transitional probabilities between messages with different communication styles and function were converted into transitional state diagrams using DAT. In the diagrams, each response category was represented in a node. Directional arrows were drawn from one node to another node to represent the relative frequency of each observed message-response interaction. The density of the directional arrows connecting the nodes illustrates the strengths of the transitional probabilities between the nodes. This graphical representation of the interactions provided a means to readily identify prevalent patterns of interaction produced by messages that exhibited expository styles and epistolary style. Most of all, the diagrams provided a visual approach to identifying differences in message-response sequences between the message types.

Results

Summary statistics and overall level of interaction. Figure 3 shows the frequency matrix that summarizes the number of observed messages and responses across categories. The four debates produced a total of 323 messages. Of the 323 messages, 239 were posted in reply to a previous message and 166 of the messages did not elicit any replies. The matrix also shows how many messages of a given category were observed, and how many responses were elicited by the message within a given category. For example, the debates generated a total of 84 arguments (ARG), 65 messages (BUT) that challenged its merits without using an epistolary style versus 20 challenging messages (BUTs) with epistolary style. In Figure 4 is the transitional probability matrix, which shows the relative frequency of each type of response elicited by each message category. For example, 50% of responses to ARG were BUT (65 of the 129 replies) versus 16% BUTs (20 of the 129 replies). This matrix also shows the overall response rates for each message category. For example, 81% of the arguments elicited a response based on the finding that only 16 of the 84 did not receive any responses at all. The overall response rate across all message categories was 67%.

Figure 3 – Matrix with message and response frequencies

| | ARG | BUT | EVI | EXP | ARGs | BUTs | EVI s | EXPs | Replies | No Replies | Givens | Target% | Givens% |
|-------|-----|-----|-----|-----|------|------|-------|------|---------|------------|--------|---------|---------|
| ARG | 0 | 65 | 23 | 12 | 0 | 20 | 4 | 5 | 129 | 16 | 84 | 0.0% | 26.0% |
| BUT | 0 | 26 | 5 | 3 | 0 | 14 | 1 | 2 | 51 | 75 | 117 | 49.0% | 36.2% |
| EVI | 0 | 11 | 1 | 3 | 0 | 1 | 2 | 0 | 18 | 19 | 31 | 13.0% | 9.6% |
| EXP | 0 | 5 | 0 | 2 | 0 | 4 | 0 | 0 | 11 | 14 | 24 | 10.0% | 7.4% |
| ARGs | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.0% | 0.0% |
| BUTs | 0 | 6 | 2 | 4 | 0 | 10 | 1 | 1 | 24 | 31 | 51 | 21.3% | 15.8% |
| EVI s | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | 7 | 8 | 3.3% | 2.5% |
| EXPs | 0 | 3 | 0 | 0 | 0 | 1 | 0 | 0 | 4 | 4 | 8 | 3.3% | 2.5% |
| | 0 | 117 | 31 | 24 | 0 | 51 | 8 | 8 | 239 | 166 | 323 | 239 | 323 |

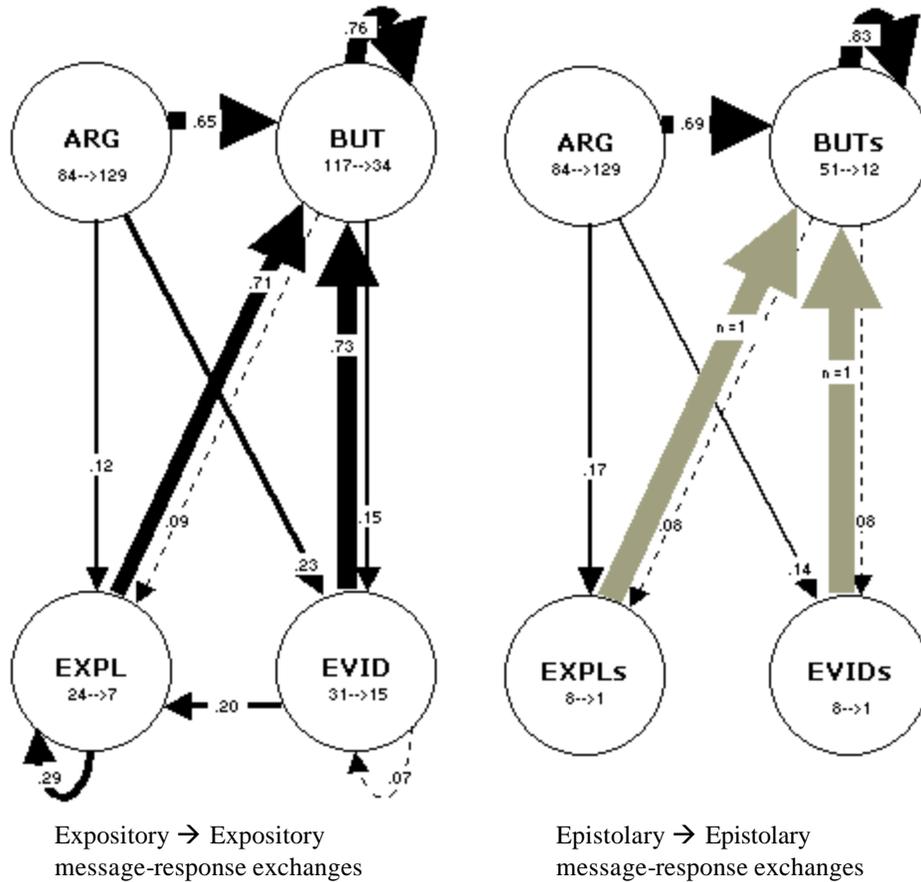
Figure 4 – Matrix with transitional probabilities between messages and responses

| | ARG | BUT | EVI | EXP | ARGs | BUTs | EVI s | EXPs | Replies | No Replies | Givens | Reply Rate |
|-------|-----|-----|-----|-----|------|------|-------|------|---------|------------|--------|------------|
| ARG | .00 | .50 | .18 | .09 | .00 | .16 | .03 | .04 | 129 | 16 | 84 | 81% |
| BUT | .00 | .51 | .10 | .06 | .00 | .27 | .02 | .04 | 51 | 75 | 117 | 36% |
| EVI | .00 | .61 | .06 | .17 | .00 | .06 | .11 | .00 | 18 | 19 | 31 | 39% |
| EXP | .00 | .45 | .00 | .18 | .00 | .36 | .00 | .00 | 11 | 14 | 24 | 42% |
| ARGs | .00 | .00 | .00 | .00 | .00 | .00 | .00 | .00 | 0 | 0 | 0 | 100% |
| BUTs | .00 | .25 | .08 | .17 | .00 | .42 | .04 | .04 | 24 | 31 | 51 | 39% |
| EVI s | .00 | .50 | .00 | .00 | .00 | .50 | .00 | .00 | 2 | 7 | 8 | 13% |
| EXPs | .00 | .75 | .00 | .00 | .00 | .25 | .00 | .00 | 4 | 4 | 8 | 50% |
| n = | 0 | 117 | 31 | 24 | 0 | 51 | 8 | 8 | 239 | 166 | 323 | 67% |

Level of interaction between opposing viewpoints. By analyzing only the interactions produced by exchanges between participants on opposing teams (e.g. +ARG→ -BUT, -BUT→ +BUT, -BUT→ +EVID, etc.), the results showed that messages presented with personal acknowledgments and direct references to an individual’s previous statements (epistolary style) received significantly fewer return responses (or rebuttals) from the opposition ($X = .39$, $STD = .60$, $n = 67$) compared to messages that were presented without using this style ($X = .61$, $STD = .83$, $n = 256$), $t(321) = 2.08$, $p = .038$, with the effect size of $-.31$.

Impact on level of critical discussion. To explore the potential impact of using the epistolary style of communication on the subsequent direction and level of critical discussion, the transitional probabilities from the upper-left and lower-right quadrants in the probability matrix (Figure 4) were examined separately to compare the types of discussion that would or could be produced if *all* messages in a discussion were presented with versus without the epistolary style. The transitional probabilities produced by messages without the epistolary style (upper right quadrant) are depicted in the left diagram in Figure 5. The diagram on the right depicts the interactions produced only by messages presented with the epistolary style.

Figure 5 – Possible patterns of interaction when discussions consist only of expository messages versus only epistolary messages.



A comparison of the two diagrams reveals possible differences in outcomes following interactions produced with epistolary style versus without epistolary style of communication. When the epistolary style was not used, challenges (BUT) directed at an argument (ARG→BUT) were more likely to elicit responses with evidence in defense of the challenged argument. In other words, the sequence of events produced without the epistolary style (ARG→BUT→EVID) was more likely to occur (in 15% of replies to BUT) when the epistolary style was not used to challenge an argument. When the epistolary style was used to present a challenge (ARG→BUTs), this interaction was less likely to lead to the production of evidence (in only 8% of replies to BUTs). The left diagram in Figure 5 also suggests that once evidence was elicited by a challenge (without the epistolary style), students were more likely to sustain and develop the discussion with explanations (ARG → BUT → EVID → EXPL → EXPL). These differences suggest that the use of expository style produced discussions that exhibited more reflection and critical examination of arguments during the online debates. However, these observations must be considered with caution because these observations are based on low frequencies of messages presented with the epistolary style.

Discussion

The findings of this study show that the epistolary style of communication – namely the direct reference to individuals by name and direct reference to previous statements - inhibited the critical discussion and examination of arguments, and that critical discussion is more likely to occur when students adopt and implement a more expository rather than epistolary style of discourse during computer-supported collaborative argumentation. This finding may appear to contradict the prediction that a more epistolary or conversational style of communication encourages individual participants (particularly female participants) to reciprocate responses and extend a conversation by helping to build rapport between participants (Fahy, 2002). However,

the findings in this study showed that the epistolary style inhibited rather than supported student responses to challenges. One possible explanation for this unexpected finding is that the confrontational nature of collaborative argumentation may have been intensified or even personalized when students made direct reference to individual names and previous statements. Engaging in discussion without this epistolary style would seem to have helped the students maintain focus on the ideas and not the personalities involved in the discussions, thereby reducing the sense of contentiousness inherent in the debate activity.

The findings from the exploratory analysis also suggest that the use of the epistolary style could have a potentially negative effect on the level of reflection, critical analysis and discussion. The analysis of the state diagrams revealed patterns to suggest that the epistolary style can reduce the frequency of evidence and explanations presented in defense of arguments following challenges to the arguments. To thoroughly test the effects of discourse styles on students' interaction patterns and the outcomes produced by the interactions, future studies will (a) need to collect a larger corpus of data to gather sufficient number of messages with contrasting styles, or (b) conduct a controlled experiment in which students in multiple groups are instructed to implement different styles of discourse as they participate in online collaborative activities such as debates, problem-solving, and case-studies.

In conclusion, this study was successful in making a first attempt at determining the effects of discourse styles on student performance in CMC when no previous studies have succeeded or attempted to determine its actual impact. The findings in this study serve to demonstrate the efficacy of using event sequence analysis, combined with the use of response constraints to label messages by function, to precisely measure and study the effects of epistolary versus expository styles in computer-mediated communication. Ultimately, this study will also serve as a model for investigating the effects of other styles and protocols commonly observed in online communication, which include the use of emoticons, qualifiers, humor, rhetorical questions, and the explicit versus discrete expression of disagreements. Measuring the precise effects of these communication styles and protocols will enable researchers and instructors to develop more refined strategies and computational models for supporting and optimizing student performance in computer-supported collaborative learning.

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Rural Creativity: A Study of District Mandated Online Professional Development

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Introduction

According to the annual industry report in “Training” magazine, money spent on employee training dropped approximately six percent—the first time that training expenditures have dropped since the mid 1990’s. At the same time, web-based training increased from 48% of all computer-based training to 61% in just one year (2002-2003). The most “bang for the buck” in the business sector is in one area of rapid growth—e-learning. (Galvin, 2003).

School districts are not exempt from this growing trend. Rodes, Knapczyk, Chapman & Haejin (2000) suggest that the population most in need of e-learning is “[c]ontinuing education students, teachers in rural areas, and inservice personnel in need of professional development”. However, how well “e-training” meets the needs of professional educators remains to be seen.

In the spring of 2002, the professional development committee and administrative team of a rural school district in the Midwest decided to implement an online staff development learning opportunity. Each educator at the middle and secondary education level would enroll in and complete one online course in his or her chosen discipline. This course would be paid for by the school district as part of staff development.

Background

In a forward-thinking technology district, administration is constantly challenged to come up with new and creative ideas for faculty and staff support and development. During a professional development committee meeting, the superintendent offered the idea of online staff development. Members of this committee included the curriculum director, high school principal, and faculty representatives. The faculty representatives included the chairperson, one elementary teacher, one middle-level teacher, one high school teacher, and one at-large teacher.

The committee believed the online opportunity would allow teachers to become more familiar with the technology they had available, help teachers better understand the experience of students enrolled in online courses, and provide specialized training that would not otherwise be available. The committee agreed that the online staff development would be required of all secondary teachers.

Although all the teachers had laptops and technology provided by the district, the diversity of the faculty also included a wide range of integration and comfort-levels issues dealing with technology. The flexibility of studying a variety of subjects online might improve the effectiveness of the staff development as it was important subject matter to the educators taking the courses.

Requiring educators who were unfamiliar with the expectations and happenings of online learning to take an online course might foster negative feelings. Creating a survey to analyze how the faculty felt about the online experience would provide helpful information for future district online staff development and for other districts considering the implementation of online professional training.

Methodology

Subjects

Subjects were not chosen at random as this was a district mandated program. Each educator teaching grades six through twelve was required to select and complete an online course; kindergarten through fifth grade educators would not be required to fulfill this requirement. In all, 23 secondary educators, two administrators and one full-time tutor participated in this program.

Technology Training

The school district would provide the technology, time, and money for the endeavor into online learning. During the year and a half prior to participating in the online program, each educator was given a personal laptop and received training on how to use the laptop properly.

District-level staff development time scheduled in mid-August before school began was utilized to teach the faculty how to set up and use the computers. One session was held for the elementary and middle-level faculty while another session was held for the high school faculty. Additional required sessions included learning how to use the email system and grading programs. As the programs and computers were updated, required building-level training was provided during scheduled in-service days.

Online Courses

Although educators were allowed to choose their courses based on personal preference, most educators chose topics that were specialized according to his or her particular area of teaching. For example, music educators completed "Internet for Music Educators." The remaining educators chose broader subjects that would benefit the school as a whole or were more traditional in-service topics. These included such topics as classroom management, sexual harassment, and curriculum compacting.

Of the 26 participants, 22 educators chose online courses provided by a recommended provider, three educators chose graduate courses offered by a regional university and one educator chose an alternative online course provided by an additional provider.

The recommended courses ranged in cost from \$72 - \$120; 20 of the 22 courses cost \$72. The three educators who chose graduate courses each enrolled in three-hour courses and were reimbursed \$180 total. University graduate courses were reimbursed at the rate of \$60 per credit hour as outlined in the district's negotiated agreement. The approved alternative course by an outside provider cost \$100, which was paid by the district. Courses offered through the recommended provider were completely paid for by the district.

Courses were to be completed by May with the exception of three educators enrolled in graduate-level, semester-length courses. The remaining educators enrolled in courses that were independent in nature and allowed the educators to work at their own pace. While a few were able to complete the course in one intensive day session, most of the educators completed their courses in two months.

Instrumentation

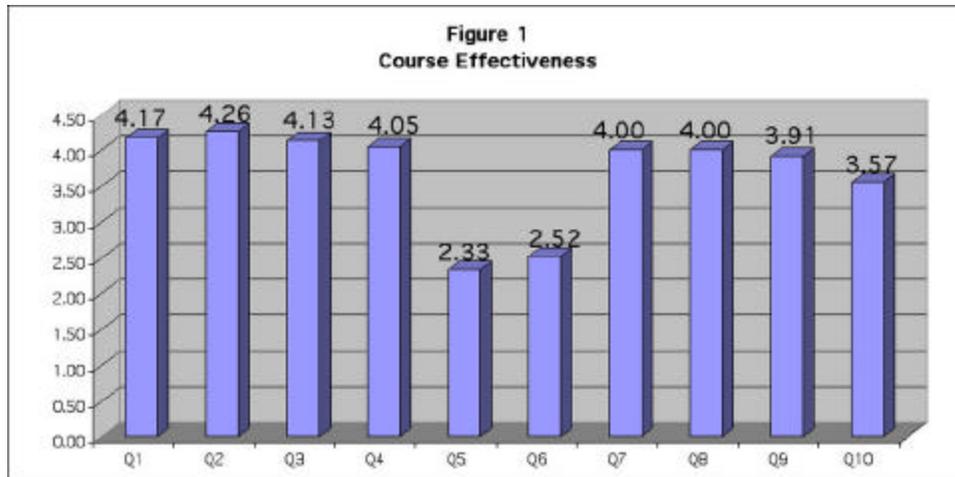
The data collection instrument was a survey consisting of 26 likert-scale questions and four open-ended/short answer questions. Question categories included course effectiveness, instructor effectiveness, self-perceptions of the educator as a student, and support services and technology. See Appendix A for a copy of the full survey. A source of reference was an online course survey from a regional university that was completed by students near the end of a semester online course. Particular points of interest from the professional development standpoint included whether the faculty felt comfortable with the technology, whether the online format was effective, and would the faculty consider enrolling in another online course.

Data Collection

The survey was sent via an email attachment and hard copies were also placed in each educator's mailbox. 88 percent (23/26) of the participants completed and returned the online staff development survey. 21 respondents returned the hard copy that was placed in their mailboxes, one respondent printed off the attachment and sent in the completed survey, and one respondent returned the completed email attachment.

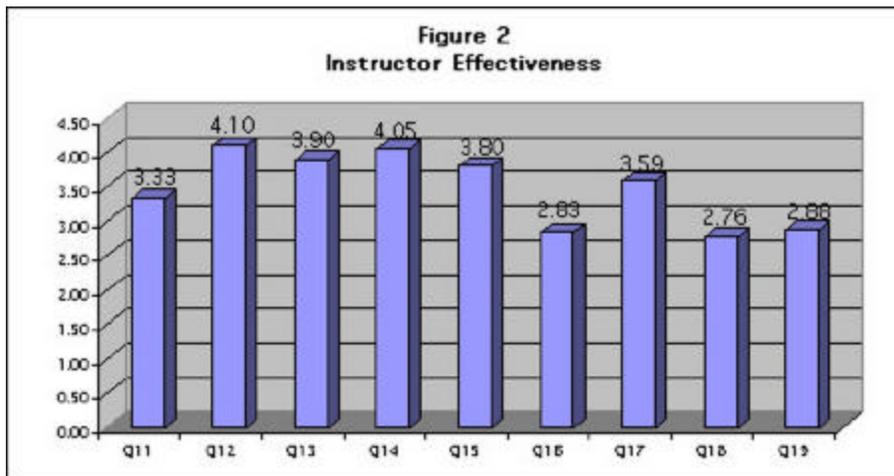
Results

As displayed in Figure 1, the majority of the questions in the first section titled Course Effectiveness received high marks. Respondents believed the syllabus accurately described course content and objectives (Q1) and that the course pace and difficulty was appropriate (Q3) and assignments were reasonable and appropriate (Q2).



Interaction with fellow students (Q5) and interaction with the instructor (Q6) received relatively low rankings. Two respondents noted that there was no interaction between fellow students and no interaction with the instructor. Respondents agreed, as indicated by the 4.00 average that the online course increased their interest in the subject (Q8) and they would recommend the course to other students (Q7).

In the second section, Instructor Effectiveness, overall effectiveness as a teacher and facilitator of online learning (Q11) received mostly positive responses as did the class was well-prepared with stimulating lessons (Q13) and used grading procedures that were fair and equitable (Q17).

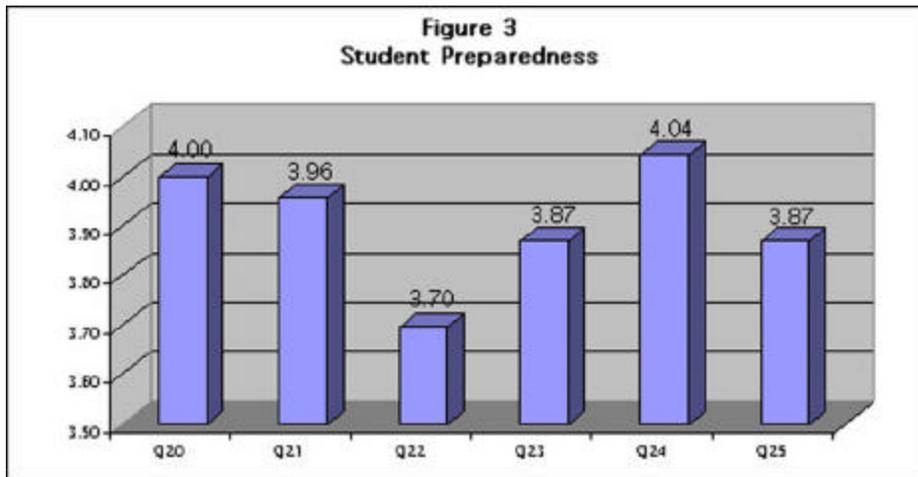


Questions 16, 18, and 19 all received 2.88 and below ratings. Respondents did not feel like instructors commented on their work in ways that helped them learn, instructors did not realize when students did not understand, and instructors were not willing to help students outside of the class. Five respondents did not answer question 16 because instructors did not comment at all on assignments or coursework. Six respondents did not answer questions 17 – 19 concerning fair grading practices, realizing when students did not understand, and helping outside of class. Two respondents commented there was not an instructor presence because it was an online course.

In the section on Student Preparedness, graphed in Figure 3, all of the questions received relatively positive ratings. Question 20 rated interest in taking the course, which the respondents rated as a 4.00.

The next question related to effort applied toward learning, which remained high even though the course was required. The amount learned in the course received the lowest rating of the student section with a 3.70. One respondent commented that the course was better suited for a new student instead of an experienced educator. Confidence in using the learned information was the highest rating in the section with a 4.04. The freedom to choose any course allowed educators to select online courses that were relevant for their particular

situations or teaching fields.



Question 23 rated prior computer experience, which received a rating of 3.87. Each educator was provided a laptop in the fall of 2000; educators had the computers for one-and-a-half years before the online requirement. Subsequent in-service opportunities have been provided and technology support staff was available for additional help during the regular workday. The last question in the student section asked if the respondent would consider enrolling in another online course. With a score of 3.87, respondents leaned toward agreement.

The ability to receive technical assistance from appropriate support services received a rating of 3.52. Respondents were able to use support services from the online provider, the professional development committee, and the technology support staff. Respondents also referred to other educators for assistance.

Results and Relationship to Research

Successes of Online Experience

Flexibility of Time Five respondents specifically mentioned flexibility of completing the course as a benefit of online learning. Educators could use the two in-service days set aside for the course or they could use their own personal time. Coursework could be completed at work or it could be completed while at home. Since educators each had a laptop, they could work on their online course anywhere they could find an Internet connection. The courses were also asynchronous so educators could log on at any time of the day.

Online staff development also provides “just in time” learning when educators need it most (Richardson, 2001). The increased accessibility allows educators to log on at anytime but it also allows them to retain online resources and refer to them at anytime during the semester or in the future (Barkley and Bianco, 2000).

Self-Paced Courses Five respondents also added that working at their own pace was a benefit of the online learning atmosphere. Some educators completed their courses in one session on one of the provided in-service days while others worked on the courses as it was convenient to their schedules.

The self-paced atmosphere also allowed educators the privacy of reviewing materials they did not feel they mastered. Educators did not have to worry about fellow peers realizing they were reviewing past information. “Constructivist research has demonstrated that teachers, as well as students, generally prefer to be in charge of their own learning and prefer to build their own knowledge,” added Odasz in his article on Alaskan professional development (1999).

Educators enjoy the self pace because they can move as quickly or as slowly as they feel is necessary. Odasz also added that once the teachers were comfortable with the instructions and course, they appreciated “not being specifically led, but being left to learn on their own, in their own way” (1999).

Viable Content and Information The district allowed the educators to choose what course they would enroll in for their online learning experience. By providing the educators with the topic choice, educators could choose

whatever topic they felt would benefit them the most. The educator was also allowed to select the provider, which allowed more opportunity for specialization and refinement of content.

One technology coordinator agreed that “tailored training would certainly be more motivation to our staff than the en masse training that is currently typical” (Zahner, 2002). Requiring the online staff development and allowing individual educators to select course topics provided a wonderful opportunity for customized learning for each educator’s needs (Richardson, 2001).

New Ideas In addition to useful content, the online courses also provided the educators with the opportunity to meet new colleagues and share new ideas. Online collaborative tools allowed the educators to “develop new insights into pedagogy and their own practice” and to “explore new or advanced understandings of content and resources” (Zahner, 2002). Educators were able to engage in learning with other online students with similar interests and to “facilitate the exchange of ideas and information” (Simkins, 1998).

Considerations for Improvement

Online Course Offerings Some educators commented they did not have enough information on how to find an online course or evaluate the providers of the online courses. One respondent specifically mentioned that a list of available courses and a synopsis of content would have been helpful during the selection process. Although there was an information packet distributed to the participants, little information was included on the content of specific courses.

The majority of the educators enrolled in the recommended courses primarily because they were recommended in the notification and the tuition would be completely covered by the school district. One educator did research an additional online course provider but encountered problems logging in, accessing the course, and receiving assistance.

A list of colleges with graduate level online courses would also be helpful as well as web addresses to online course offerings. Web sites that provide links to example course pages would also help educators make a more informed choice on the type of online course and level of interaction. Educators could also use these graduate hours to recertify with the state department.

Support Staff Technology support staff was available during the course of the semester but the hours of availability were somewhat limited. Each member of the tech support staff was also a part-time teacher and had teaching responsibilities throughout the regular workday. Educators who did not share plan time or tech support time with a support staff member had difficulty receiving help during the workday.

Time was available if educators were willing to report before or after school. Odasz commented, “Anxiety is reduced knowing help is readily available, anytime they need it” (1999). If a support staff member was available during each hour of the workday, this would decrease anxiety and help solve problems while they were still small and manageable. Educators would also be able to seek help and advice during the regular workday and would not have to make appointments before or after school.

Also an initial meeting with all participants could have eased the transition into online learning. Many of the problems encountered by the educators were problems with the initial log in and compatibility issues with browsers. An initial meeting with tech support could have provided an opportunity for educators to log in, try passwords, and choose the best browser for the online course.

Time Allowance Most educators who did not enroll in graduate-level, semester courses spent an average of 10.8 hours on the course. Two other educators estimated it took 20-30 hours to complete the online coursework. The majority of the participants worked on the course during their personal time. Working on the course during personal time may have also made it feel like there was not enough compensated time (a total of two inservice days) set aside to complete the assignments and the necessary research.

Facilitator and Student Interaction The majority of the respondents felt their online experience could have been improved with more interaction from the facilitator and fellow students. 23 of the online courses chosen by the professional development committee were designed as self-paced, independent lessons for individual professional development. The benefit was the educator could work through the content at his or her own pace.

The disadvantage was the lack of interaction. Educators did not feel like there was a facilitator or instructor for the course, and there was very little interaction between the educators enrolled in the courses. One high school educator commented, “If I want to read more about it, I’ll go to the library and check out a book and read it at home, on my deck or in my recliner, rather than at a keyboard.”

Educators enrolled in graduate courses were able to experience more interaction between the facilitator and the fellow students enrolled in the course. The graduate courses used more interactive collaborative tools such as discussion forums and chat rooms. The graduate courses also included assignments that required group projects in which the educators had to work online with fellow educators to complete assignments.

Student-to-student interaction plays a vital role in online learning. Students can post questions to discussion forums and have peers offer assistance. This student-to-student interaction improves the communication between the students during the course, helps relieve the number of questions the facilitator must answer, and builds colleague relationships that will extend beyond the length of the online course.

As online students, educators learn how to use online collaborative tools to exchange ideas with peers; continuing to use these communication tools will allow educators to stay more up-to-date with the ever-changing world of education. This new opportunity for peer collaboration and simply “talking” with fellow teachers is something teachers often cannot find time for during the standard school day (Killion, 2000).

Conclusions and Suggestions for Future Research

Overall, requiring educators to take an online course as part of staff development appears to have been a positive endeavor. In an environment where time is often an opponent and funding for staff development is scarce, it is important to find alternatives for providing training opportunities.

However, several issues arose during the analysis of the data for this study. These issues may be important for future research. First, what types of information should be provided so that educators could make informed decisions about online courses? How can this information be provided in an unbiased manner without appearing to advocate certain courses?

Next, should a "starter" online course be provided before taking the required course? In other words, would a "how to learn online" course be of benefit to the overall feelings of success in online course environments? If so, how would this be developed, delivered and funded?

Finally, how much time should be allotted for staff development? Should additional time be allotted and funded (as this was a district requirement) or is the traditional allotted time (one or two inservice days) sufficient for online courses? Should the district provide alternatives other than inservice days (such as a monetary incentive)?

It is the opinion of the authors of this article that online venues can provide ideal training alternatives for educators in rural or other districts who may not have access to the varied courses available in larger metropolitan areas. Districts considering such proposals will need to be aware of potential issues over which they have control—time, compensation and information. Armed with this knowledge, we hope educators and administrators can make informed decisions about implementing online staff training and development.

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Appendix B

Online Staff Development Evaluation

Name: _____ Position: _____

Course Title: _____ Course Provider: _____

How long did it take you to complete the course? _____

Please give honest and thoughtful answers to the following questions. The evaluation contains five sections. The first section is course effectiveness. Section two is instructor effectiveness. The third section relates to you as a student. Support services and technology is the fourth section. The final section contains open-ended questions. Please respond to the questions in each section. You may omit an item if you feel unable to make a fair judgement.

Please rate your level of agreement using the following scale:

| | | | | |
|-------------------|----------|--------------------|-------|----------------|
| 1 | 2 | 3 | 4 | 5 |
| Strongly Disagree | Disagree | No Opinion/Neutral | Agree | Strongly Agree |

COURSE EFFECTIVENESS

| | | | | | | |
|----|--|---|---|---|---|---|
| 4 | Syllabus accurately described course content and objectives | 1 | 2 | 3 | 4 | 5 |
| 5 | Assignments were reasonable and appropriate | 1 | 2 | 3 | 4 | 5 |
| 6 | Course pace and difficulty were appropriate | 1 | 2 | 3 | 4 | 5 |
| 7 | Exams and quizzes reflected important course aspects | 1 | 2 | 3 | 4 | 5 |
| 8 | Level of interaction with fellow students | 1 | 2 | 3 | 4 | 5 |
| 9 | Level of interaction with the instructor | 1 | 2 | 3 | 4 | 5 |
| 10 | I would recommend this course to other students | 1 | 2 | 3 | 4 | 5 |
| 11 | The course increased my interest in the subject | 1 | 2 | 3 | 4 | 5 |
| 12 | Having completed the course, I feel knowledgeable in the subject | 1 | 2 | 3 | 4 | 5 |
| 13 | Overall, the course and instructor met my expectations | 1 | 2 | 3 | 4 | 5 |

INSTRUCTOR EFFECTIVENESS

| | | | | | | |
|----|---|---|---|---|---|---|
| 14 | Overall effectiveness as a teacher and facilitator of online learning | 1 | 2 | 3 | 4 | 5 |
| 15 | Making clear the goals and objectives of this online course | 1 | 2 | 3 | 4 | 5 |
| 16 | Being well prepared for the class (ex. designing well planned lessons and activities) | 1 | 2 | 3 | 4 | 5 |
| 17 | Explaining the subject matter so you understand | 1 | 2 | 3 | 4 | 5 |
| 18 | Stimulating you to think more deeply about the subject | 1 | 2 | 3 | 4 | 5 |

| | | | | | | |
|----|---|---|---|---|---|---|
| | (applying information, analyzing, solving problems) | 1 | 2 | 3 | 4 | 5 |
| 19 | Commenting on your work (tests and assignments) in ways that helped you learn (ex. online discussions, etc). | 1 | 2 | 3 | 4 | 5 |
| 20 | Using grading procedures that were fair and equitable | 1 | 2 | 3 | 4 | 5 |
| 21 | Realizing when students did not understand | 1 | 2 | 3 | 4 | 5 |
| 22 | Being willing to help students outside of class (give assistance via email, phone, virtual office hours, and supplemental mailings) | 1 | 2 | 3 | 4 | 5 |

YOU AS A STUDENT

| | | | | | | |
|----|---|---|---|---|---|---|
| 23 | Your interest in taking this course before you enrolled | 1 | 2 | 3 | 4 | 5 |
| 24 | Your effort to learn in this course (studying, completing assignments, brainstorming ideas) | 1 | 2 | 3 | 4 | 5 |
| 25 | The amount you have learned in this course | 1 | 2 | 3 | 4 | 5 |
| 26 | Your computer experience prior to this course | 1 | 2 | 3 | 4 | 5 |
| 27 | How confident do you feel about using the information presented in this course | 1 | 2 | 3 | 4 | 5 |
| 28 | Would you enroll in another online course? | 1 | 2 | 3 | 4 | 5 |

SUPPORT SERVICES & TECHNOLOGY

| | | | | | | |
|----|--|---|---|---|---|---|
| 29 | Your ability to receive technical assistance from the appropriate support services | 1 | 2 | 3 | 4 | 5 |
| 30 | What could be done to make it easier for you to be a distance learner? | | | | | |
| 31 | Describe any frustrations or problems with technology in this course. | | | | | |
| 32 | What did you like best about this online course? | | | | | |
| 33 | What did you like least about this online course? | | | | | |

Thank you

In the Pursuit of a Virtual Community of Practice: Electronic Mail Discourse as a Technology Integration Resource

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[Note: the appendices cited in this document are not included, but can be found online at <http://www.freedomseas.net/Pro/Pro.htm>]

Introduction

Computer mediated communication has become a regular part of most teachers' professional daily routines. In a relatively short amount of time (a mere heartbeat when compared to the speed with which many other media came into regular use), email has emerged as a primary method of communication by which administrators disseminate important information to a school's teachers, appointments are made, notices posted, and professional connections are established and maintained between educational professionals - within a school or the rest of the outside world. Not surprisingly, teachers involved in online instruction have embraced computer-mediated communication as the method of choice for providing class interaction and opportunities for knowledge construction within the course context.

Online forums that purport to offer access to learning communities for practicing teachers have proliferated in recent years. The net-seminars offered through the Concord Consortium (Tinker & Haavind, 1996), Tapped In (Schlager & Schank, 1997), the Maryland Electronic Learning Community (Rose, Allen, & Fulton, 1999) and Teachers.Net (Kovacic & Bott, 2000) are among the first groups to focus on providing practicing teachers with opportunities for professional conversations about teaching and learning. For some time though, researchers have noted disparities between the promise of community and professional dialogue for participants in these online forums and the actual practice and experience (Harrington, Quinn-Leering, & Hodson, 1996) of those who join such groups. Issues regarding the quality of both the content and level of critical discourse, as well as the authenticity of the 'community' that is actually established, have been raised (Whipp, 2004). A closer examination is needed regarding how, or if, the *nature* of the interaction, and the *content* of conversation, can result in viable online communities that support professional practice.

For all teachers, an extensive network of communication existing for the sole purpose of social interaction and entertainment has also arisen, and exists sometimes superimposed on top of, or, perhaps more accurately, just beneath, their professional discourse. Within many of these contexts, the potential for a melding of social/personal interaction and professional discussion into an active attempt at community building through electronic discourse seems a very real possibility, a natural outgrowth of the capabilities of this online communication. Unfortunately, there are few stories documenting the successful use of such tools in creating, structuring, even encouraging teacher communities with a shared sense of identity and purpose. Since electronic discourse brings with it the advantage of instantly archivable sources of data, the motivation to try, document, and analyze such community-building activities (thereby contributing to the closing of this research gap) has never been higher. In this paper we will examine one such activity. In the process, we hope to contribute to an expansion of the analytical approaches available to assess the success by which this type of activity contributes to, or reflects, a community of practice amongst teachers with a shared purpose across a school district.

The Need for Teacher Community, and the Context of Computer Mediation

A sense of professional community amongst teachers can be a pivotal part of the educational landscape. Teacher communities can reinforce negative stereotypes and poor habits, but more likely they will allow a joint development of teacher practice, and a sharing of resources and traditions (Barab, MaKinster, Moore, & Cunningham, 2001; Beck & Kosnik, 2001; Grossman, Wineburg, & Woolworth, 2001; Hara, 2001;

McLaughlin & Talbert, 2001). At the high school level, existing communities of practice tend to coincide with disciplines or departments, and "...how traditions of teaching play out in the classroom depends on the strength and the character of [these communities]" (McLaughlin & Talbert, 2001, 64). However, it is entirely too easy to assume the existence of professional communities of practice for teachers, where there may be little that is observable of what we normally ascribe to the phrase (Grossman et al., 2001). Teachers may very well want to connect to each other, but such connections do not always develop naturally, and the natural groupings present in schools – departments, grade levels, shared space, even the school itself – may not successfully create a sufficient sense of community to be useful to, and influential on, classroom practice (Carver & Neuman, 1999).

Of course, the reasons for this lack of connection may be as sinister as poor preparation for the process of teacher community building in teacher preservice training, or as pedestrian as a simple lack of time or forums for community-building interaction. It is in this context that we look to computer connectivity and text-based computer mediated communication to step forward. Although LISTSERV-style email discussion forums and other communications formats nearly span the history of computer connectivity, there are few examples of how such interaction might work with an informal connection between teachers within a district who share a commonality of purpose and responsibility across school boundaries. Barab, MaKinster, *et.al.* (2001) included the possibility of on-line forum interaction into their electronic Inquiry Learning Forum, a web-delivered entity which deliberately attempted to establish a community with a plurality of purpose – an exploration of shared interests as well as an exploration of the concept of online communication and community itself. However, of the three initiatives from this project ("Visit the classroom metaphor," "Knowledge Creation–Management–Networking," and "Commitment to Community"), the latter – the encouragement of a community of practice between participants - proved to be the most challenging of the goals of the project. Participation in the interactive aspects of this initiative often depended on structured relationships, such as class requirements. The designers despaired of ever reaching the "critical mass" required to achieve the goals of community amongst veteran teachers (Barab et al., 2001, 92).

Threaded online discussions are a regular feature of online courses, but even within the context of structured relationships through class participation and required interaction, one cannot assume that such communication will lead towards connections associated with community. In a graduate course for inservice teachers, Merryfield (2001), discovered that "...teachers wrote about highly valuing the online technologies for creating a place for frank discussion, and then, even within the same message or on the next day, they described those same technologies as barriers that kept them from 'knowing' one another or having 'real' relationships" (p. 295). Herring (1999) notes such a dichotomy of attitude as well while examining synchronous chat and other text-based computer mediated communication. Although such media remain incredibly popular, a cursory analysis often shows little useful communication and meaningful interaction which might imply community building. One might assume that a designated topical purpose in an asynchronous environment might encourage more useful and cohesive discourse, but, as Herring further remarks, "[such forum] discussions also tend towards topic decay" (Herring, 1999, 13).

There are, of course, lots of examples of the successful use of computer mediated communication in course structures (King, 2001; Sujo de Montes & Gonzales, 2000), but overall, the use of such media to build community within a district or school context through a free discussion of issues and interests is extremely rare, or at least rarely examined, since there is a substantial lack of research.

The FCPS-TRT-L Discussion List

The focus of the research for this paper is the email discussion list FCPS-TRT-L, a LISTSERV-style forum implemented through capability provided by Fayette County Public Schools (Lexington, Kentucky) Office of Technology. The forum included technology resource teachers (TRT) – both those hired by and based in schools, and those hired by the educational support arm of the Fayette County Office of Technology to float between schools. School-based Microcomputer Resource Technicians (MRT) - a position found in many elementary schools, and a few middle schools – were also included, even though MRTs are not generally certified teachers. However, because of their primary responsibility as lab managers, they often are called upon to perform instructional support duties, making their interests much the same as TRTs.

The issue of successful integration of technology into instruction is important to Fayette County, as well as the Kentucky Department of Education and its Educational Professional Standards Board, as reflected in the latter's New and Experienced Teacher Standards (EPSB, 1999). In addition, Fayette County initiated a set of technology curriculum standards for students, which were passed by the School Based Decision Making councils of all district schools during the end of the previous decade. The Office of Educational Technology is

the single largest district-supplied resource for Fayette County schools and teachers, further illustrating the commitment of the district towards the importance of technology integration into the classroom. Connecting and supporting school-based front-liners such as TRTs and MRTs was viewed as an important function of the Office of Educational Technology.

The FCPS-TRT-L discussion list was piloted in the fall of 2002 to fill this educational technology integration support niche. Previously, this need was addressed by semi-monthly face-to-face meetings, but since participation in the meetings was sparse (many had only one or two in attendance), it was decided to try another format, and a new email discussion list capability put on line a few months before was selected. Unlike most email discussion lists, FCPS-TRT-L is a closed forum – that is, membership was pre-loaded (all TRTs and MRTs were identified and included in the membership of the list in advance), and members have to request to be added or leave the group. As the list's creator, I served as its moderator, and initiated many of the threads for discussion, although the need for that role began to drop off as the list began to develop.

Conceptual Framework for Research

One goal of the email discussion list was to attempt to establish and encourage a community of practice between educational technology integration front-liners. For the purpose of this study, "community of practice" will follow the description outlined by Wenger (1998), that is, we would expect a successful community to exhibit:

- ✓ **mutual engagement** – specifically, the ability of members of the community to interact in such a way that it displays complementary participation and provides for specialization, as an extension of practice rather than ideas or structures,
- ✓ through the reflective process of negotiation, evidence of an indigenous **joint enterprise** with mutual accountability, and
- ✓ a **shared repertoire** of actions resulting from engagement.

The result would be a community which can present and solve problems relating to its duties, to discuss policy and practice in the classroom and lab, to introduce new capabilities and examine resources, in a format that encourages collegiality and a sense of shared experience and purpose (Hunt, 1999).

It was also the intent of the design of FCPS-TRT-L to have members explore the email discussion format itself, with an ultimate goal of encouraging its use directly in the classroom. In addition to this previously-mentioned purpose of the Inquiry Learning Forum (Barab et al., 2001), this duality of purpose matches very closely the definition of community illustrated by Grossman and Wineburg's work with Seattle English and history teachers (Grossman et al., 2001). In that work, another perceived benefit of such a building of community is the encouragement of instructional leadership, a further goal of FCPS-TRT-L and (not incidentally) a part of Kentucky Teacher Standards (EPSB, 1999).

Research Design

The data available for use in examining this on-line community were nine simple text files generated by the list management software, taken during the weeks between the 12th of September and the 15th of October 2002, constituting the first 8+ weeks of discourse for the list. Because of budget constraints, a free list management package was selected by Fayette County to support email discussion lists – David Harris's Mercury Mail Transport System. This system produces raw text archives which are not in a format conducive to analysis, or even comfortable reading. Hence a simple Visual Basic routine was written to strip out extraneous header, inclusion, and formatting text, and to isolate and define important data fields (including date-time stamps and participants) for later processing (see Appendix D). The results were not as readably available and instantly useable as the on-line searchable list databases normally a part of commercial list management packages – text files had to be downloaded and converted locally – but the results were exportable to an Access2000 database, which allowed for a variety of queries and report formats not usually available on line. Even so, some direct handling of the data was still required – most notably because of configuration decisions made early on and subsequently corrected. In the interests of a mixed method analytical approach (Tashakkori & Teddlie, 1998), the resultant data was then used to create two images of the interactive community of teacher participants - a collection of statistical **gross descriptors** (time factors, number of participants, frequency of responses, length of threads, and the like), and **two threads examined qualitatively as instances**, analyzed informally in an attempt to ascertain the presence of characteristics of a community of practice through the

application of Wenger's theoretical framework.

An interest in establishing gross trends and descriptors implied the use of some broad categories for the contributions to the list. Marra et al (2004) examined two forum discourse analysis frameworks with similar goals – the IAM model (Gunawardena, Lowe, & Anderson, 1997), and the Newman, Webb, and Cochrane model (Newman, Webb, & Cochrane, 1996) - but these methods, more focused on the instructional goals of online coursework, were viewed as too general to be useful in this setting, and too divorced from the interests and foci of the Wenger framework.

Rather than simply separating thread initiation postings from responses, postings were categorized by a somewhat detailed assessment of function:

- ✓ Informational (not implying or requiring response, though some did),
- ✓ Question,
- ✓ Response on topic,
- ✓ Response off topic (“on” or “off” was determined through a simple matching of subject line to content), and
- ✓ Other.

This framework was an attempt to establish a structural relationship between postings and threads, and to supplement the natural time hierarchy of asynchronous interaction.

In addition to disaggregating and reporting by subject line, contribution content was categorized by general subject, including

- ✓ Instructional (applying to the classroom),
- ✓ List use (postings about the use of the forum itself),
- ✓ Technical (how-to and other technology-specific questions),
- ✓ Policy (having to do with school or district level technology integration policies and strategies),
- ✓ Personal (concerned with non-professional interests),
- ✓ Me too (one-line postings of simple agreement or thank-you's), and
- ✓ Other.

This additional framework, it was hoped, would allow the data to paint a broad picture of how the list was being used by its participants. Through the use of both of these frameworks, it was hoped that a general characterization of the interests and abilities of the membership would arise, as well as the presence or absence of potential community-building interactivity.

A detailed examination of instances of or threads in the interaction did not easily lend itself to the use of an acutely analytic approach. Over the past three decades, a great deal of attention has been paid to the use of conversational analysis (CA) to describe human verbal interaction, and there are implications in this approach for computer-mediated communication (Mazur, 2004). However, beyond the mediating effects of the technology itself, there are factors which tend to limit the direct application of CA tools in this context. Such concepts as turn-taking, repair, and adjacent pairs of exchange do not occur naturally in a setting where discussion participation takes place interspersed between other work responsibilities, and response times can often be measured in days. As we shall see, the emerging character of the list, and the nature of the interaction between its participants, produced a formality which more closely matches correspondence than conversation.

Gunawardena, Lowe *et. al* (1997) gives a review of several analysis models, and contributes one as well, which were applied to an on-line discussion occurring over a week. However, the focus of the studies cited there were concerned with constructed knowledge and learning rather than an assessment of community. Although an important part of the Wenger model, the construction of knowledge is beyond the scope of this paper, and will be discussed in brief in “Implications for further research.” Hence, for the purpose of analysis in this context, two threads – one exemplary, one perhaps not – were simply compared to the Wenger model, and an attempt was made to assess the presence of indicators of the various components of that model.

Research Findings and Discussion

Gross Descriptors

During the time span of the data, the 86 members of FCPS-TRT-L produced a total of 164 postings by 43 members. These postings represented 39 distinct subject lines, with a mean thread length (postings with the same subject line) of 4, with a standard deviation of 4.86 over a range of 1 to 27. As we shall see in our posting function data, there are a high number (18) of informational postings which did not imply the need for a response (although 5 did garnish responses anyway). If we remove the remaining unanswered 13 informational postings, the mean thread length becomes 5.60 with a standard of deviation of 5.46, a mode of 3, and a range of 2 to 27. Of the 43 participants, the mean number of contributions from each was 3.42 with a standard deviation

of 5.68, and a median and mode of 2 and 1, respectively. Since I was the list's designer and moderator, I contributed a total of 37 postings to the list – more than triple the next most active contributor. Dropping this value as an outlier produced a mean of 2.61 with a standard deviation of 2.22.

In an attempt to ascertain the overall activity for the list as well as the engagement in specific topics, posting response times are reported in three categories. As is often the case, the median time proves to be a better descriptor for describing the overall pace of the participation, since there were occasional long gaps between contributions (the maximum was 6.67 days).

Raw Response Times (time span between postings):

- ✓ Mean Response Time: 9:40 hours
- ✓ Median Response Time: 29.42 minutes

1st Response to Question (time between a question, and the first posted response):

- ✓ Mean Response Time: 13:28 hours
- ✓ Median Response Time: 2:28 hours

Response to Thread (time between thread contributions):

- ✓ Mean Response Time: 3:06 hours
- ✓ Median Response Time: 26.35 minutes

The postings were categorized as to their function within the discourse. The determination of “On Topic” versus “Off Topic” was done by simple inspection – if the content of the posting matched its subject line, it was considered on topic, hence many of the “Off Topic” postings may actually have contributed to the thread in some way, or have been “Me Too” or personal contributions.

Total postings by Type

- ✓ Response - On Topic: 87
- ✓ Response - Off Topic: 33
- ✓ Question: 20
- ✓ Informational: 18
- ✓ Other: 6

The broad topic categories proved to work reasonably well – there were very few “fence sitters” – postings which could have fallen into more than one category.

Total postings by Category

- ✓ Technical: 44
- ✓ Instructional: 40
- ✓ Policy: 29
- ✓ Personal: 15
- ✓ List Use: 21
- ✓ “Me too”/“Thank You”: 13
- ✓ Other: 2

The above gross descriptors paint a reasonable picture of the nature of the contributions, with implications for the participants themselves. Within the first two days of the list, I posted a “this is how to deal with lots of email from a list” remark, which defined list participation as strictly voluntary:

...you have permission to be cutthroat! If you don't have time, or your email box is full, just delete the FCPS-TRT-L email without reading! Nobody will know, or care!
If anyone really does not want to be in this forum, please let me know, and I'll remove you - no questions asked...

Despite this, half of the members of the list chose to participate during the data time span, and only one person asked to be removed. With only 13 of the participants contributing once, most who chose to participate did so a number of times on a range of subjects. As indicated by this and the distribution of the members' contribution counts, one can clearly see that this list – still in its very early stages of development – displays characteristics of mutual engagement beyond the structure and function of the list itself.

The response time data paint a picture of participation which belies the physical positioning of this list

in the professional workday of its participants. The overwhelming majority of the postings (133 of 164) took place from 7:30 am to 4:30 pm, a reasonable “normal working day” range, hence most postings came from members who were mixing their participation into their other responsibilities. This makes the median raw response time and median response to thread time quite remarkable.

The list can be characterized by a fairly formal and business-like mode of participation. Off-topic contributions to threads are the exception rather than the rule, and personal or simple “Me too” contributions constitute a very small percentage of the overall traffic. In addition, the use of a color-coded representation of the threads (see Appendix A) as they evolved on the list shows that the scattered nature of thread connections and adjacency of thread contributions gradually formalized over time, making adjacency of contributions only interesting as they continued the thread. This reflects the substantial difference between this style of online forum, and synchronous or highly active forums in which adjacency contributes to the overall character of the discourse (Herring, 1999). Hence an examination of this aspect of the data was discarded as uninteresting.

TRTs often worry that their working day will be filled with simple technical support issues, but with combined posting totals for “Instructional,” “Policy,” and “List use” subjects over 90 (well over half, with purely technical postings less than half that), it is clear that many of the participants of this list are seriously engaged in the defined purpose of the forum. Two factors tended to encourage the formality of this particular list community – the presence of a vocal moderator with a specific agenda and a large number of postings, and an early departure of a list member who complained of a high number of “chatty” personal postings on the first days of the list. Nevertheless, over the span of the dataset, the subject data seem to reflect the sense of joint enterprise through the reflective process of negotiation, an important part of the Wenger model.

Thread Instances

For the purpose of this analysis, two threads will be examined: The Digital Storytelling thread (Appendix B) and the Mobile Lab thread (Appendix C). The former is the second longest thread in the dataset (16 contributions), and serves as an exemplary exchange on one of the district’s classroom technology integration initiatives. The latter, in contrast, actually comprises two threads. The original poster attempted to restart the thread with a second asking of essentially the same question. It had a total of 11 postings - 4 in the first group, 7 in the second. Beyond this, there has been no attempt to quantify the nature of these postings. The analysis is merely descriptive - the nature of the contributions, and the overall character of each thread, are described as they potentially reflect the Wenger model of a community of practice.

Digital Storytelling: The thread concerns itself with an instructional topic – the expansion of tools used in the process of rendering personal narratives (or other writing) as electronic multimedia. Initiated by a technology resource teacher who was the coordinator of this initiative, the question mentions the current technology being used (a video editing suite and digital imaging software), and wonders if any others are being tried. The responses occur in a solid time block over a four-hour period, with 9 list members contributing. The 16 contributions include three off-topic postings, all in reference to clerical errors in the posting process.

The contributions exhibit a great deal of interest and thoughtful participation. Although most of the contributors were attendees of a face-to-face professional development class on this subject, some were not. The postings are characterized by a problem-solving and divergent-thinking approach to the question, and exhibit directly a reflective process of negotiation with mutual accountability, as the contributors examine each other’s ideas or volunteer past successes...

Joy, (and anyone else interested) The "talking books" I made were created with Microsoft Publisher. It's a really easy way to make a story with sounds. The info. about the PD I did is at:
http://dixie.fcps.net/Professional_Development/Making_Talking_Books.htm You can also use Front Page but I think Publisher is a little easier. It would be possible to do with Power Point as well. You are only limited by your imagination. (and time, of course, always a problem!) Jan

The contributions also clearly illustrate the fact that this forum serves to display complementary participation and provides for specialization, as the varieties of the participants’ expertise and interest unfold. Although it is difficult to ascertain how much of the character of the postings is a function of the medium, its defined role, and the formal nature of the relationship between the participants, there is evidence that the interaction actually represents a community of practice (the following contribution follows one in which the participant failed to identify himself with an auto-signature)...

Nathan: You're on here as a courtesy...you better shape up! ;-)

Assessing the nature of the "...shared repertoire.... resulting from engagement" is difficult to assess. Obviously, it is not possible for a virtual environment to provide visibility for the results of the community in action, since the members of the list, by and large, are distributed one each to over 50 school sites. The actual repertoire of actions as they are made manifest in the classroom will not appear in the forum, except as they are described (Jan's example is one of several that does so). Nevertheless, the entire thread on its face implies the development of such a repertoire.

Mobil Labs: This thread, initiated by a district TRT who was doing some exploration for a conference presentation, became a brief discussion primarily between two individuals – the asker of the question, and one elementary school participant. The low overall level of participation in this thread may be evidence of the weakness of the community in supporting all discussed topics. It might also be evidence of the specialized nature of the topic and the relatively rare use of the technology being discussed. It is impossible to determine this from the dataset.

The first instance of the thread included two contributions from one participant, with a second expanding on the first's remarks (he was a floating TRT who included the same school in his rotation). Since the thread promptly died, it was reintroduced three days later by the original asker. The second instance of the thread produced two more postings from the first respondent, plus one new participant's contribution, plus two short remarks (one of which was off topic) and a further remark by the asker.

This thread was selected because of its contrast to the first, that is, the inability of this asker to extract a wide participation in the exchange. This illustrates one of the problems inherent in applying a theoretical definition of a hoped-for goal as a tool for analyzing the success or failure of electronic discourse in meeting or illustrating that goal. Obviously, the low participation level of the exchange means that the sense of community, specifically "complementary participation...as an extension of practice," is not in evidence for the group as a whole. However, the nature of the individual contributions shows an insight and participation in the topic (and, by extension, the forum itself) which establish a joint enterprise and shared repertoire...

It's much cheaper too. The cart is available through Alpha Smart for about \$550.00 vs. \$5000 or more for the big cart. It has some drawbacks to be sure, but is very functional. I can send pics if anyone is interested...

Overall, the on-task contributions were very much longer than the norm for this forum –another potential explanation for the small number of contributions, since large postings often intimidate or overwhelm members who have insufficient time for lengthy thoughtful exchanges. This meant that, in several cases, a variety of scenarios, problems, and insights were included in a single posting, making the contribution to the community that much potentially stronger...

Kim, Today was the first day with the wireless lab at SMS. A 7th grade social studies class was the first to use the new wonders of technology. One problem we encountered was that we did not have enough computers with administration, Middle School Review, and a teacher having checked one out we were a few short for everyone to have one. The first activity was in the library which worked well with more space and large tables. I would encourage anyone who is considering this venture to have a in-service for the staff in utilizing the technology.

As in the Digital Storytelling thread, it is difficult to assess how much of the formality and "all business" nature of the postings are an extension of the structure of the medium, but it seems unlikely. Again, there were off-topic exchanges which showed that the structure provided for personal banter...

Great suggestion. so...John....when do you want us to come to SMS for your PD session?

If I knew who, I could then invite!

This, again, was an exchange born of the lack of an identifying signature – when this technical

problem was corrected through an improvement in the structure of the list, the banter didn't disappear. But the personal exchanges and collegiality associated with many online discussions remained at a relatively low level of occurrence.

There are several other threads in the dataset which serve to illustrate the cohesion, participation level, and other evidence of the possibility of a community of practice within the members. Especially revealing is the longest of the threads at 27 contributions on student use of teacher workstations in the classroom. This thread lead directly to a further discussion of computer workstation security, and resulted in the preparation and scheduling of a professional development class on the topic. Clearly this is evidence of the mutual engagement, the joint enterprise, and the shared repertoire of a potential community of practice. However, in informal discussion with some of the members of the list, the lack of face-to-face discussion was cited as a concern. Of course, the irony of these observations in the face of the previous year's lack of participation in meetings is not to be missed. But, overall, one might conclude that a great deal of the benefits of a community can be obtained by this text-based medium, and this evidence can be, to a certain extent, derived directly from the text itself.

Implications for Design, and Further Research

With a goal of establishing a community of practice through the use of online discourse, and assessing its veracity through an analysis of the resultant archive logs, there are several limitations inherent in this research design. First of all, a more direct marriage of analysis and model is required, since a simple inspection for evidence leaves much to be desired. Also, a more formal delineation of the discourse using more general tools of analysis might give a better, more transferable method of assessing the ability of this medium in meeting its stated goals, and in describing its character in a way more easily compared to other such communities. As mentioned previously, the Wenger model directly addresses the presence and importance of learning as an integrated part of the community of practice model, placing it at the center of practice, community, identity, and meaning (Wenger, 1998, 5). Assessing the process of learning in computer mediated communication has a more extensive history of practice (Gunawardena et al., 1997), and the use of those tools in this study might have served to increase the accuracy of the community's description.

Another problem with the scope of the interests of a community as compared to a text-only dataset is the inability of the data to represent all of the membership. Although the participation level in this forum was really quite high, there is no way to extract from the dataset the nature of *non*-participation, that is, why members failed to post or react to postings. And, as Wenger and Wenger and Lave have noted (Wenger, 1998, p. 149), legitimate peripheral participation – that is, engaging in community activity in various stages, from the outside to within, is highly characteristic of novices who are in the process of establishing membership in a community. An informal discussion with a list member revealed that she had information relevant to one of the threads, but did not bother to pass that information on to other members. It would be quite revealing to attempt to discover if non-participant members were “lurking” (watching without participating, as this member was) or simply taking the advice I offered at the inception of the forum and deleting contributions without reading them, for reasons of time or other factors. One cannot realistically hope for 100% participation in an online forum (many large forums are lucky to enjoy 5% or more), but the Wenger model attempts to describe the *entire* community rather than only the most visible and vocal members of it. An attempt was made to get at some of this information through an informal online survey, participation in which was solicited through the list. However, the survey enjoyed even lower participation than the forum itself – not surprisingly, since the participants in the survey were most likely to be participants in the forum, which is already a subset of the whole membership. Hence the expansion of the research that these interests imply must, by definition, take one away from the capabilities of the forum itself, and would require a great deal more effort than a simple analysis of text.

One of the difficulties with the numerical data, the “gross descriptors,” was a lack of data with which to compare. The overwhelming majority of the small research data on electronic discourse was on environments created to enhance the interactive nature of online courses, and most of the analysis was at the “micro” level (CA-styled analysis) or the “macro” level (overall effectiveness in enhancing class viability and achieving learning goals). Those few examples of research which were aimed at community building amongst teachers gave no numeric data at all. Although every forum is different, without some purely statistical representation of participation it is impossible to establish expectations and norms for response, in the goal of painting a picture of the success or failure of a forum in enhancing the goals and interests of the community which it represents.

The final concern, of course, is for the encouragement of community itself. The application of the Wenger community of practice model to teachers is not without precedence (Crawford, 2001; Davenport, 2001), and it has great implications for a profession struggling under the burden of assessment, accountability,

and classroom practice pressures. The interests of technology integration are diverse, and the front-liners in this battle are often disconnected and displaced. The need for community is strong, and the exploration and expansion of computer mediated communication in this support seems full of potential. This line of thinking has strong implications for the design of electronic forums. Wenger gives some direction on this point, noting that communities of practice are “as old as humankind and existed long before we started to concern ourselves with systematic design for learning. Communities already exist throughout our societies—inside and across organizations, schools and families...some are potential...some are active, some are latent (1998, p. 228).” The data and analysis of online talk presented in this preliminary study gives needed information on how the content and structure of the interaction can impede or promote the progress from a potential to an active community of practice.

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Contributions to These Practices from a Professional Program

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Introduction

Teacher professional development is assumed to be enhanced through reflective, collective, collaborative professional communities (Little, 2003). Universities in these teacher community developments play a big role by providing teachers with pedagogical helps and professional developments. By not only encouraging teachers to go to conferences, do research publications, and use technology in their teaching practices but also leading them to work together, evaluate each others' instruction, and do collaborative lesson plans, these professional university driven communities seem to remarkably contribute to teachers' teaching practices and professional development.

Getting to know how these communities influence the teaching practices through analyses of teaching applications in classrooms become an important issue not only for the communities as a way of assessing their programs but also for many practitioners and professionals in education who would like to see possible teaching situations, issues, teaching strategies.

As one group of these practitioners and professionals, instructional designers and instructional theory developers are aware of the importance of the possible situationalities for teaching practices. It is because one of the main goals for these professionals is to describe how instruction should look like, what possible conditions and issues may take place will be, and so on within instruction. Unlike learning theories that describe how learning occurs, instructional theories are more goal-oriented and tend to give more explicit ways to follow in supporting learning in instruction (Reigeluth, 1999). In this respect, instructional theories are expected to provide methods in details and variety of situations. In that way, audiences for the theories who are teachers, instructional design and theory developers, and other practitioners interested in pedagogical issues, can make sense of and apply these prescriptive theories into their practices successfully.

The case study presented in this paper aims to document the teaching practices of four high school mathematics teachers who have been involved in a math professional development program provided by one of the Midwest Universities. This paper aims at benefiting the professional development program and many educators, such as instructional design and theory developers by laying out the teachers' teaching practices and examining influence of the program on these practices.

In order to analyze teaching practices, I thought it is important to find a well-accepted framework so that laying out the individual aspects of the teachers' instruction becomes easier and meaningful. For this study, I chose Gagne's nine events of instructions as the framework because as accepted by many professionals, Gagne's events are assumed to be the most general events that can take place in any type of learning situations. For a better learning, these events should be accomplished to satisfy the necessary learning conditions for relevant learning type (Aronson, 1983) such as motor skills, intellectual skills, attitudes, cognitive strategy and so forth. Even though "Gagne's nine events of instruction are his methods of instruction" (Reigeluth, 2003), these general events-methods hardly mention the situations where the methods should be applied in different ways. That's why, any situational differentiation that could be found in the teachers' teaching practices may provide details to applying these nine events under many conditions, which Gagne gives little guidance about. Below are the nine events that Gagne proposes:

Event 1- Gain the Learner's Attention: This event includes techniques to appeal learners' curiosity and interest such as presenting something novel, giving challenging situations or problems, putting students in uncertainty, and so forth.

Event 2- Inform the Learner of Objective: This is about familiarizing students with what they will be learning during the lesson and how they will be assessed. Knowing what to learn provide students with a determined focus in their learning.

Event 3- Stimulate Recall of Prerequisite Learning: This is to help students to recall their necessary prior knowledge and experiences to understand the new acquired information in a meaningful way.

Event 4- Present Stimulus Material: It is the presentation of the content through variety of media and approaches to expose information to the learner.

Event 5- Provide Learning Guidance: This is about the methods such as providing examples, hints, cognitive tools - handouts to make learning easier.

Event 6- Elicit Performance: This event is about providing opportunities to students for practicing through having them “do” instead of having them just “listen”.

Event 7- Provide Feedback about Performance Correctness: This includes methods in which learners are given a description of how they have done in given practices. It could be verbal, written, or other forms.

Event 8- Assess Performance: It is more about a process of assessing students’ performance after they have been exposed to a learning event.

Event 9- Enhance Retention and Transfer: This is the event where learners are given more opportunities to practice or review the materials so that they can recall them in a later time easily and meaningfully.

Method

This study is a case study in which a group of teachers’ teaching practices and professional development experiences were examined in a bonded system, which is a professional development community that affects these practices and experiences. As Merriam mentions (1998), in case studies, researchers are more interested in discovering and interpreting based on a phenomena taking place in a bounded place, instead of testing a hypothesis. The teachers’ teaching experiences within their professional development process is the phenomenon that I am trying to “discover” through this study. The approach I took for the study could be hermeneutic (Brantlinger, 1993) because I try to see the teachers’ practices from their “eye” along with myself interpreting what they “see”.

Setting & Participants

Participants were four high school mathematics teachers that have five, thirteen, sixteen, and twenty-eight years teaching experiences respectively. They were currently participating in a professional development program provided by one of the Midwestern Universities. This math teacher professional development program aims at engaging many practitioners, secondary and high school math teachers, university mathematicians and mathematics educators in a collaborative environment where mathematics teachers can get benefit for their teaching practices and professional developments.

The teachers involved in this study were currently teaching algebra, geometry, and calculus, to 9-12 graders by the time study was being conducted. While the teacher-George with a twenty eight and Kurt with thirteen years teaching experiences had been involved in the meetings of the math professional development program for more than 2 years, the teacher-Kristen with 5 years teaching experience recently got involved in meetings for last couple of months. On the other hand, while the other teacher-John with sixteen years teaching experience had been in the professional development program for 2 years, he had not been able to attend the meetings regularly because of his busy schedule. The teachers were all from a same high school in one of the midwestern city that is dominated by a big university by which the professional development program has been driven.

Researcher

Pursuing a doctoral degree in instructional technology department at a school where the professional development program had been carried out made it easier for me to contact with the manager and the director of the math teacher development program. After initial contact and agreement based on my research purpose and interest in instructional theory development and possible benefits that the program can get from the study, I was allowed to ask the teachers to participate in the study. I was introduced to the teachers as a graduate student member doing research studies for the program.

Data Collection and Analysis

The data collected are mainly through interviews. In addition, observations of initial meetings and document analysis regarding the mission and the structure of the program were used as ways of collecting data.

Document Analysis

Mainly, I searched in the website of the program for its mission, activities, regular meetings and so forth. It just gave me an initial plan for meeting the director and the manager of the program and proposing my research agenda.

Observation

To be introduced to the teachers in the program, I participated in one of the regular meetings taking place within the program. This gave me a chance to see the structure of meetings and issues held during the meetings as well as an opportunity to meet the teachers face to face.

Interview

Convenience sampling approach was used to involve teachers in the study because by the time study was started, it was getting close to the second half of the first semester in high schools when many teachers are pretty busy their schedules for the school.

One or two weeks after the meeting I attended, teachers were emailed by the manager of the program whether they would be willing to participate in a proposed study for which I would be interviewing them. Among them, did four teachers agree to participate. All of the teachers were (45 minutes to 1 hour) interviewed in their schools within the following 2 weeks.

The questions to be asked in the interviews had three different facets: The first one included general questions such as the teachers' years of teaching experiences, how they had got involved in the program, what their initial expectations were and so forth. The second one was about teachers' teaching practices in details. Gagne's nine events were used as a framework regarding what tactics teachers are using, and what they are encountering in each event. The last part was focused on how the teacher professional development program had been contributing to their teaching practices and what their possible suggestions would be regarding a better professional program. Each teacher's interview was audio taped and transcribed for the analysis.

Findings

The Teachers and the Program

Teachers were mainly participating in the program by attending two main meetings held in the university; (1) joint meetings in which teachers, university mathematicians and mathematic educators gathered together to discuss the future activities, goals, and directions for the program. Approximately 40 joint meetings had been held since 2000, with an average of 5 meetings per each semester (including summers). (2) The other meetings were those in which teachers meet as subgroups regularly in every two weeks to discuss about a particular lesson plan they are developing consistent with their particular teaching area. While Kurt and Kristin were in a group that was dealing with multiple representations, George was in a group for proof in math, and John was in a group for technology in math area.

Based on my observation and information gathered from the website, in the second type of meetings, which are called LSG (lesson study groups) meetings, teachers generally spent 30 minutes for a general discussion about the next week's agenda. Then, they grouped in their LSG groups- multiple representation, proof, or technology groups, etc. to elaborate a lesson plan that they have been trying to form for long time. Their problems in their teaching experiences could also be a discussion topic if other teachers in the group were also interested in it. For example, when elaborating the lesson plan in proof group, one of the teachers, George, was addressing an issue that he considered to be important for his students - the lack of language level in math and, then, others continued the conversation by giving their own examples. This similar conversation seemed to show me that there could be some problems in teachers teaching practices that I should consider in my interviews later in the study. That definitely led me to put an additional question into the interview questions regarding what kind of problems that teacher can face in their teaching. In the following section, I will describe my main findings from the interviews of the teachers.

Why Are the Teachers in the Program?

When asked, the teachers seemed to have similar reasons for joining the program. Looking at lessons in depths, trying to be reflective on their own teaching practices, collaborating with other teachers, and doing pedagogical readings were the general reasons why the teachers got involved in the project. On the other hand, as a professional development, the program seemed to address other expectations of the teachers such as being given opportunity to go to conferences, do academic publications, and use pedagogical resources and technological equipments that the program can provide.

What Do the Teachers' Teaching Practices Look Like?

The followings are the main teaching events and issues that the teachers had interesting points and

strategies about. Thus, I do not necessarily mention about each of the nine events here. Rather, in the conclusion part, I put a table that describes all of the activities that the teachers carry for each event as a summary.

Gaining Students' Attention: The teachers mentioned questioning, making announcements about the lesson plan/objectives, starting with high level of tasks, or presenting a problem, as the main ways for grabbing students' attention. In many instructional tactics challenging students with questions is one way to get students attention as seen in teachers' explanations (Dalton, 2003). However, one of the teachers, Kristin, seemed to be careful regarding presenting challenging question.

In the past, I tried to do things like here is an attention-getting problem "here you work here and I work". It was kinda frustrating.

In many learning situations if students are left alone in a given challenging question, they may become frustrated. It is a concern that both Kristin and Kurt pointed out. Regarding challenging question, Kurt continued with another point, student achievement level:

They should have a background to figure out when doing problems. I do not challenge my lower level students.

In a similar way, George mentions about challenging students in relation to their levels:

I can say it is hard, I have a couple of students in second year cal[culus] that are really difficult.... To challenge them plus keep the class going is tough, because I can develop my class period if you are doing things that they are capable of doing and that's kinda hard. It is tough to have the appropriate thing for every student.

As seen in George and Kurt explanations, students level could be a problematic situation in which low level of student are more likely to get stressed when confronted with a challenging problem. On the other hand, high level students are believed to get benefit from it. As George noted, it could be really difficult to address issues tailored to every student. Especially when the class size is considered, posing challenging questions to the students might not be a preferred option for teachers. Hargreaves and her colleagues (1997), examining the class size and student-teacher interaction, observed that challenging questions, which students need to give more reasons to answer, are often used in smaller classes. The bigger the class size, the more likely it is to have different level of students and the less often teachers ask challenging questions. The ideal way for such a situation like this could be to try to find out a middle point of "how often" to use challenging questions or to figure out other ways.

Rather than starting with a question, Kristin suggested another way, which is not directly targeted on gathering attention but on keeping students' focus in a meaningful way.

I have a folder for them, they go and check that so they are busy organizing their binders firstly, they are required to keep a binder and it is separated into sections like handouts and notes homework and quizzes and tests, they have these sections and they go to their folder, you know, they have things to do, they know that that is expected so they bring it back and sit down and organize it and whatever it says, they need to do that point too.

Keeping students busy in doing some sort of tasks was seen as another way of maintaining the students focus by Kristin. Maybe, this is not something that grabs students' attention directly but something that warms them up before the class starts. On the other hand, this is not to say that starting with an interesting and challenging question will always cause to frustration among the students. As long as students are given chance to think and discuss about the question, it may be still possible to stimulate students' thinking. Those students who can be stressed by teachers' challenging question may have more effective discussion if they are given chance to collaborate with each other. Maybe, putting students in pairs and letting them discuss about the question will work well in leading students to have focus and pay attention to the class flow as another teacher, George, did. Talking about how he kept students attention level high, George went on:

I actually question them to ask their partners to respond their partner or " here is something I would like you to work on for a few minutes" so they do not have long periods of times whether or not doing something.

But again, without enough help and resources, students even in groups can feel frustrated. Students

confronted with bunch of information and problems to solve without any adequate resource, can be in trouble. Kristin, trying to describe the ideal challenge, addressed this issue:

To me, I guess the ideal challenge is not just pushing information on them but helping them learn the information. I never ask them to, “ok put away your book and do not look at that” [instead] “Use all your resources” you know and to set up a challenge in that way that you [students] always have resources to use. So, “use what you have” and “ use somebody sitting next to you, ask some questions you do not understand”.

It seemed to Kristen that attention gathering is not necessarily to ask students something interesting and challenging that directly grabs their attention, but to keep students focus in a meaningful way, which could be in the form of asking students to organize their folders, discuss in their groups or pairs, or so forth.

Stimulating Recall of Prior learning In many subject matters, understanding a concept is very important learning outcome like in mathematics. Understanding concept is not just to describe something as a concept but rather to see the concept in relation to others and to be able to perceive how it behaves in different unfamiliar situations. To understand, it is important for the learner to make connection between the newly acquired knowledge about the concept and the already acquired prior knowledge in meaningful ways (Reigeluth, 1998). Through these connections, the learner is able to see where the “new” fits into “old” ones, consequently, understands the concept meaningfully. In cognitive theories, this process is defined as assimilating new information to existing knowledge structures and accommodating these already structured knowledge units to the new information as necessary. Thus, it is important to have agreeability between the newly coming information and existing knowledge unit in mind is important. When learners get exposed to information units similar to those already structured in their mind, it is easier to activate these already structured units (Winn, 2004). In other words, showing relevancy of new information seems to help process and make sense of the information for learners.

When teachers were asked about their ways to help students recall their prior knowledge, the main ways they described were (1) reminding students the prior knowledge as necessary before or during teaching a new topic verbally or on the board and (2) having students memorize information from prior classes.

John and Kurt had the same way that they just go back and review the materials when they think that there is a weakness in students’ understanding of the new topic. It seems that time spent in stimulating the prior knowledge is pretty limited especially when the students are not able to recall the “old” knowledge well and there are many new topics to be covered in one lesson. Kristin, when talking about recalling prior knowledge, continued that:

Within the range of the students we have in one class that some, of course, recall and you know that’s the hard part... we have some [students] that do not recall at all, they do not remember. When you start a new instruction, [you say] “here is your path on the back what we did before, you remember those” and through that, “o yeah o yeah” like all start going often and you just do the best you can with that and then lead them slowly into a new topic.

On the other hand, mostly, students are expected to recall what they have already learned. George, explaining his way of stimulating prior knowledge, mentioned that:

I have them memorize quite a bit, they have to know the statement or some theorems. I mean I try to tell, “ you need to know the exact languages or you need to be able to talk about the ideas on this theorem”. My point to them is “well, it’s just like learning speaking a language, you have to be fluent, and you have to know the vocabulary”.

Even though George had a good point in knowing certain aspects of prior knowledge in understanding new ones, he did not appear to provide certain ways of helping students recalling the prior knowledge pool other than having them memorize.

Kurt noted another issue in recalling prior knowledge. Even though he said that he reviewed some materials as he felt that students needed to recall, his expectation from high-level students was pretty different than from the low ones:

I teach two honor classes. I expect them to know certain things and often I am disappointed because they do not recall what I hope they do.

It appeared that he was more likely to review materials for low level students because he believes that high level ones can remember and know some certain aspects already but in fact, often “they do not recall” either as he mentioned his disappointment.

Presenting the Stimulus Learners are supposed to get exposed to certain types of information in order to make sense of it. This event is mostly where the students are given the information presentation in variety of ways

(Aronson, 1983). Verbal information, demonstration, visual means, and others are the general ways for presenting a concept, examples, and relevant supportive information.

Drawing on the board, verbally given examples, problems, use of video and some basic computer applications for visual representations were the main ways which the teachers mentioned for presenting stimulus. However, there were some points that the teachers made in terms of how students could have problems with a given stimulus. One big issue that George was concerned with is the complexity and importance of language level in math. He said:

One problem that they have I am convinced is just the language level in math..... I mean I have students that can read a book read a page in an English class and it's a full of details too but they can bluff it by not having to read that quite everything in English. I mean, in math, it's so much more compact in that things really matter, you have got to know every word in a sentence and what it means, there is a lot of language issues.

As George pointed out, the first matter for students is to know the "every word" to make sense of the "sentence". Maybe the ways in which information is presented is important but it seems that it may not matter for students to see the information in different forms if they do not have the certain prior understanding of that information.

Scared of Math? When talking about problems that students can face in math, teachers were aware that students may have negative feelings about math. According to the teachers, unsuccessful math background and lack of confidence were the main reason. George perceived feeling lack of confidence and feeling hesitations as a part of bad interaction between students and teachers. He went on:

I think a lot of teachers are open to questions... well, I answer any kind of questions,.... some teachers would talk about, you know, "students are asking dumb question or stupid questions" if you asked me a question in math what $3+4$ is, I would tell you in a strait face.... I want them to really feel like that they can ask me anything in math.

He had the same remarks when suggesting that:

I know that again, it's deadly if the teacher says "if you had listened to me, you would know it, you did not listen". I think, we have to avoid this [kind of remarks]..... I think we have a lot of [this] kind of things going on and that makes students reluctant to ask because they do not wanna ask [at all].

In addition to attributing lack of confidence to the bad student-teacher interaction, George also viewed the interaction among students as another reason for a negative attitude about math.

...if they judge the smartest person in class, maybe then they might be thinking that "I am the dumbest person in the class" They all are very good but rank themselves, you know, for good or bad. I think some do like competence.

Examining the opinion on one's own confidence based on the belief about other people's ability, Wagner (1984) found that one's confidence gets higher if a superior other (in ability) is perceived to agree with him whereas the confidence becomes lower if a superior other disagree with him. In other words, a student can feel less confident in a classroom setting if he thinks that there are some other better students who would disagree with him when he talks. Bandura (1997) notes that observing or perceiving others in their ability to carry on a task creates a vicarious experiences, which contributes to the ones own beliefs in whether he can carry the same task as well. Likening self to others in terms of ability, accordingly, can be helpful for one to complete a task as long as others are perceived successful in completing it. On the other hand, if one lowers his perception about his own skills and sees those, who successfully complete tasks, superior to him, then, the vicarious experience would not benefit him. In fact, it would create negative feelings and lead to lowering expectations about his performance on a given task.

Kristin, on the other hand, made another point in explaining why students may have negative attitudes toward math. She believed that parents' thoughts and experiences on math affect students' confidence about math. Based on her conversation with parents, she commented that:

At home, they [-students] are told that "I can not help you with this homework I do not understand math" and parents tell them right a way that it is ok not to understand it and you know "I am afraid to try to look at it with you" so I think they are discouraged, some of very early age.

This might be the same thing as verbal persuasion that Bandura describes (1997) in terms of how one's

belief about his ability to carry on a task can be affected by others' ideas, encouragement, or discouragement about the person's potential performance. In this case, parents' beliefs about their own low ability in math and consequent low expectations of their own kids' ability might serve as a discouraging factor for kids to develop confidence in math.

Kristen also talked about family meetings in which teachers introduce short class sessions to parents. She sees this as a way of changing parents' perceptions about math, consequently, helping students not have negative attitudes toward math:

This is our third year, in the first year we had 30 parents and students come, last year it's about 120, this year 300. So, what they do is that we have teachers' teaching 25min. session using graph and calculator, there are simple things, using GEO boards, origami. Parents are terrified to come, you see them when they walk in the door, we have pizzas, we talk to them a little bit, in the end, they all just smile.

If parents' perceptions are really considered to be influencing their kids perceptions about math, these meetings really seem to help parents and students respectively.

The Program's Contribution to the Teaching Practices

After talking about their teaching practices, the teachers were asked whether being in the program contributes to their teaching practices. It seems from the teachers' comments that the program influenced teachers' teaching practices in a broader but not direct way. They see the program as an opportunity to collaborate with other teachers, do lesson plans elaborately, do pedagogical readings for their own instruction. When talking how the program affects his way of teaching, Kurt emphasized that :

I think the program has not necessarily influenced how I assess, how I present, or how I communicate [with students] but it is all in there together. It makes me concentrate on certain aspects of my own instruction.

For one of these "certain aspects" , he added that:

I am in the multiple representation group and I have found myself trying to include multiple representations of algorithmic relationships. I think, it's important for students to see relationships in multiple ways because they are not gonna understand [the relationships in] one way.

Kristin also noted how her teaching practices became different as a result of joining the program: ...there are three multiple representations that I used and I really think it helped. By the end, the kids are saying " oh I know how to do it in algebraically, can I just write it all out" Before I have not thought about doing these three things, I was just struggling to get them to write it out in one of the ways. You know, they would just make statements like they would put -2 and -2 on each site rather than writing a new statement that is actually new something mathematically. So they are begging me, "I am ok with this, do I have to draw it anymore?, I just wanna write it all out", and then, I am like " you just want to write it out, ok, that's fine".

Based on similar comments, it is pretty obvious that the program affected teaching practices of the teachers by not only enabling teachers to focus on specific elaborated lesson plans but also encouraging teachers to promote different multiple ways for students to understand and learn. The teachers also agree that the program contributes to their professional development by giving opportunities such as going to conferences, using technologies and resources in their classroom etc. On the other hand, there are some suggestions that the teachers made how meetings could be enhanced. More reflective and interactive discussions are what the teachers would like to have. Regarding how group meetings should be taking place, George noted that:

I think I like that we talk to the whole group a little bit about what our small groups are doing because I feel like I want to share with everybody what we were talking about in our proof [group] like " we are trying to get this theme of justifying more often in class".... In proof [group] we have got something to start to share and the multiple representation group talked about specific lesson plan but when we ask that they said something, they did talk about what kind of their overall goal.... I enjoyed doing that, but I like to have some chances to hear some more things that may have impact on all the teachers.

It seems like the subgroups of the program, even though they are active within their own groups, need to "be heard" and need to "hear" in other subgroups as well. More feedback from other groups is something Kurt would like to have:

I would like to get more people speak on what we are doing in our sub groups.....I wish that there were ways to get people to give me more feedback on my teaching practices..... the more feedback I can get on what I do in my classroom, the better teacher that would make me.

Enabling teachers to communicate with each other more and provide with feedback necessarily seems to be a good point that the program needs to take into account. Leading the teachers to use communication tools such as online discussions could be one example as George mentioned with regard to an existing discussion tool [ILF]:

There have been times that [ILF] was used effectively but for whatever the reason, we have not used ILF resources in terms of the facility to work on a common document or the chat. I thought it would be worth trying to some time to have discussion online but we have never done that.

Conclusion

In this paper, four high school mathematic teachers' teaching practices and their professional development experiences' contribution to these practices was documented. Not only the professional development program was expected to benefit from this documentation but also many educators, such as instructional design and theory developers were assumed to learn from these teachers teaching experiences.

For the Program

It is obviously seen that, the teachers' initial expectations are pretty met with the support from the program. Collaborating with other teachers in meetings to discuss lesson plans in details, doing pedagogical readings for their own instruction, providing feedback to each other, being reflective about the teaching practices, and being in a professional development are those the teachers expected to have and mostly were provided by the program. There are many ways that the teachers incorporate their experiences from the program to their teaching practices. Presenting students in multiple ways that were mentioned in the group meetings is one of the obvious direct pedagogical contributions of the program. On the other hand, there could be some ways to improve the program as a better professional development. (1) Having more and easy discussion environments among the teachers such as those online communications and (2) providing more constructive feedbacks not only within subgroups but also among the groups are the main ones noticed by the teachers.

For Educators

Regarding the teaching practices, it seems that there are many similar and different ways that teacher applies in each nine events of instruction. In addition to that, there some issues that the teachers pointed out for implementation in some of the events. Below is a general table that describes the strategies applied and important issues considered by the teachers in these nine events.

Table1- Teachers' Ways in Each 9 Events and Possible Corresponding Issues

| Events | Teachers' ways in events | Issues mentioned |
|---|---|---|
| Gaining attention | <ul style="list-style-type: none"> ➤ Questioning ➤ Announcements ➤ Starting with Problems ➤ Starting with High level of Tasks ➤ Listing Objectives ➤ Yelling etc. ➤ Keeping students busy and focused on certain tasks ➤ Putting students in pairs and letting them discuss | Students can get frustrated when confronted with a difficult questions or high level of tasks. |
| Informing learners of the objective | <ul style="list-style-type: none"> ➤ Announcing verbally ➤ Written objectives on the board ➤ Written objectives in handouts | It may take too long so there may be not enough time to start and go on the new topic. |
| Stimulating recall of prior learning | <ul style="list-style-type: none"> ➤ Reviewing necessary prior information ➤ Verbally reminding students the prior knowledge during or before the presentations of a new topic ➤ Having students memorize prior knowledge and expecting them to recall ➤ Providing resources to students as much as they need | Students have to have necessary prior knowledge but it might be hard for them to recall everything. |

| | | |
|---|---|--|
| Presenting the stimulus | <ul style="list-style-type: none"> ➤ Using Visual tools (powerpoint, graphics, drawing on the board, graph calculator, etc.) ➤ Using Numerical Representations ➤ Giving students enough time and Letting them discover ➤ Giving examples and problems | <p>Students may have different preferences regarding the teaching way –structured Vs less structured lesson</p> <p>Students may have problems when being exposed to stimulus and trying to make sense of it at the same time</p> |
| Providing learning guidance | <ul style="list-style-type: none"> ➤ Providing handouts, ➤ Giving more examples ➤ Re-explaining points made in books | Not mentioned |
| Eliciting performance (Practice) | <ul style="list-style-type: none"> ➤ Problem solving after each concept or before the class is over ➤ Encouraging students to solve on the board | Not mentioned |
| Providing feedback | <ul style="list-style-type: none"> ➤ Showing students their own mistakes rather than showing the all solutions. ➤ Using positive reinforcements (e.g Mc Donald cards) ➤ Asking students to provide each other feedback in group work | Not mentioned |
| Assessing performance | <ul style="list-style-type: none"> ➤ Questioning students for their response ➤ Controlling homework and journals completions ➤ Doing Quizzes, tests, etc. | Not mentioned |
| Enhancing retention and transfer | <ul style="list-style-type: none"> ➤ Putting things in tests from prior class sessions ➤ Asking students to take notes, ➤ Making connection to previously acquired knowledge through reviewing and reminding ➤ Giving Homework | Not mentioned |

Among these nine events, gaining students attention, stimulating recall of prior learning, presenting the stimulus are the ones that the teacher seemed to focus on more. Teachers also have different types of strategies and problems that they can encounter in each event. According to the teachers, challenging tasks as a way of gathering students’ attention could be problematic depending on the level of the students. Also the lack of resources to use in solving these challenging problems could be frustrating for students. On the other hand, regarding the stimulating the prior learning, students may be expected to recall instead of being help to remember. This sounds problematic if they are only expected to memorize and be “fluent” because like in many subject matters, understanding concepts heavily depends on the connections that the student can make between what he is learning and what he has already known. Presented the stimulus, students may have problems in both trying to take notes (being exposed to the stimulus) and trying to understand what the stimulus means. Even though they have a chance to review the notes that they take later, it may be hard for them to understand something that they did not in class. Another issue in this event is the preferences that students may have for their learning styles. For those who “resist” discovery approach, using more structured information presentation may seem to the teachers as a good strategy but in this case, those who are willing to “discover” are not given the opportunity to discover. The ideal way, as emphasized in the interviews, could be a combined approach in which students are exposed to both discovery and more structured ways of learning so that everyone, at least, can have a chance (to some degree) to learn in way that they prefer.

The teachers also mentioned the reasons of negative feelings that students might have toward math. Lack of confidence due to lack of positive feedback from teachers, seeing other students superior to self, discouraging prompts from the teacher, and low expectations that parents have about their kids’ performance were perceived as main reasons. More caring and positive communications between teachers and students and more encouragement from parents about the students’ performance are the ways that the teachers perceived to handle the students’ negative attributions to math.

As George mentioned, “*it is tough to have the appropriate thing for every student*” but it is always worth trying to have multiple ways and necessary communications to approach the students in a caring, motivating but not discouraging ways so that their learning can be enhanced by letting them go beyond their possible fears and learning obstacles.

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Forming Virtual Learning Community within Online Course: Students' Perspectives

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Abstract

This research intends to explore students' aspect and impact on forming virtual learning communities within online courses. A formal online course that is on the process of building virtual community is closely examined to discover students' perceptions of learning community approach, their online performances, and how these perceptions and performances facilitate or hinder the forming of a virtual learning community. The study can serve as a useful guide for online education practitioners and online learners.

Introduction

In this information era, institutions of higher education are delving into the world of online learning: there has been rapid growth in the number of course being offered either entirely online or as a supplement to a face-to-face course (Underwood et al., 2000).

On the other hand, online courses have been appearing so rapidly that little thought or effort seems to be given to the specific needs of the classroom in cyberspace. Traditional teaching methods are being attempted in a nontraditional environment (Palloff & Pratt, 1999). Many online courses simply put face-to-face class's lecture-based content online. Such kind of "traditional" online courses, as demonstrated by the research (Besser, 1996; Carr, 2000; Herrington, et al., 2001, Kerka, 1996; Schrum, 1995, Swan, 2001), have caused high dropout rates, bad learning outcome, and low satisfaction rate. Therefore, how can we modify current educational strategy to enhance online learning process? In answering the question, educational researchers have recurrently proposed the virtual learning community approach.

Briefly, virtual learning community is an extension of the physical learning community outward to the electronic one (Russell & Ginsburg, 1999), which is originated from the constructivism learning theory that proposes a goal-based collaborative learning within a community context (Wenger, 1998). Palloff and Pratt (1999) have explained the importance of community in electronic classroom by arguing, "The learning community is the vehicle through which learning occurs online...Without the support and participation of a learning community, there is no online course." The importance of community in online learning is also supported by empirical research. Quite a few studies (e.g. Hiltz, 1998; Pretera & Moller, 2001; Russell, 1999; Russell & Ginsburg, 1999; Shrivastava, 1999; Wang, et al., 2001) evidence that virtual learning community is a powerful tool to boost online learning participation and achievement.

A virtual learning community, according to Rovai (2002), can be constitutively defined in terms of four dimensions: spirit, trust, interaction, and commonality of goals (learning). Similar definitions of virtual learning community can be also seen in the works of McMillan & Chavis (1986), Jonassen, Peck, & Welson (1998), and Kowch & Schwier (1997). These definitions suggest an essential framework of a virtual learning community, which comprises: an active learning environment that fosters a climate of learning in community, a dynamic learner-directed process of "communication, collaboration, interaction, and participation" (Lock, 2002, p. 397), and the development of feeling or sense of community.

However, even though literature has explained why virtual learning community is important and what it is, another fundamental question remains poorly answered – how to build a virtual learning community?

Currently, there are a select few studies examining the development of learning communities within online courses. These studies focus on the community environment and address the issue through the lens of designers and developers. Some attempt to describe a systematic development model for building virtual learning community, including the research by Barker (2001), Lock (2002), and Ravitz, (1997). For instance, Ravitz (1997) proposed a seven-stage ISD model for building virtual communities, which involves management, front-end analysis, communication environment design, projects development, implementation, community evaluation, and information dissemination.

Others (e.g. Kuhl, 2002, Nixon & Leftwich, 2002; Pretera & Moller, 2001; Quitadamo & Brown, 2001; Snyder, 2002; Yoder, 2003) emphasize the pedagogical issues when designing instructional context that promote community. A representative one is done by Yoder (2003) who presents seven strategies to foster a

community-promoting online communication process.

Finally, some design research (e.g. Cutbbert, et al., 2002; Jin, et al., 2001; Lally & Barrett, 1999) has evolved around the technological issues in constructing a virtual “community place”. For example, Lally and Barrett (1999) discussed the strategy of using computer-mediated communication to reduce transactional distance and facilitate the construction of learning communities in an online environment.

Few of these studies, however, are empirical research. Additionally, previous literature has not amply described students’ perspectives and impact in community development. As Lock (2002) and Jonassen, et al. (1998) have pointed out, the learning community model depends largely on students. Students need to be aware of the community philosophy and “make a paradigm shift in their learning strategies” (O’Sullivan & Miron, 2000, p. 7). However, guidelines on how students respond to community in cyberspace are scarce.

As a conclusion, significant work, especially empirical research, is needed to well address the issue of building community within online course in terms of learners’ perspectives, responses, and impact on community forming.

Research Purpose and Questions

This qualitative study intends to explore learners’ perspectives and responses to forming virtual learning communities within online courses. Specifically, the central research question to be answered is: what are students’ responses to the virtual learning community and how do these responses relate to the community development?

This research contributes to the literature by attempting to shed light on the development process of virtual learning community in terms of what is really happening to participants and how their responses influence the forming of the community.

Methodology

The research is designed as a qualitative case study. According to Stake (1995) and Creswell (1998), case study is employed when the project involves a “case” (bounded in time or place) and extensive materials from multiple sources are collected to provide an in-depth picture of the “case”.

In this study, a formal online course in a major American university, which takes learning community approach in instructional context design, is identified as a “bounded case,” bounded by time (5 months data collection) and place (a single course). Extensive data from individual in-depth interviews, online activities observation, email messages, transcripts of bulletin board and chat room discussions, students’ assignments, and other course materials have been collected. Through this data collection, the researcher then makes a detailed description of the context or settings of the case, conducts an analysis of themes, and gives an interpretation or “assertions” about the case (Stake, 1995).

The Case Setting

INSYS 446 (spring, 2004) was a purely online graduate course delivered by a major American university through ANGEL course management system. The course was medium-sized (with 30 students). The instructor of the course has taken a constructivism learning community initiative to design and develop the instructional context.

First, instructional and learning activities evolve around intensive online interactions and collaborations using both synchronous (chat room) and asynchronous (bulletin board) conferencing tools. Online interaction and discussion is required and graded. The syllabus lays out a clear specification on the frequency and content of the peer feedback. Group work with project-oriented collaboration and information exchange is emphasized in the course assignment. Students need to develop application projects in the unit of small group. This fact is explicit in the following description cited from the course syllabus:

You will work in teams of 3 when possible and each team will create three mindtool projects. We will begin with a planning week then have three production weeks. You will act as team leader for one of the production weeks and team member for the other two. Each team leader will guide the production of a mindtool using a different software package. Team leaders can ask teammates for assistance with development and assessment ideas, and will ask teammates to test the mindtool. Each class member will act as a codeveloper on 2 mindtools projects. Codevelopers will advise team leaders and serve as beta testers of mindtool projects (INSYS 446, March 8th, 2004)

Second, the learning process is student-directed rather than lecture-based. In the introduction part of the course syllabus, the instructor claims that he will let students explore the subject before sharing his opinions

with them. This claim can be observed from the fact that on the course site there is no section for explicit lectures. Online instruction is conducted in forms of feedback and guidance, through bulletin board and emails. Learning is active and project-based: Students need to develop projects from real world problems to illustrate their knowledge of subject content; they share expertise and contribute multiple perspectives to peers during project development and assessment; in addition, they are provided opportunities of taking on various roles (leadership or regular member) in support of their learning process. Such a project-based situated learning, as Tam (2000) and Lock (2002) suggest, helps to cultivate an environment that promote community.

Third, the instructor encourages an “atmosphere of adventure” (Hill, 2001, p. 9) in his evaluation mechanism. Learning tasks, whether reading review or application projects, are mostly open, heuristic, not assuming only one standard answer. Students’ assignments, as observed, displayed multiple presentation format and multiple perspectives. They are evaluated more in terms of efforts and richness, rather than absolute correctness.

Finally, the setting of the online discussion has emphasized group cohesiveness and identity. In the bulletin board, each group has its own group discussion forum in addition to the general class forum, and each group has a specific name for identification, such as “Banana” team, “Apple” team, and the sort. Then, the grouping is developed based on two criteria: interest in the same learning topic choice, or the same professional background that rear interest in similar real world problem. This kind of grouping strategy, as the researcher interpreted, is a reflection of “commonality of expectation” among group members (Rovai, 2002).

During observation and interviewing, the researcher has not found an obvious concern on relationship development in INSYS 446’s instructional design and development. However, the instructor does allocate one orientation week for students to post a detailed self-introduction message to the whole class. He also opens a personal page for each student and asks them to upload pictures and personal information there. Most of participants interviewed express their appreciation of the orientation and personal pages as customs to develop sense of familiarity and relationship.

Based on the above-mentioned features, the researcher believes that INSYS 446 (spring, 2004) is a representative and valuable case to be examined for the research intended. Hence the researcher asks for the instructor for the permission to access, and has examined the case as an avid spectator.

Participants

Creswell noted, “The purposeful selection of participants represents a key decision point in a qualitative study” (1998, p. 118). By following his “maximum variation” strategy to select subjects that represent diverse perspectives, the researcher has selected 12 participants from the students enrolled in INSYS 446 (spring, 2004), who are diverse in terms of age, gender, nationality, professional background, prior online learning experience, and finally, learning styles.

These 14 participants, aged from 20s to 50s, 5 females and 9 males, comprise full-time education-majored graduate students and part-time adult students who are pursuing Instructional Design certificates. Two of them are non-American, one Korean and one Chinese. The participants come from different career fields: K-12 education, corporate training, organization consultant, and higher education. They also vary in their prior online learning experiences: some of them are very expert online learners (having taken 2 to 3 e-courses before) while others have INSYS 446 as their first online course. At the beginning of the study, all participants have taken the Myers-Briggs Type Indicator (MBTI) (Association for Psychological Type, 2000) and the Cognitive Styles Assessment (CSA, Riding & Rayner, 1998). Their test results indicate multiple personality types along the four personality dimensions (extraversion/introversion, sensing/intuition, thinking/feeling, and judging/perceiving) and different cognitive styles (the ratio of field dependent to field independent being 6 to 8).

Data Collection

To enhance the vigor of the study, the investigators have employed data triangulation, which includes interview, observation, and discourse analysis. The interview was individual, semi-structured, extended, and iterative. Concurrently, the investigators have observed these subjects’ online discussion activities by both reading through their on-going message exchange and personally observing them in their home space. Finally, the investigators have also reviewed course documents, class emails, and bulletin board scripts (of 10 weeks) to examine subjects’ online participation process.

In-depth interview: The researcher conducted individual in-depth interview with every participant, each interview lasting for one hour. The interview was semi-structured: an interview protocol with open-ended questions was framed to activate the exploring of interviewees’ stories. The researcher did face-to-face

interviews with two participants who lived around the school area and telephone interviews with the others. All interviews were tape-recorded. The participants were encouraged to explore their responses to virtual learning community to the fullest.

Observation: The observation in this study took two forms: online and face-to-face. For the online observation, the researcher logged into the course site and read through participants' postings in bulletin board and chat room. A semi-structured observation protocol was developed to guide the attention during observation, though the actual observation was open to any situational changes. The researcher also personally observed two participants when they logged onto course site and did online posting at their study rooms.

Document analysis: Course documents, such as the syllabus, course timeline, students' projects, and their class emails, were also collected and coded.

Data Analysis

By following Stake's (1995) proposition on the case study, the researcher has first aggregated the data into about 24 categories (categorical aggregation) and collapsed them into two patterns with nine themes. Member checking has been employed to ensure the credit of direct interpretation. Finally, generalizations about the case in terms of patterns and themes are developed in comparison with the published literature on virtual community development.

Findings

Two general patterns with nine themes have emerged through the process of data generation, analysis, and comparison of participants. These central patterns and themes are listed and discussed below. Participants have been referred as "P1" or "P2" in the quotations.

Cognitive Response

The cognitive response involves participants' learning strategies and actions to the collaborative learning in a community context. These strategies include meaningful communication, interacting academically, managing group work, instructor-monitored participation, and self-adaptation.

Meaningful communication: The participants expressed, "typically I would not just post, you know, for the sake of it." In other words, meaningless communication is deemed non-necessary. They cared a lot about the content of discourse. It was observed that the participants did not respond to all the postings. Actually, they purposely selected message to reply, based on their evaluation on whether the discourse was constructive or not. P1 said:

When I respond, I respond to the ones that I feel that I have a comment that is worthy of making posting. I don't necessarily always want to put down "yes I agree" "no, I don't". I want to have something that I can add to the conversation. So I read a lot more postings than I respond to. I don't respond to all the postings. I don't think that is necessary.

The messages that I tended to respond first are ones that are practically based, usable in the real world. At the same time, the participants would like to post meaningful messages to peers. By "meaningful", participants meant: being able to inform, or being able to help. For instance, participants explained the usual occasions when they would post messages:

Let's say somebody asked questions that I thought I had answer for or suggestions I might post that. Or maybe somebody made a comment that I could maybe add additional information to or my own personal opinion that were my expand on that comment, I might add that (P2).

Usually when someone who are new, need help with something, I would like to help and tell (P8). In order to ensure the "meaningfulness" or quality of their discourse, some participants stated that it was helpful for them to do a careful pondering before posting any messages :

And that's why I liked the (discussion) board: it is because it gives you opportunity to think about what you are going to say just before you blur it out. Sometimes I will start to write a posting and then decide that "well, I don't want to say that" so I will delete it, I won't post it (P3).

It is hard to get across which you are trying to say without careful thinking or something, so I will try to reread what I typed in, I will rearrange sentences, it 's more like typing a memo. And then I will send it. Usually I try to be conscious on what I am posting (P10).

I prefer online discussion to face-to-face one. With online, you can have a time to think it over before responding to the other persons (P4).

With all these messages, the participants demonstrated that they were concerned about the content or the knowledge density of a discourse. They believed that a worthy discourse was filled with “valid and important information” rather than “gossiping” (P3). They even used “being usable in the real world” as a criterion to judge the value of a message. Therefore, they felt disappointed with a simplistic exchange of “yes, I agree” or “good job” which supported none of “information exchange” but only “social reinforcement” (Moller, 1998).

Interacting academically more than socially: The interactions among the participants, as they put, “have been on academic level”. In coding the participants’ online discourses, the researcher found that almost all the messages they posted or responded were around the projects to be developed or class readings. Few of postings were to fulfill a social function, such as the exchange of personal information or feelings. This finding was also confirmed by the interviewing data. For instance, some participants said:

I don’t know. I see this more as...I guess my interactions have been on professional level. I haven’t been contacted on personal level, nor have I contacted anyone on personal level. There is not enough time for that. Maybe because people are just so spread out that, that has an effect on how much you want to invest in developing an relationship that would probably just last over a couple, you know, several weeks (P5).

I think we were in touch academically, not necessary socially. We had little social talk. What is the point? I probably will never meet these people. Why bother some social relationship? (P6)

These explanations indicated that timing and physical distance were two practical concerns that deterred the social interaction. However, beyond these surface reasons, a hidden explanation is that the participants did not value social reactions. They wondered about the meaning of social talk (by saying “what is the point”) and deemed the investment in developing social relationship as extra or non-necessary (by questioning “why bother”).

The social-networking-relative interactions happened mostly during the first orientation week when the instructor required students to introduce themselves to each other and each person published their personal pages. A point to note is all participants interviewed expressed their appreciation of the orientation week and peers’ personal pages. As P3 told, “At least now I know who I will work with in the team and where he comes from.”

Non-academic interactions happened also when a student, intending to explain his delay on coursework, posted message telling he just got a new baby. It was observed that most participants responded with a brief “congratulation” note. When asked about why, P1 explained, “I don’t know, it’s just a formality to congratulate someone getting new baby.” During the course, such a formality-bounded social interaction did occur several times.

Finally, in the chat-room sessions more interpersonal networking messages popped up. The comparison of bulletin board scripts and those of chat-room indicated a difference: the former were written in a more formal tone while the latter displayed more a personal voice and mixed with more social presence signs (such as “☺”). Some participants expressed preference of chat-room to bulletin board because “it is more like face-to-face talk” while the others believed they tended to think more during bulletin board discussions.

Managing group work: Group work, in participants’ perspectives, involves critical management issues of timing arrangement, responsibility specification, communication tools selection, and investment in peer support.

First, online observation showed that timing was a critical issue in group work. Some participants displayed a particular concern about the timing within teamwork. On the group discussion forums, these participants tended to be active ones who initiated the negotiation of team schedule. Typically, they volunteered to be team leaders, with an intension “to get it done and out of it anyway”. They posted their speculations of the timeline to the whole team. They softly pushed the others to abide by the schedule by posting the messages like, “how is everything going...we have only one week left for the finalization” and the sort. Other participants, differently, felt more comfortable being passive and pushed by the peers. One said, “I am not a very organized person and usually wait to the last minute to do my work. Group is a great way to monitor and push me onto the track.” Due to such a difference of the timing concept, a tension or conflict is inevitable in the group. Actually, in their emails to the instructor, quite a few participants complained their teamwork experiences were not as positive as they expected, because “work progress was delayed as teammates did not do their work on time”.

Second, some participants demanded responsibility specification in the teamwork. They said: Having labor division is very necessary. Everybody then will understand what to do and when to do.

Usually, when I collaborate with people, you know, especially at work, we do good job defining, you know, evening out roles and responsibilities at the beginning. So it ends out being fair, you know, break out the work.

They hoped that by specifying responsibility, there would be “fairness” among members’ investment and commitment. However, they also expressed a concern on the binding power of the responsibility specification, “Although the rules were laid out, people would not interpret them as the same, so they did not do the same.” Therefore, some participants requested that the instructor should have played a more powerful monitor role, “He should be able to tell who is working who is not.”

Third, the participants employed specific strategy in selecting communication tools during teamwork. P4 described:

I use group discussion forum to post my assignments, ask for teammates’ opinions, and post feedbacks to teammates. If I need to talk to someone privately, I will send personal email. I would like to use chat-room for instant opinion exchange, but it is so difficult to schedule a time when all of us can be online. Then I usually email the instructor.

This description was echoed by the researcher’s observation and other participants’ explanations.

Finally, the participants interpreted their investment in peer support as an intentional action of “giving and taking” with a sense of fairness. For instance, P2 complained:

I think I’ve given more than I got it returned. I mean they did not email or post message to me often enough. Even when they did post or email me, they did not write enough. I feel a little frustrated, you know...

Instructor-monitored participation: Generally, the participants favored a participation process that is monitored and supported by the instructor, whose important role in facilitating the online discussion was evident. In the bulletin board, the instructor’s posting attracted the most responses. A discussion thread, once replied by the instructor, usually gained a lot more responses than others. This might be, for a major part, due to the fact that online interaction and discussion was required and graded in the course. Responding to the instructor’s message, deemed by most participants, was an important way to showing presence and involvement.

Additionally, the instructor was regarded an expert or authority in subject content. P6 said, “It is good to have multiple opinions, but I feel confused as to which one to pick. I think the instructor should present his view so we will know which one is correct.” And the frequently mentioned expectations of the instructor were, “He can make public posting to everybody.”

Finally, in interviewing, the participants expressed a strong desire that the instructor should specify assignment timeline and monitor students’ teamwork progress. For example:

I know that we have assignment timeline in this course content, but sometimes it is a little confusing to put them together. So if he (the instructor) could just say “here is where we are, here is what is coming up next, just to give...just to make sure everybody is in the same track (P2).

If there is anything, I think he should monitor people with the things we are doing. ‘cause right now our group is behind the schedule for the one who was sick and the other one who is not so responsive.

I guess if he can remind people to work on time, it will be great (P3).

With these requests, the participants preferred the frequent monitoring by the instructor. This finding was also evident in students’ emails to the instructor: the most-often inquired topic was the schedule of assignments.

Self-adaptation: Some participants, when describing their online learning histories, demonstrated a process of personal change and a want for self-adaptation. P3, a trainer who had experienced traditional school education, military technical training, and online education, said:

Oh, yeah, it is definitely a change. Before I went to the Navy, I was accustomed to the traditional classroom. Then when I went to Navy and learned different type of training, that was very concentrated, very fast. And then now I am back to school again and I am doing this online. And this is the third type where it is not as slow in the classroom. I feel I get more comfortable with it now.

Similarly, P8, a self-claimed solitary learner, said:

I have always known that I love individual work more than teamwork. I realize it is my comfort zone. But I need to go beyond this comfort zone and take challenge. So to answer your question, I will say I definitely prefer individual work, but will probably choose team project.

These messages reflected that these adult participants were willing to actively adapt themselves to different learning contexts and demands.

Affective Response

The affective response involves participants' perceptions and feelings developed through their learning processes, including: unwillingness to be interdependent, sense of unfairness, sense of responsibility, and satisfaction.

Unwilling to be interdependent: Some participants obviously displayed a reluctance to rely on other members of the team in completing learning tasks. P2 said,

I tend to know what my ability and capability levels are, and I would rather rely on just myself to accomplish an assignment versus the other people, because I've been disappointed so far (sigh)... My time is limited. It is very difficult to depend on some other's schedule. I have to work ahead. If I have to wait for others' pieces before I can do, I cannot work ahead. It is difficult for me.

Her unwillingness to be interdependent might be due to several motives: trust on personal ability rather than others; former teamwork experiences being disappointing; and timing concern. Like P3, P4, and P5, she felt relying on herself is the most "secured" way to feel "more at control".

Sense of unfairness: The participants were sensitive to peers' different levels of participation and interaction. They read this difference as a sense of unfairness. For instance, P5 and P8 complained, "People participate at different levels, you know. I am in the middle, in terms of posting and giving feedbacks." P2 noticed that "some persons' messages getting more feedbacks. I usually respond to my teammates' messages, but when I posted, there was not much returned." Pressed by their sense of unfairness, the participants demanded a clear labor division in the teamwork:

P1: Having labor division is very necessary. Everybody then will understand what to do and when to do.

P2: So it ends out being fair, you know, break out the work.

As a result of sense of unfairness, most participants expressed "feeling disappointed" and did self-blaming: "I don't know. Maybe what I wrote was not interesting enough (P2)," "I guess it is my language. People cannot understand my English. I need to make my ideas clearer (P10)," and "I guess it is because of my background. I found most students in this class are teachers, I am not (P3)." Generally, they found themselves "spending less time on online activities now and focus on my offline reading and completing assignment."

Sense of responsibility: When asked about their roles in online participation and collaboration, participants kept mentioning "responsible" or "responsibility":

P2: I followed all the instructions that were laid out regarding the responsibilities as the project leader.

P3: I think I have a strong sense of responsibility. Individually, I may wait to the deadline to do my work. But in teamwork, I have to do it right 'cause others need my work to continue. And I just don't want to let them down.

P4: The difference between individual and group work is by individual, I am responsible for my schedule and my progress; by group, I am also responsible for my teammates' progress.

P5: Being responsible is to do the work on time and giving feedback to your teams. At least, do what the syllabus required.

P7 and P10: Responsible teammates are necessary for good collaboration.

P12: I did ask them why (they were late in doing work), like, "How come you did not post". I think that is not my responsibility.

Sense of responsibility, as the researcher observed and interpreted, was the most important factor fostering the appropriate behaviors in online learning participation and collaboration. Being irresponsible was understood as "personality issue" (P3). An interesting point to note was one participant, who had been regarded by peers as not responding and being delayed in coursework completion, also believed responsibility was necessary, "Yeh, of course I think responsibility is important. I will do what I am expected to do." Reluctance to admit being irresponsible seems natural.

Satisfaction: During interviewing, most participants explained they were satisfied with their present learning processes in INSYS 446. Positive view on the instructor seemed to be the top ground for the satisfaction:

P2: I think he is a good instructor. I think that...he is very available. I did not like my first one (online learning course), I did not think the instructor was that great.

P3: I think he is good. He is getting back right away in responding email. If there is anything, I think he should monitor people with the things we are doing.

P5: Sometimes we have very open-ended questions, like what we had in reading review. Sometimes we have a checklist to review what we should pay attention to in project. I think this is a good balance.

P6: He usually gives detailed feedback to our assignments, which is really great.

Then, participants expressed welcome to their learning tasks:

P7: There is a clear guideline on what we should do for the project, but it also gives us space for free thinking.

P8: I like the first two weeks' general discussion (on readings) very much, I feel I have learned most from that.

P11: I like my project. It is my problem in the work. I will teach my people how to use Excel as a management tool.

P12: I like the way we did our learning. First we read and gained necessary knowledge, then we had hand-on experiences. I think this is reasonable.

Finally, the participants valued collaboration opportunities in the online course. They felt they could test and enrich their thoughts in teamwork and group discussion:

P2: The nature of the project was that it did require participation from the other members' in the group just so that we can get feedback on how our mindtool was being used, so if I were to do it myself, it would be really hard to get feedback from somebody who understand what I was doing.

P5: I think when I am working with the group, and I am having that feedback back and forth, it lists more information pulled more out of me and I get more information from other sources besides what I have, so I get more knowledge than what is in my head, more experiences that other people might have that I wouldn't have had myself.

The above statements indicated that the participants involved in collaboration for sharing perspectives with fellow students. Getting informative feedback and expertise exchange attracted them into group work.

Discussion

Conclusively, in the case studied, the participants share similar responses to communication, action, and participation in terms of purposes and rules; they implement communication tools to collaboratively learn; and they prefer to experience a division of community labor or responsibility. These three operations agree with the activity theory which Hung and Chen (2002) have proposed as a framework for learning community operation: rules, tools, and division of labor as three bonds to affiliate subjects with the learning community.

Then, in this case the participants interviewed and observed have not presented enough evidences showing a strong sense of connection or belonging (McMillan & Chavis, 1986). Actually, the participants did not value the investment of timing and efforts into relationship construction, mainly due to timing concern and doubt on the networking purpose. This finding echoes Brown's (2001) study conclusion: The participants did not perceive community to exist online and they did not place a high priority on devoting time to fostering relationships. However, a sense of relevancy do exist and help to create a degree of bonding: participants tend to respond to familiar names in bulletin board; participants prefer views from people who share similar career background; and participants who have different background from the majority deem themselves as more "outsider" (P2 and P9).

Additionally, the feeling of trust (Rovai, 2002) is not realized in this case. Most participants are unwilling to rely on other members of the team. Reasons may be the frustrating teamwork experience from previous online learning, the individual difference in perceptions of responsibility and learning habits (organized or not), and the lack of familiarity of peers. One week's online introduction cannot construct trust across the distance.

Based on these findings, the researcher tends to believe that in spite of the instructor's community initiative in instructional context design, a sense of community has not been developed among students. As Lock (2002) argues, a community-promoting virtual learning environment will not ensure the forming of community. It is students' initiative and active participation cultivates the forming of virtual learning community.

Some particular pedagogical issues, as this case reveals, should be taken care of in order to assist students to make a shift into community philosophy and actions:

- *Awareness of a learning community framework at the inception*: The participants should be aware of community philosophy and how it works at the inception period. As Shapiro and Levine (1999) recommend, students need to be open and to be willing to reframe their roles as learners. Lock (2002)

- also proposes, “It is the informed initiative of members and the leadership of the community that influence and foster and sustain the vibrancy and resiliency of an online learning community” (p. 406). Designers and developers of a virtual learning community need to build students’ awareness of community model and have support structures in place to foster their shift in thinking and behaviors. For instance, showing role models and explicitly explaining appropriate learning strategies will encourage students to display more investment and commitment into peer support within community context.
- *Constructing guidelines and norms on communication and participation*: Clarification of expected individual behavior and responsibility is necessary when planning a virtual learning community. As Lock (2002) explained, the construction of norms can be first directed by instructor then modified or developed by students.
 - *The instructor’s role and heavy load*: As demonstrated by the findings in this case, instructor needs to play an important role (as a monitor, facilitator, and expert) in the learning process, even though the community approach is more student-centered. The instructor’s presence and instant feedback are the most active catalyst to support online participations. However, this usually means a heavy load on the instructor part. A strategy to reduce instructor’s load may be the leadership development: students who play the leadership role are able to initiate and organize the community learning voluntarily.
 - *Small group verse class community*: It is also noticed that in this case participants have a stronger sense of interaction with peers in their groups rather than the general class community. This kind of task-oriented group-based interactions, to some degree, has hindered the development of sense of connection to the class community.

Suggestions for Future Research

Bounded by timing, this case study has not done a follow-up data collection of participants’ perspectives and activities beyond the course. As Brown (2001) indicates, participants may be involving in long-term interactions that are beyond the course cycle. Therefore, a follow-up study on people who involve in long-term learning affiliations with others may be desirable. In addition, an evaluation research on measuring the development stages of virtual learning community construction is also necessary. Finally, how can the leadership role be supported and nurtured with the purpose of fostering virtual learning community development is also an important research question to be explored.

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Utilizing multimedia PBL to engage pre-service teachers in Multi-cultural special education decision-making

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Introduction

Pre-service teacher programs have a central goal of fostering skills necessary for students to become successful professional educators. This goal is often challenging because students typically do not have sufficient opportunities to gain realistic experiences before becoming teachers (Andrews, 2002). In addition, teaching is a complex, dynamic profession where challenges regularly occur which require teachers to incorporate new information, make decisions, and problem-solve on a regular basis (Howard, 2002; Jonassen & Hernandez-Serrano, 2002).

Teaching students with disabilities represents one such challenge to general education teachers. For example, the 1997 Individuals with Disabilities Education Act (IDEA) requires that students with disabilities receive a free, appropriate public education (FAPE) in the least restrictive environment (LRE). The LRE is an environment that best meets students' needs in the most typical educational setting. This requirement has resulted in a dramatic change in the way students with disabilities are educated. A majority of students are now educated in typical general education classrooms with special education supports (Hallahan & Kauffman, 2003; Turnbull, Turnbull, Wehmeyer, & Park, 2003). This change has meant that general education teachers need to have sufficient background knowledge and experience with identifying students that may need to be assessed and referred to special education services. This challenge may be compounded for general education teachers who are working with students who are English Language Learners (ELL). These educators may lack experience distinguishing between academic difficulties resulting from second language acquisition and those resulting from learning disabilities (Ochoa, Gerber, Leafstedt, Hough, Kyle, Rogers-Adkinson, & Koomar, 2001).

A further requirement of IDEA mandates that teachers, parents, students (when appropriate), and support personnel (i.e. school psychologist, principal) meet to develop an Individualized Education Program (IEP). The IEP is a planning process that results in a signed legal document that specifies a student's academic skills, needs, and goals and acts as a guide for academic instruction for the student (Hallahan & Kauffman, 2003). This process requires an understanding of special education law, as well as skills to work collaboratively with a diverse group of individuals with different goals to reach a decision.

Pre-service teachers require extensive knowledge and experience. But, it is neither practical, nor in the best interests of students with disabilities, to train pre-service teachers solely in a field-based classroom (Andrews, 2002). Opportunities for contextualized learning beyond observation and practicum experiences are important to support pre-service learning (Baker, 2000). One such approach is problem-based learning (PBL). PBL is an instructional technique in which meaningful tasks, often in the form of problems, serve as the context and stimulus for knowledge building and critical thinking (Howard, 2002). Situations used in PBL are often what are called "ill-structured" (Jonassen & Hernandez-Serrano, 2002) and typically mirror real life decisions that professionals (i.e. educators, doctors) need to make based on incomplete and constantly changing information that often don't have a clearly defined solution (Baker, 2000; Howard, 2002).

This study researched the implementation of a multimedia PBL module, entitled Multicultural Special Education (MUSE), in a contextualized learning experience. The MUSE module was developed as part of the CASELINK series of multimedia PBL cases designed by researchers at the University of California at Santa Barbara to train pre-service teachers to think about special education issues in a realistic, professional context (Gerber, English, & Singer, 1999). The main goal of the modules is to give pre-service teachers an opportunity to use information and interact with their peers in such a way that they become self-sufficient, life long learners that are able to adapt to new professional situations (Ochoa, Kelly, Stuart, & Rogers-Adkinson, 2004).

The MUSE module in this study was utilized as part of a course designed to introduce elementary

education majors to special education and teaching exceptional learners. The module required pre-service teachers to assess a student named “Andres” who has limited English proficiency (LEP) and potential learning disabilities, to participate on a team to create an IEP, and make decisions about whether or not to refer Andres to special education (Ochoa et al, 2004). The module provided information about the student through interviews with school personnel and family representatives, video footage of actual school interactions, artifacts of the student’s work (i.e. writing samples, drawings, test scores) and background about appropriate special education laws. In addition, pre-service teachers were required to role-play a typical IEP member during the decision-making process to encourage realistic, collaborative problem-solving. Roles included a school principal, a special education teacher, a parent, a classroom teacher, a bilingual education teacher, and a school psychologist. Students were provided with video and audio interviews, documents, and Internet web-links that described each role’s perspective.

Research questions

- 1) Are pre-service elementary school teachers enrolled in an introductory special education course satisfied that engaging in the PBL activity prepares them to be professional educators?
- 2) What are ways in which PBL fosters engagement with special education concepts and practices for pre-service teachers?
- 3) How does the use of multimedia in the module impact satisfaction with the PBL experience?

Method

Participants

Thirty-three students were enrolled in an introductory course on teaching exceptional learners in elementary education at a large Midwestern university. The students were required to complete the MUSE module as part of the requirements for the course. Twenty-nine students were female and four students were male. Thirty-one students were Caucasian, one was Asian, and one was Latino. Ten students were seniors, nineteen were juniors, and four were sophomores. Twenty-nine students were elementary education majors and four were non-education majors. The majority of students had some practicum or field experience prior to enrolling in the class, but the majority of students indicated that they had little or no experience working with students with disabilities. Students also had no experience evaluating a student, creating an IEP, or using a PBL-based case. In order to complete the module, students worked for six 75-minute class periods in groups of five to six to assess the case student, explore the problem from different roles/perspectives, create an educational plan, and make a decision about whether or not the student should be referred to special education.

Setting

The study was conducted at a large Midwestern research level one university. The instructor was a second year doctoral student with diverse experiences working with students with disabilities. She had taught this course twice previously and used the MUSE module both times. She was also one of the researchers in this study.

During the PBL activity, the class was grouped into six self-formed groups. The activities took place over the course of six sessions. The first and last sessions took place in the general classroom and the remaining four took place in a computer lab equipped with thirty-five computers. The first session provided an introduction to the PBL process. The instructor gave a brief overview of PBL, had students view excerpts of problem-solving strategies from the movie *Apollo 13* and discussed problem based learning concepts.

Over the next four classes in the lab, the pre-service teachers participated in three activities that involved both individual and group work. The first activity was an introduction to the student and required participants to write a brief assessment based on the information provided in the case. The second activity involved individuals investigating the scenario more in-depth and developing a group consensus about the student’s situation. The third activity involved participants selecting a role strand and exploring information from only one role’s perspective and deciding on an IEP goal for the student. The small groups then met, compared information and developed a common educational plan through a process of negotiating, discussion, and problem-solving. On the final day, students met again in the regular classroom in their small groups to develop final recommendations on whether the student should be referred to special education or not, and then participated in a class-wide discussion about their recommendations and their overall thoughts about the PBL module.

Procedures

The study used both qualitative and quantitative methodologies to collect and analyze the data. This mixed methodology approach was not only useful in understanding the student's learning but also allowed the opportunity to triangulate and verify both quantitative and qualitative results.

Quantitative data was collected from a satisfaction and perception survey (see Table 1) developed by the researchers to gain participant feedback on our research interests: satisfaction with the level of professional preparation from the PBL module, perceived knowledge acquisition of special education concepts, and satisfaction with the multimedia component of the PBL module. Survey questions were formulated after two observations by researchers that gathered preliminary data about module usage and group interactions.

A 15-item questionnaire was administered to pre-service teachers after the completion of all MUSE module activities (see Table 1). Twenty-nine students (n=29) were in attendance the day the survey was administered and all students responded. Two separate metrics were used in the survey. Questions 1 – 13 utilized a five-point Likert scale which measured relative strength of agreement, while questions 14-15 utilized a 4-point Likert scale measuring relative frequency. Scores were standardized by converting them to z scores. Some questions were worded in a manner such that the metric measured low satisfaction, therefore it was necessary to reverse-scale items representing an opposite dimension. Reverse-scaled items included 4, 8, 10, 12, 13. All subsequent calculations used standardized scores and appropriate reverse-scaled items.

The statistical package SPSS was utilized to calculate an internal consistency estimate of reliability on the survey questions (Green & Salkind, 2002). Each item of the survey was assumed to be approximately equivalent to every other item and questions were all designed to measure participant response to the MUSE module. It was also assumed that any errors in measurement between questions were unrelated. There was no time limit and questions were syntactically different in order to reduce the likelihood that measurement errors were related, as in the case where, for example, someone had circled all '1's. Lastly, it was assumed that the internal consistency estimate would accurately reflect the scale's reliability.

Two measures were computed: a coefficient alpha and a split-half coefficient expressed as a Spearman-Brown corrected correlation. For the split-half coefficient, the scale was split into two halves in a manner such that the two halves would be as equivalent as possible. In splitting the items, the sequencing of the items as well as whether or not items assessed participant satisfaction were taken into account. The first half included items 1,3,5,7,9,11,13,15, while the other half included items 2,4,6,8,10,12,14. Values for coefficient alpha and the split-half coefficient were .60 and .74, respectively, indicating moderate reliability demonstrated by the coefficient alpha and satisfactory reliability demonstrated by the split-half coefficient.

Table 1 *Andres Case Survey*

| Descriptive Statistics | N | Minimum | Maximum | Mean | Std. Deviation |
|---|----------|----------------|----------------|-------------|-----------------------|
| 1. I learned a lot about the student in the case. | 29 | 1.00 | 4.00 | 2.83 | .89 |
| 2. I felt invested in my team. | 29 | 1.00 | 3.00 | 2.14 | .44 |
| 3. I feel better equipped to make a similar decision in real life after doing this PBL module. | 29 | 1.00 | 5.00 | 2.52 | .83 |
| 4. I did not have enough information from the module to effectively make a decision on the case. | 29 | 1.00 | 4.00 | 1.86 | .69 |
| 5. The media (pictures, movies, sounds, text) helped me to understand the content of the module. | 29 | 1.00 | 3.00 | 1.97 | .57 |
| 6. I feel I could be on a real student's team now as a result of this case. | 29 | 2.00 | 5.00 | 3.04 | .68 |
| 7. The media (pictures, movies, sounds, text) helped me feel more connected to the case than if it had been text alone. | 29 | 1.00 | 4.00 | 1.55 | .69 |
| 8. I wasn't able to learn a lot from the case materials. | 29 | 2.00 | 4.00 | 3.52 | .79 |
| 9. This module gave me a sense of a real student's situation. | 29 | 1.00 | 5.00 | 2.41 | .87 |
| 10. I ignored the media (pictures, movies, sounds, text). | 29 | 4.00 | 5.00 | 4.55 | .51 |
| 11. I felt an emotional attachment to the student in the module. | 29 | 2.00 | 5.00 | 3.28 | .88 |

| | | | | | |
|---|----|------|------|------|-----|
| 12. I ignored the hyperlinks to external websites. | 29 | 2.00 | 4.00 | 2.72 | .92 |
| 13. I am not likely to have a situation like this in my own classroom. | 29 | 3.00 | 5.00 | 4.31 | .60 |
| 14. How often did you refer to information you had learned earlier in the case during the final group decision? | 29 | 1.00 | 2.00 | 1.48 | .51 |
| 15. How often did you use the hyperlinks to external websites to gain more information? | 29 | 1.00 | 4.00 | 2.79 | .98 |
| Valid N (listwise) | 29 | | | | |

The study utilized a variety of qualitative data sources to evaluate the research questions in order to triangulate the findings and increase the internal validity of the data. Data sources included student reflections submitted to the instructor as part of the general module requirements, an interview with a student participant, and observations of the collaboration process. The constant comparative method (Glaser & Strauss, 1967) was used to evaluate transcripts and documents and identify emergent themes from the data.

The qualitative data came from three sources: student reflections during the case, an open-ended question on the survey, and an interview transcript. Students posted reflections to online questions viewed only by the instructor after the completion of the second and third activities during the module. They were asked to respond to the following prompts:

Reflect on the Andres activities up to now. What are some of your thoughts, concerns, questions, or issues that come to mind? Think about what you're exploring related to Andres as well as the Problem Based Learning (PBL) process itself.

After the final session, students were required to post a response to the following prompts:

One of the major objectives of this activity was to simulate the dynamics of the interdisciplinary team. What were some of the challenges your group experienced? How did you resolve them? Respond to these two questions. Also, provide any additional overall comments on this activity.

Participants were also given a space to respond to an open-ended question on the survey. The questions asked students to "Please add any additional comments about the Andres activity."

Results and Discussion

In analyzing the data, we found several recurrent themes that characterized the pre-service teachers' experiences using the multimedia PBL module. We have categorized the themes within the framework of each research question.

Question 1: Are pre-service elementary school teachers enrolled in an introductory special education course satisfied that engaging in the Problem Based Learning activity prepares them to be professional educators?

1.A) The experience had real-life applicability

The sense of authenticity about the characters and team planning extended to the ability of the learning experience to have real-life applicability for the participants. The PBL process involves participants in solving 'real-life' problems from which knowledge and experience can be gained (Bridges & Hallinger, 1997). The MUSE participants were enthusiastic in their opinions of the experience and the sense of preparation they felt as a result of their participation in the process. Three primary areas of real-life applicability included a sense of better understanding the requirements of teaching students with special needs and second language learners, being more prepared to assess a student, and participating on an IEP team.

Participants expressed the opinion that they gained a realistic sense of what it would be like to have a student with a disability or an English as a Second Language learner in their classrooms. The MUSE case gave them the opportunity to explore materials about the student through observations of his interactions in the school, samples of his academic work, and comments about the student by school personnel and family representative. After interacting with the material, they were able to discuss the content and their perspectives with teammates, and make decisions based on what they viewed. Participants commented that this process gave them an opportunity to get to know how to better meet the needs of students in their future classrooms. For example, participant comments included:

The Andres case has given me a good perspective what it would be like to have a child in the classroom that needs special help and also struggles with the English language.

I believe I learned a lot and I now realize how hard it is to be a teacher dealing with a student like Andres and the time and effort that goes into working with this child.

For most, if not all, of the participants, this was the first time they had exposure to the IEP process. This finding also was the case for the student interviewed:

I think it helped to an extent. I did not really know what an IEP was before. So at least I am aware of what it is, what the expectations are, and what to go about making one.

In addition to feeling a sense that they gained insight into having a student with special needs in the classroom, the students also expressed that they felt better prepared to assess whether or not a student had a disability. This particular notion is not often held by novice teachers, especially within general education (Stough & Palmer, 2003). This challenge is particularly compounded when a student's first language is different than the teacher's because it may be difficult to assess whether learning difficulties are a result of not understanding the language of instruction or from a disability (Rogers-Adkinson, Ochoa, & Delgado, 2003). The participants were part of a team that explored what they each knew about the student and then made decisions about the student's academic needs. The pre-service teachers expressed that they gained an increased understanding of the assessment process through their activities in the MUSE case. Typical comments included:

I have really enjoyed this exploration. I have learned many things that will help me be able to evaluate students who might need special help. I have really enjoyed the group activities.

Referral is a really tough job to do and as a future educator you want to do what is best for the child. It was really hard, but on the other hand, it gave some really great experience on the evaluation process.

1.B) Participants developed collaboration skills

In school settings, collaboration skills are essential (Tschannen-Moran & Woolfolk-Hay, 2000). General education teachers must be skillful in working with special education teachers, parents/caregivers, and other school professionals in order to successfully meet the needs of their students (Gerber et al., 1999; Matthews & Menna, 2003). Collaboration is often a skill that is not taught enough in teacher education programs but is required more and more due to educational reform efforts (Tschannen-Moran & Woolfolk-Hay, 2000). In addition, those involved in the decision process represent different goals and knowledge bases – all of which must come together to insure that students are being taught the goals identified in the IEP in the Least Restrictive Environment (Gerber et al., 1999; Howard, 2002).

The MUSE module provided numerous opportunities for participants to have discussions, negotiate and work together with a team. Team members each took on a typical role of an IEP meeting participant (i.e. teacher, parent, psychologist) and contributed their information to the team from that perspective. Once participants shared their information, teams were required to make decisions about the student. This process of information sharing and decision-making provided students an opportunity to learn to collaborate to accomplish their goals. Student reflections included numerous comments about the collaboration process:

This activity has been very successful in working as a group with other people in our class. We have learned so much as a group in how to solve problems in the education field with this real situation regarding Andres.

It was in this exercise that we really came together as a group, all offering our own insight into what would be the best assessments for Andres, as well as important goals for him.

Question 2) What are ways in which PBL fosters engagement with special education concepts and practices for pre-service teachers?

2.A) PBL provides an authentic context for learning

One of the goals of PBL is to provide an authentic learning experience for participants (Albanese & Mitchell, 1993). This goal is particularly important for pre-service teachers who are working to gain skills in order to make them more effective teachers (Bridges & Hallinger, 1997). Issues of meeting the needs of students with special learning needs are of particular concern for pre-service teachers (Ochoa, Vasquez, & Gerber, 1999). Since each student's individual needs differ greatly, they require individual attention and unique interventions to tailor a plan to create the best environment for their learning (Andrews, 2002). Their needs require the ability to use general educational concepts in a variety of situations. One particular challenge for teachers of students with limited English proficiency (LEP) is distinguishing between issues of second language acquisition and learning disabilities (Ochoa et al., 1999). The MUSE module offered pre-service teachers the opportunity to engage in a learning experience that explores the process of assessing the needs of a student with LEP and a potential learning disability and then participating on a team to address his learning needs.

From the comments expressed by the participants, there is a sense that they had gained an understanding of the student's situation, internalized it, and were concerned for his future. They had been able to incorporate material about the student's current level of performance and made inferences about what may happen to him in his future. They also wanted to make sure they are responsive to his perceived needs ("...if Andres needed us to.") and want to be able to address his needs in their planning.

The emotional connection to the characters was particularly evident when they expressed frustration about Andres' general education teacher. Typical participant remarks include strongly worded, judgmental comments:

What bothers me most about his situation is his general ed [sic] teacher. I don't feel as though she puts 100% effort towards Andres. I understand that she has other students in the classroom, but she doesn't even try to communicate with his parents. The whole situation with her really bothers me.

One of my main concerns with Andres is that he is way behind the rest of the students in his academics. If he doesn't catch up, he is just going to get further and further behind.

2.B) PBL challenges students to resolve ill-structured problems

One of the key characteristics of the PBL process is working with an 'ill-structured' problem that reflects the messy, real-life complications of problem-solving (Howard, 2002). Students are expected to solve problems without enough information. They seek out information from various sources, prioritize relevant information and filter out irrelevant information in order to define the problem. After defining the problem, students make decisions without perfect knowledge and are not sure whether the decision is the correct one (Duffy & Cunningham, 2001).

The MUSE case provided comprehensive albeit incomplete information about the student. Participants were able to review work samples, video footage of interactions in the classroom and recess, and comments from teachers, a parent representative, and other school personnel. Despite the variety of information, a number of the teams expressed frustration at the perceived lack of information. For example:

I also feel that we don't have enough info to really make a realistic IEP.

It would have been a better activity if we had more information about Andres b/c [sic] I felt for the most part we were really struggling to make a decision because of lack of information.

Despite concerns about the lack of information, participants were required to utilize the resources and information provided and accomplish the activity goals by engaging in collaborative learning (Duffy & Cunningham, 2001). It was necessary for the teams to develop a process to use the information they had and overcome their perceptions that it was an inadequate amount from which to make a decision. A number of participants shared their teams' problem-solving strategies with an 'ill-structured' (Jonassen & Hernandez-Serrano, 2002) scenario in response to a final reflective question that asked participants to identify the challenges their group experienced and describe how they resolved them:

Our biggest challenge in the group was that we really did not know Andres. We had to make assumptions about what was going on and how to assess him and it was hard to make decisions. We really never resolved it, but did the best that we could

with the information that we were given.

We did not feel like we had all the information we wanted to complete the activity. We overcame it by talking it out with each other and using everyone's input to try and complete the information as much as possible...or at least make up a scenario that was as close as we could get to the actual truth. There was also several times we just disagreed on certain things, but we would talk through them as well. I think our team did an excellent job talking through things and reaching conclusions based on our knowledge.

All teams developed an educational plan for the student and were able to make a final decision about whether or not they would recommend that the student be referred to special education. This ability for participants to accomplish the goal indicates that the PBL module was appropriately 'ill-structured'. Students perceived they didn't have all the answers, but were able to successfully collaborate and problem-solve sufficiently enough to respond to the module questions.

This incomplete problem structure mirrors how a real IEP meeting may progress because each team member brings to the meeting their personal interactions and experiences with the student. Some team members may have ownership of certain information as well (Gerber et al., 1999). For example, a teacher would have special insight on classroom management, whereas a school psychologist may have one-on-one counseling information about the student.

Question 3) How does the use of multimedia in the module impact satisfaction with the PBL experience?

Participant responses about their perceptions of the impact of media (video, audio, images) supported the survey findings. The interviewee was asked her opinion on the impact of providing the MUSE module through a text-based case study without multimedia. The student indicated that it would have been a different experience for them:

I don't think it would have been as interactive. I wouldn't have been as responsive to it, I don't think. If they just give you paper, it would not have been as much fun.

In addition, it increased her later recollection of the Andres case. One student indicated that media increased the connection she felt to the student and helped personalize the context. When asked if she felt attached to the Andres case, the student offered:

I would not say an attachment, but it was more like.. I could picture him. I could picture kinda [sic] what he was thinking. It was easier that way. I could picture him in my head. I could know what he was like and see him. Emotionally attached no, it definitely made him more interactive knowing what he was like.

Through a variety of qualitative and quantitative measures, students were able to give insight into their interactions and reactions to this case-based multimedia PBL module. Their comments indicated that while they grappled with a perceived lack of information, through the process of forming a solution, they collectively increased their knowledge of special educational processes, developed collaboration skills, and began to develop a connection with their future professional community. One student summarized it best when she said:

I really enjoyed this activity. I feel that this will soon affect me as I become a teacher in a year. I think this type of teaching (PBL) is very important in teaching education. This is the sort of stuff we will be involved with and this will help us become more knowledgeable about this subject.

Conclusion

The results described by this study offer insight into the effectiveness of using multimedia PBL strategies to teach special education concepts to pre-service elementary education teachers. Student reaction indicates that the module provided an effective learning experience. In the future, follow up with students once they are educators would provide an additional measure of the impact of this case on their practice.

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Effect of Visual Scaffolding and Animation on Students' Performance on Measures of Higher Order Learning

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Abstract

Animation is being used extensively for instructional purposes; however, it has not been found to be effective on measures of higher order learning (concepts, rules, procedures) within the knowledge acquisition and knowledge integration domains. The purpose of this study was to examine the instructional effectiveness of two visual scaffolding strategies (simple and complex scaffolding) used to complement animated instruction. About 90 undergraduate level students were randomly assigned to three treatments (control, simple and complex). After receiving their respective instructional presentation students took four tests – drawing, identification, terminology and comprehension. The results of a preliminary study indicated that animation has a significant impact on acquisition of factual and conceptual knowledge. On the other hand, visual scaffolding strategies, used as a complement to instruction that already involved animation did not have a significant impact on students' performance on measures of higher order learning.

Introduction and Theoretical Framework

Animation in Multimedia Instruction

(Mayer & Moreno, 2002) have defined multimedia instructional environments as ones in which “learners are exposed to material in verbal (such as on screen text or narration) as well as pictorial form (including static materials such as photos or illustration, and dynamic material such as video or animation)” (pg. 87). The authors propose two theories of how students learn from words and pictures:

1. Information Delivery Theory of Multimedia Learning: Based on the theory that learning involves adding information to one's memory (Mayer, 1996). Multimedia instruction is effective in delivering information effectively to both types of learners – learners that prefer verbal presentation and those that prefer pictorial presentations.
2. Cognitive Theory of Multimedia Learning: Meaningful learning occurs when students mentally construct coherent knowledge representations (Mayer, 1996). This theory is based on three assumptions: (1) humans have separate channels of processing visual and verbal representation (dual-channel theory) (2) the capacity of short term memory is limited, and (3) meaningful learning (knowledge integrations) occurs when learners actively engage in cognitive processes such as selecting, organizing and representing knowledge.

Further, (Mayer & Moreno, 2002) have examined the role of animation in multimedia learning environments. Animation is defined as “[Animation] refers to a simulated motion picture depicting movement of drawn (or simulated) objects” (pg. 88). They found that “Animation can promote learner understanding when used in ways that are consistent with the cognitive theory of multimedia learning.”

Potential Problems with Multimedia Instruction using Animation

Animation and simulations are being utilized at all levels of instruction. However, most research which has identified positive gain from animation has reported it at the fact and concept levels (Reiber, 1990; Dwyer, 2003). One hypothesis that may be proposed to explain this phenomenon is that when students are expected to learn a hierarchy of learning outcomes, the cognitive load associated with the animated presentation and the content complexity provides a stimulus field which is too complex for effective assimilation (Young,

1993). Another hypothesis is that “The ineffectiveness of animation in facilitating higher level cognitive functions may be because learners do not possess the prerequisite facts and concepts to use in constructing rules and principles necessary for higher order comprehension.” (Dwyer, 2003)

Scaffolding in Instruction

“*[A scaffold] lends consciousness to a child who does not have on his own*” (Bruner, 1986, p. 86)

Scaffolding has been defined as a strategy which involves supporting learners by limiting the complexities of the learning content. In her paper (Dabbagh, 2003) cites definitions of scaffolding provided in (Young, 1993) – “Scaffolding involves supporting novice learners by limiting the complexities of the learning context and gradually removing those limits (a concept known as fading) as learners gain the knowledge, skills and confidence to cope with the full complexity of the context”; and (Jarvela, 1995; Pressley & et al., 1996) – “Assistance to learners is provided on an as-needed basis and as their task competence increases, fading of assistance is gradually administered to allow learners to complete the task independently.”

(Stone, 1998) defines scaffolding as a metaphor for the process by which adults or more knowledgeable peers guide children's learning and development. According to (Stone, 1998), “In providing temporary assistance to children as they strive to accomplish a task just out of their competency, adults are said to be providing a scaffold, much like that used by builders in erecting a building” (p. 344). (Wood, Bruner, & Ross, 1976) [as cited in (Stone, 1998)] describe scaffolding as a form of adult assistance “that enables a child or novice to solve a problem, carry out a task or achieve a goal which would be beyond his unassisted efforts” (p. 90).

(Wood et al., 1976) [as cited in (Stone, 1998)] identified six types of assistance that an adult tutor could provide to scaffold learning: (a) recruitment of children's interest, (b) reduction in degrees of freedom, (c) maintaining goal orientation, (d) highlighting critical task features, (e) controlling frustration, and (f) demonstrating idealized solution paths. (Stone, 1998) in referring to (Wood et al., 1976) writes “It is important to note that this list includes (a) perceptual components (e.g. highlighting critical task features), (b) cognitive components (e.g. reduction in degrees of freedom), and (c) affective components (e.g. controlling frustration).”

In her paper (Butler, 1998) describes how the scaffolding metaphor is used in Strategic Content Learning, an instructional approach that promote strategic learning in students with learning disabilities. She writes, “The scaffolding metaphor has made significant contributions to our understanding of the characteristics of effective instruction. Those contributions include an emphasis on important instructional characteristics: (a) support should be flexibly calibrated to meet students' needs; (b) support should be either increased or faded depending on how independently students regulate their learning; (c) support should be provided in the context of a meaningful task; (d) support is best provided by means of interactive dialogues conducted during collaborative problem solving; and (e) rather than breaking tasks into subskills, support should be provided for subskills as they occur in the context of meaningful tasks.”

(Hannafin, Hannafin, Land, & Oliver, 1997) have proposed a model of scaffolding in open-ended learning environments. They delineate four categories of scaffolds: (a) Conceptual scaffolding (helps students determine what to consider when solving a problem), (b) Metacognitive scaffolding (supports the underlying processes associated with individual learning management) (c) Procedural scaffolding (helps learners by providing hints on how to utilize available resources and tools), and (d) Strategic scaffolding (provides support for how to utilize strategies).

Based on the 1976 article by (Wood et al., 1976), (Pea & Mills, 2004) has described the processes by which scaffolding is “functioned” for the learner: “1. Channeling and focusing: Reducing the degrees of freedom for the task at hand by providing constraints that increase the likelihood of the learner's effective action; recruiting and focusing attention of the learner by marking relevant task features (in what is otherwise a complex stimulus field), with the result of maintaining directedness of the learner's activity toward task achievement. 2. Modeling: Modeling more advanced solutions to the task.” (pg. 432).

Origins of the Scaffolding Metaphor

The origins of the scaffolding metaphor lie in the social constructivist theoretical tradition. Scaffolding has clear connections with Vygotsky's idea of Zone of Proximal Development. According to (Bull et al., 1999), “When in the zone of proximal development for a particular skill or a piece of information, a learner is ready to learn but lacks certain prerequisites. Scaffolding is an interactive process in which a teacher or facilitator assists such a learner to build a ‘structure’ to contain and frame the new information” (p. 240).

(Stone, 1998) has pointed out that “Although the initial use of the scaffolding metaphor was largely

pragmatic and atheoretical, in subsequent discussion it was increasingly linked with Vygotsky's (1962, 1978) developmental theory. ...The implicit link between Vygotsky's ZPD and the scaffolding metaphor was first made explicit by Cazden (1979)" (p. 345).

Scaffolding and Cognitive Theory

Cognitive theory looks at *understanding* as being determined by the previous experiences of the learner, his past knowledge and the ways in which this information has been stored (memory structures determine how new information will be assimilated or represented). (Bull et al., 1999) have related *understanding* with *scaffolding* as such "To be able to learn from particular information, a learner must have sufficient background knowledge to be able, with help, to start to process the new information into personal knowledge. ...When scaffolding is necessary, the teacher should try to minimize the cognitive load by setting the environment conditions so that the student can both recall and use information that he/she already knows to perform most of the task (tie the new material to the old). Therefore the student has only to learn a limited amount of new information to be successful" (p. 242).

Visual scaffolding

Much research has been done on the role of pictures in text. Pictures can help learning by establishing a setting, contributing to text's coherence and reinforcing the text. (Levin & Mayer, 1993) have proposed seven "C" principles for explaining why pictures facilitate learning – pictures improve student learning from text by making it text more concentrated, compact/concise, concrete, coherent, comprehensible, correspondent, and codable.

(Cuevas, Fiore, & Oser, 2002) have studied how instructional strategies (such as use of diagrams in instruction) in complex task training environments can be used to scaffold learners' cognitive and metacognitive processes, especially for low ability learners. Their findings suggest that incorporating diagrams into training facilitated performance on measures of integrative knowledge (they found no significant effect on measures of declarative knowledge). They write "Diagrams additionally facilitated the development of accurate mental models and significantly improved the instructional efficiency of the training. Finally diagrams effectively scaffold participants' metacognition, improving their metacomprehension accuracy (i.e. their ability to actually monitor their comprehension)" (p. 433). "There are several theories that elucidate why inclusion of illustrations, such as pictures and diagrams leads to better understanding of the presented material and improved retention and application of its concepts. One theory suggests that diagrams repeat the information in the text. ...Another interpretation of positive effects of diagrams attributes improved learning to dual coding of the information in memory. Paivio (1971) proposed that verbal and nonverbal (i.e., visual/ spatial) information are processed in separate, functionally distinct, although interconnected, long term memory systems. ...Accordingly, presented information using both texts and diagrams activates more than one mechanism of memory.... Therefore, since the information is processed by two distinct mechanisms, encoding is reinforced, and retrieval from memory should be facilitated" (p. 434).

According to (Cuevas et al., 2002) diagrams increase the efficiency of the learner's information processing by decreasing the cognitive load, "Well-designed instructional programs would be expected to increase the efficiency of the learner's information processing, so that fewer cognitive resources are required for task performance after training (Paas & Van Merriënboer, 1993). Within the context of the mental model approach we propose that diagrams may reduce the cognitive load on working memory and attention associated with complex tasks by making structural relations clearer and more transparent (Marcus et al., 1996). Thus, incorporating diagrams into the training would be expected to result in higher instructional efficiency (i.e., higher performance will be achieved with less mental effort exerted.)" (p. 437).

Visual Scaffolding and Cognitive Theory

(Cuevas et al., 2002) have suggested the Metal model theory as a theory for why diagrams are so effective in instruction. In the Metal model theory thinking is considered equivalent to manipulating internal representations stored in the mind. According to (Cuevas et al., 2002), diagrams may serve to scaffold the development of mental models.

Research Hypothesis and Problem Statement

Research Hypothesis

It is hypothesized that *visual scaffolding* used to complement *animated* sequences would serve to

emphasize the critical attributes to be learned, thereby reducing the cognitive load. This will, in turn, enable students to process information more effectively. The visual scaffolds designed to complement animation would function to facilitate generative and metacognitive processes necessary to facilitate the comprehension of higher level learning objectives and the transfer of information from short term into long term memory. This notion of using scaffolding to provide procedural guidance to more effectively process the information acquisition has been supported by McLoughlin & Oliver (1999).

Problem Statement

Dabbagh (2003, p.42) has hypothesized that “low and high scaffolding are highly correlated with the type of instructional strategies implemented in a learning environment.” The purpose of this study was to examine the instructional effects of scaffolding in facilitating higher level performance outcomes. Specifically, the focus of this study was to examine the degree to which two levels of visual scaffolding strategies (simple and complex), used to complement animated instruction, facilitated achievement of higher level performance outcomes as measured by four criterion tests.

Instructional Content and Dependent Measures

Instructional Content

The instructional content used in the study is related to the physiology and functions of the human heart. This content was selected because it provided a hierarchy of learning objectives (from facts to problem solving). Problem solving required learning the terminology of the human heart, location of the parts and their respective functions, and positions during the systolic and diastolic phases. The dependent variables in the study were achievement on test measuring different levels of learning. Achievement was measured in terms of facts, concepts, rules/procedures and comprehension. A 20-item test was developed for each of these criterion measures. Average Kuder-Richardson Formula-20 reliability coefficients from a random sampling of studies (Dwyer, 1978) are: .83 for the Terminology Test, .81 for the Identification Test, .83 for the Drawing Test, .77 for the Comprehension Test, and .92 for the Total Test. Following are descriptions of the criterion measures employed, (Ibid. 45-47).

Dependent Measures

Drawing Test. The objective of the drawing test was to evaluate student ability to construct and/or reproduce items in their appropriate context. The drawing test provided the students with a numbered list of terms corresponding to the parts of the heart discussed in the instructional presentation. The students were required to draw a representative diagram of the heart and place the numbers of the listed parts in their respective positions. For this test the emphasis was on the correct positioning of the verbal symbols with respect to one another and in respect to their concrete referents.

Identification Test. The objective of the identification test was to evaluate student ability to identify parts or positions of an object. This multiple-choice test required students to identify the numbered parts on a detailed drawing of a heart. Each part of the heart, which had been discussed in the presentation, was numbered on a drawing. The objective of this test was to measure the ability of the student to use visual cues to discriminate one structure of the heart from another and to associate specific parts of the heart with their proper names.

Terminology Test. This test consisted of items designed to measure knowledge of specific facts, terms, and definitions. The objectives measured by this type of test are appropriate to all content areas which have an understanding of the basic elements as a prerequisite to the learning of concepts, rules, and principles.

Comprehension Test. Given the location of certain parts of the heart at a particular moment of its functioning, the student was asked to determine the position of other specified parts or positions of other specified parts of the heart at the same time. This test required that the students have a thorough understanding of the heart, its parts, its internal functioning, and the simultaneous processes occurring during the systolic and diastolic phases. The comprehension test was designed to measure a type of

understanding in which the individual can use the information being received to explain some other phenomenon.

Total Test Score. The items contained in the individual criterion tests were combined into a composite test score. The purpose was to measure total achievement of the objectives presented in the instructional unit.

Research Methodology

Two pilot studies were conducted to develop the instruction that is used as the control treatment in this study.

Pilot Study 1

In the first pilot study, programmed instruction focusing on facts and concepts necessary for higher order learning was prepared and tested. The rationale for developing the programmed instruction was a hypothesis from (Dwyer, 2003): “The ineffectiveness of animation in facilitating higher level cognitive functions may be because learners do not possess the prerequisite facts and concepts to use in constructing rules and principles necessary for higher order comprehension.” Students were presented with this instruction followed by the heart content tests. Their scores on the drawing and identification test (facts and concepts) were found to be significantly better than those students that took regular instruction (in previous studies). Students’ scores on the terminology and comprehension tests (rules and procedures) were still low. These results showed that although programmed instruction was effective in transfer of facts and concepts; rules and procedures still needed attention.

Pilot Study 2

Based on item analysis of the identification and comprehension test (rules and procedures), points in the instruction that needed improvement were identified. Animation (developed using Macromedia Flash) was designed and placed at these points. A second pilot study with 138 students and three treatments: Condition A (Control group: regular instruction), Condition B (programmed instruction), and Condition C (programmed instruction + animation) was conducted. Results from this study *again* showed that the programmed instruction was effective in transferring facts and concepts. It should be noted that no significant gains in the terminology and comprehension tests (rules and procedures) were obtained in Condition C. (Table 1a and 1b)

An item analysis of the identification and comprehension test for Condition C in the second pilot study was conducted to identify points in the instruction that needed further improvement. Simple and complex scaffolding was designed and placed at these points.

Development of Simple and Complex Scaffolding Treatment

We have used the cognitive model to define simple and complex scaffolding as such – simple scaffolding instigates lower levels of cognitive processing in learners as compared to complex scaffolding, which instigates higher levels of cognitive processing in the learner.

Another dimension along which scaffolding can be differentiated is suggested by (Azevado et al, 2004). (Azevado et al, 2004) examined the role of different scaffolding interventions in facilitating students’ shift in mental models. They found adaptive scaffolding (access to a tutor and specific goals) facilitated shift in a learner’s mental models significantly more than fixed scaffolding (access only to specific goals).

Note: It has been the experience of the author that instruction that uses complex scaffolding is more challenging from an instructional design and development point of view. For example simple scaffolding for this study is designed using simple HTML forms, whereas the complex scaffolding is designed with Java applets.

Visual Scaffolding using *Transformational (Mnemonic) Function of Images*

The use of diagrams as mnemonics to provide scaffolding is supported by research. (Levin, 1981) has delineated five functions that pictures serve in text processing: decorative, representational, organizational, interpretational and transformational. According to (Carney & Levin, 2002) decorative pictures “simply decorate the page, bearing little or no relationship to the text content”; representational pictures “mirror part or all of the text content and are by far the most commonly used type of illustration”; organizational pictures “provide a useful structural framework for the text content”; interpretational pictures “help to clarify difficult

text”; and *transformational* pictures “include systematic mnemonic (memory enhancing) components that are designed to improve a reader’s recall of text information”. It is worth noting that in theory research (Carney & Levin, 2002) found that “Purely decorative pictures exhibited virtually no beneficial text-learning effects, whereas the remaining effect sizes ranged from moderate benefits (for representational pictures) to quite substantial benefits (for transformational pictures)” (pg. 7-8).

Moreover, on the basis of (Levin et al, 1990), (Carney & Levin, 2002) suggest the following about the *interpretational* function of pictures in instruction, “Of particular interest to these investigators was whether mnemonic illustrations could enable students go beyond the information given and assist them in performing higher order cognitive application tasks such as those involving inference, problem solving, and analogical and syllogistic reasoning based on the botany content” (pg. 18). Further “Combined with separate mnemonic illustrations for solidifying unfamiliar terminology and definitions, the pictorial mnemonomy was found to be a potent facilitator of students’ information reconstruction and application performance both on immediate tests and on delayed tests up to 2 months later” (pg. 18). Finally, according to (Carney & Levin, 2002), (Atkinson et al., 1999) have argued that “that the ready access to information that mnemonic strategies afford can facilitate students’ acquisition of higher order concepts and skills” (pg. 20).

Results

For the present study, three conditions were used: Condition A (programmed instruction + animation), Condition B (programmed instruction + animation + simple scaffolding), and Condition C (programmed instruction + animation + complex scaffolding). Dependent measures were scores achieved on the drawing, identification, terminology, and comprehension tests. 87 students were randomly assigned to the three treatment groups. Data from each criterion measure was analyzed collectively and individually to comprehensively examine the contributions of visual scaffolding in complementing animation. No significant differences in scores were found. (Table 2a and 2b)

Discussion

According to (Mayer & Moreno, 2003), a potential problem of multimedia learning environments is that processing demands evoked by the learning task (words and pictures) may exceed the processing capacity of cognitive systems. Such a situation is called *cognitive overload*. (Mayer et al, 2003) describe three kinds of cognitive demands: (1) *essential processing* (cognitive processes that are required to make sense of the presented material); (2) *incidental processing* (cognitive processes that are due to the design of the learning task); and (3) *representational holding* (cognitive resources used to hold a mental model in working memory). Cognitive overload occurs when the sum of these processing demands exceeds the processing capacity of the learner’s cognitive system.

The insignificant results of this study may be explained by the increase in cognitive load that visual scaffolding and animation put on the learners. In other words, positive effect of visual scaffolding and animation may be cancelled by an increase in task complexity.

Conclusions

The results of the analyses indicated that specific types of visual scaffolding (simple and complex) are important variables for facilitating specific types of performance outcomes. Initial interpretation of the results indicated that visual scaffolding strategies, specifically designed, developed and positioned, have the potential for focusing and illustrating procedural understanding thereby reducing the cognitive load associated with the higher processing levels in the knowledge acquisition domain.

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Tables

| | | N | Mean | Std. Deviation | Std. Error |
|---------------------|----------------|---------------|-------|----------------|-------------------|
| Drawing Test | Control | 47 | 10.17 | 4.669 | .681 |
| | PI | 47 | 15.77 | 4.439 | .647 |
| | PI+Animation | 44 | 14.95 | 4.242 | .640 |
| | Total | 138 | 13.60 | 5.081 | .433 |
| | Model | Fixed Effects | | | 4.458 |
| | Random Effects | | | | 1.760 |
| Identification Test | Control | 47 | 13.96 | 3.833 | .559 |
| | PI | 47 | 17.55 | 2.083 | .304 |
| | PI+Animation | 44 | 17.25 | 2.616 | .394 |
| | Total | 138 | 16.23 | 3.353 | .285 |
| | Model | Fixed Effects | | | 2.944 |
| | Random Effects | | | | 1.160 |
| Terminology Test | Control | 47 | 10.60 | 3.916 | .571 |
| | PI | 47 | 12.70 | 4.123 | .601 |
| | PI+Animation | 44 | 11.80 | 3.980 | .600 |
| | Total | 138 | 11.70 | 4.073 | .347 |
| | Model | Fixed Effects | | | 4.008 |
| | Random Effects | | | | .617 |
| Comprehension Test | Control | 47 | 10.43 | 4.026 | .587 |
| | PI | 47 | 11.23 | 3.661 | .534 |
| | PI+Animation | 44 | 10.80 | 3.986 | .601 |
| | Total | 138 | 10.82 | 3.878 | .330 |
| | Model | Fixed Effects | | | 3.892 |
| | Random Effects | | | | .331 ^a |
| Total | Control | 47 | 45.15 | 13.680 | 1.995 |
| | PI | 47 | 57.26 | 11.763 | 1.716 |
| | PI+Animation | 44 | 54.80 | 11.577 | 1.745 |
| | Total | 138 | 52.35 | 13.391 | 1.140 |

Table 1a

ANOVA

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---------------------|----------------|----------------|-----|-------------|--------|------|
| Drawing Test | Between Groups | 854.107 | 2 | 427.053 | 21.488 | .000 |
| | Within Groups | 2682.973 | 135 | 19.874 | | |
| | Total | 3537.080 | 137 | | | |
| Identification Test | Between Groups | 370.798 | 2 | 185.399 | 21.396 | .000 |
| | Within Groups | 1169.782 | 135 | 8.665 | | |
| | Total | 1540.580 | 137 | | | |
| Terminology Test | Between Groups | 104.909 | 2 | 52.455 | 3.266 | .041 |
| | Within Groups | 2168.308 | 135 | 16.062 | | |
| | Total | 2273.217 | 137 | | | |
| Comprehension Test | Between Groups | 15.397 | 2 | 7.699 | .508 | .603 |
| | Within Groups | 2045.074 | 135 | 15.149 | | |
| | Total | 2060.471 | 137 | | | |
| Total | Between Groups | 3831.252 | 2 | 1915.626 | 12.471 | .000 |
| | Within Groups | 20736.053 | 135 | 153.600 | | |
| | Total | 24567.304 | 137 | | | |

Table 1b

| | | N | Mean | Std. Deviation | Std. Error |
|---------------------|----------------|---------------|-------|----------------|-------------------|
| Drawing Test | Control | 29 | 15.97 | 3.257 | .605 |
| | Simple | 29 | 16.31 | 4.425 | .822 |
| | Complex | 29 | 16.79 | 2.858 | .531 |
| | Total | 87 | 16.36 | 3.550 | .381 |
| | Model | Fixed Effects | | | 3.576 |
| | Random Effects | | | | .383 ^a |
| Identification Test | Control | 29 | 17.62 | 2.470 | .459 |
| | Simple | 29 | 17.55 | 2.759 | .512 |
| | Complex | 29 | 17.45 | 2.544 | .472 |
| | Total | 87 | 17.54 | 2.565 | .275 |
| | Model | Fixed Effects | | | 2.594 |
| | Random Effects | | | | .278 ^a |
| Terminology Test | Control | 29 | 11.93 | 5.028 | .934 |
| | Simple | 29 | 11.97 | 4.547 | .844 |
| | Complex | 29 | 12.10 | 4.220 | .784 |
| | Total | 87 | 12.00 | 4.557 | .489 |
| | Model | Fixed Effects | | | 4.610 |
| | Random Effects | | | | .494 ^a |
| Comprehension Test | Control | 29 | 11.00 | 3.464 | .643 |
| | Simple | 29 | 10.31 | 4.001 | .743 |
| | Complex | 29 | 11.14 | 3.998 | .742 |
| | Total | 87 | 10.82 | 3.802 | .408 |
| | Model | Fixed Effects | | | 3.829 |
| | Random Effects | | | | .411 ^a |
| Total | Control | 29 | 56.52 | 11.903 | 2.210 |
| | Simple | 29 | 56.14 | 13.580 | 2.522 |
| | Complex | 29 | 57.48 | 10.950 | 2.033 |
| | Total | 87 | 56.71 | 12.064 | 1.293 |

Table 2a

ANOVA

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---------------------|----------------|----------------|----|-------------|------|------|
| Drawing Test | Between Groups | 10.023 | 2 | 5.011 | .392 | .677 |
| | Within Groups | 1073.931 | 84 | 12.785 | | |
| | Total | 1083.954 | 86 | | | |
| Identification Test | Between Groups | .437 | 2 | .218 | .032 | .968 |
| | Within Groups | 565.172 | 84 | 6.728 | | |
| | Total | 565.609 | 86 | | | |
| Terminology Test | Between Groups | .483 | 2 | .241 | .011 | .989 |
| | Within Groups | 1785.517 | 84 | 21.256 | | |
| | Total | 1786.000 | 86 | | | |
| Comprehension Test | Between Groups | 11.402 | 2 | 5.701 | .389 | .679 |
| | Within Groups | 1231.655 | 84 | 14.663 | | |
| | Total | 1243.057 | 86 | | | |
| Total | Between Groups | 27.885 | 2 | 13.943 | .094 | .911 |
| | Within Groups | 12487.931 | 84 | 148.666 | | |
| | Total | 12515.816 | 86 | | | |

Table 2b

Motivational Influences in Self-Directed Online Learning Environments: A Qualitative Case Study

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Introduction

The Web technology is changing the way people learn, work, and socialize (Bonk & King, 1998). More and more people are turning to the Web technology for their learning needs due to the flexible delivery system of the Web. Although the effectiveness of Web-based instruction has been proven in many studies (Jung & Rha, 2000), high learner drop-out rates have been a concern in Web-based instruction, which have also been the case in distance education and computer-based instruction (Diaz, 2002; Islam, 2002; Moore & Kearsley, 1996).

Past studies on the factors of learner attrition in distance education suggest that lack of time and lack of motivation are the major causes of the problem (Bonk, 2002; Gibson, 1998; Visser, Plomp, Amirault, & Kuiper, 2002; Wolcott & Burnham, 1991; Zvacek, 1991). Although instructional designers or instructors do not have control over the learner's time, they can have some influence over learner motivation as it tends to change through instruction (Coldeway, 1991; Song & Keller, 1999). Therefore, attention needs to be paid to improving learner motivation to address the issue of learner attrition in Web-based instruction.

Research abounds about the importance of learner motivation in learning. Past studies have consistently reported that motivation makes a significant impact on the student's achievement. In addition, successful learning experiences, which affect continuing motivation of the learner, are conducive to life-long learning (Wlodkowski, 1993), which is critical for adults as society becomes more complex and changes rapidly more than ever. As with traditional instruction, learner motivation is an important instructional design component of Web-based instruction (Bonk, 2002; Ritchie & Hoffman, 1997). Although the importance of learner motivation for Web-based instruction has been recognized, there is a lack of research on theories and practices of the design of motivating Web-based instruction (Keller, 1999; Song, 2000). Motivation is critical for the success of online learners. E-learning is a rapidly growing market and is expected to be so in the future. A recent survey reported that the U.S. e-learning market in 2002 was \$10.3 billion (Adkins, 2002). It is projected that the U.S. e-learning market will grow to \$83.1 billion in 2006. Considering this large amount of spending on e-learning, it is imperative that the investment to be worthwhile for the stakeholders. To accomplish that goal, we need to provide online learners with a learning environment that builds success for their learning. Fostering adequate motivation for the online learner is one of the critical factors for creating a successful online learning environment (Hofmann, 2003).

Yet, responding to the motivational requirements of learners in self-directed online instruction, which is the instructional approach in most online computer training courses, is a great challenge due to the lack of interactions in such learning environments (Bonk & Dennen, 2003; Cornell & Martin, 1997; Keller, 1999). Problems resulting in symptoms of demotivation may also stem from issues other than motivation – i.e., lack of skills, environmental factors, etc. (Keller, 1999). Therefore, a systematic approach to analyzing the problems of learner motivation is warranted for our better understanding of the motivational needs of learners in self-paced online learning environments.

The purpose of this study is to investigate the problems associated with learner motivation in Web-based instruction, in particular in self-directed online learning environments. This study is interested in identifying and exploring what motivate or demotivate learners from completing a self-directed online course, which have implications for designing motivating online learning environments. In more detail, this study will answer the following questions:

- What are motivating and inhibiting factors to learn in self-directed online learning environments?
- Does learner motivation change during instruction? if so, how?
- Are there individual differences in learners' motivational levels in self-directed online learning environments?

The results of this study are expected to increase our understanding of the motivational needs of the participants of self-directed online computer training by identifying what motivate or demotivate them to learn

computer skills in a self-directed learning environment. The results of the study are expected to inform instructional designers of how to design a motivating online learning environment.

Background of the Study

This study investigated learners of self-directed online courses to answer aforementioned questions. Here, self-directed online courses refer to courses delivered via the Web in which learners go through instructional materials delivered via the Web at their own pace without the presence of an instructor. Adult learners can participate in online learning in various contexts, yet the self-directed online learning format is the focus of this study because self-directed online learning is a primary instructional format in training settings for adult learners (Driscoll, 2002; Galvin, 2002).

The courses that the study participants took were offered by a major U.S. e-learning vendor, who offers over 3,000 online courses to 20 million learners per year worldwide. Those courses are offered to adult learners in various educational and workplace settings. The course format is stand-alone, typically 6-8 hours long, self-paced instruction delivered via the Web. The topics covered in those courses include desktop applications (e.g., Microsoft Office products), computer programming (e.g., JAVA, Oracle, MS .NET), soft skills development (e.g., coaching skills, consulting skills), and special topics tailored to the needs of specific organizations or fields.

The learners participated in this study took self-directed online courses either in school or work settings. The learners in school settings took the online courses offered by the university either for personal development or as assigned by their course instructors. The learners in work settings also took the online courses either for personal development or to improve their job skills.

Literature Review

Motivation by definition is the degree of the choices people make and the degree of effort they will exert (Keller, 1983). Past studies indicate that motivation is affected by affective, social, and cognitive factors (Relan, 1992). Keller (1983; 1987a; 1987b) identified four components of motivation – i.e., attention, relevance, confidence, and satisfaction - and strategies to design motivating instruction. Clark (1997; 1998) developed a CANE (Commitment And Necessary Effort) model that identified two processes of motivation: commitment and necessary effort. Wlodkowski (1993) suggests six major components that affect adult learners' motivation in the time continuum. These motivational models were used in other research studies to identify the gap in learner motivation and how to design motivating instruction.

Several theories have provided theoretical frameworks for understanding motivation (Pintrich & Schunk, 1996). Among different constructs on motivation, continuing motivation and intrinsic motivation are the most significant for instructional theory and research (Kinzie, 1990). Intrinsic motivation is defined as the motivation to engage in an activity "for its inherent satisfactions rather than for some separable consequence" (Ryan & Deci, 2000). Theories of motivation and empirical evidence have suggested several sources of intrinsic motivation. Some motivational researchers posit that activities that provide learners with a sense of control over their academic outcomes may enhance intrinsic motivation (Pintrich & Schunk, 1996). Lepper and Hodell (1989) have identified challenge, curiosity, control, and fantasy as primary characteristics of tasks that promote intrinsic motivation.

Continuing motivation is the type of intrinsic motivation most directly concerned with education and it reflects an individual's willingness to learn (Maehar, 1976). Studies have been done on how to improve learner motivation. Theorists argue the primary reward for the learner is the activity itself; thus, continuing motivation is facilitated by an intrinsic interest in the activity (Condry & Chambers, 1978). Similarly, Merrill (2002) posits that the primary reward for the learner is learning itself - i.e., when the learner is able to show a new skill or an improvement in a skill, he is motivated to perform even better. He suggests it as an integration component of effective instruction.

It is important to review past studies on motivational issues in computer-assisted instruction and distance education settings, since motivational features encountered in these settings are similar to those in Web-based instruction (Song, 2000). Kinzie (1990) argues that intrinsic and continuing motivation are important components in computer-based instruction. Malone (1981) suggests challenge, fantasy, and curiosity as the components of intrinsically motivating computer-based instruction. Song (2000) also argues that three types of motivation – motivation to initiate, motivation to persist, and motivation to continue – are important in Web-based instruction. Studies have been done on the effects of delivery medium on learner motivation. Several researches suggest that motivation to learn via a particular medium is influenced by the learner's beliefs about

his own ability and the difficulty level of the task, rather than by the medium per se (Clark, 1994). Similarly, Reinhart (1999) found that the learner's self-efficacy and task difficulty affects his motivation to learn via the Web. In addition, Keller (1999) posits that learner support is important for motivating learners in Web-based instruction.

Methods

Participants

An interview research method was used as a means to explore the issues under investigation. Interviews were conducted of adult learners who have taken self-directed online courses. The sample for this study was drawn from over 3,000 working adults and adult students who registered for one or more self-directed online courses between September 2003 and January 2004, which was retrieved from the user database of the company who were the provider of the online courses that the study participants enroll. From this user list, about 200 people were purposefully selected to get a sample representative of the population in terms of their status, gender, experience in online learning, and the type of courses taken. The adult student group was drawn from students enrolled in a large Midwestern university. The working adult group was drawn from learners in three different types of organizations (i.e., non-profit, university, and business organizations) throughout the U.S. The investigator contacted them via e-mail soliciting their participation in the study, so 6 working adults and 6 adult students agreed to participate. Among the 12 adults interviewed, 7 were females and 5 were males. The participants took courses of various topics; seven of them took courses on desktop applications, three of them took courses on computer programming, and two of them took courses on soft skills.

Instrument

A semi-structured interview method was used to collect interview data in this study. Several open-ended questions were asked to participants to explore their feelings and behaviors with regard to the issues under study. The interview questions consisted of three parts; introduction to the interview, leading questions, and the concluding session. In the introduction, the purpose of the study and information on the confidentiality of the participant's responses was explained to him or her. The second section included leading questions to be asked of the participant. The last section included closing remarks on thanks the participants and reminding them of possible follow-up questions in the future.

Two pilot interviews were administered in order to test the instrument to increase the clarity and the likelihood of eliciting desired information. One in-person interview and one phone interview were conducted in the pilot test stage. The interview questions were revised based on the feedback from this pilot study.

Procedures

One-on-one interviews were conducted from March through June of 2004. 8 participants were interviewed in person and 4 participants who were located at distance from the investigator were interviewed via phone. Semi-structured questions were asked to the participants to explore their motivational problems and the solutions to alleviate the problems. In-person interviews were held either at a conference room or the participant's office room, all of which were quite rooms. Each interview took between 30 – 45 minutes and was tape recorded. The interviews were transcribed verbatim for analysis.

A transcript analysis was conducted of the transcripts in order to identify emerging themes or patterns from the qualitative data. The investigator copied the transcripts into index cards. A sentence or sentences that provided information relevant to the research questions were written on to the index cards. Two investigators – the author and an external data analyst – sorted the index cards to identify emerging themes. The index cards were sorted by grouping the cards that had common issues or topics together. Several emerging themes were identified as a result. An external auditor also reviewed the results of the data analysis to evaluate the provide feedback on the trustworthiness of this data analysis.

Results

Motivation to start online instruction (Motivation to initiate)

Most of the interview participants pointed out the flexibility and convenience of self-paced online learning, (i.e., the fact that they can learn at their own pace without the time constraints of classroom instructions and at the comfort of their home) as the primary reason for choosing an online training option. One

participant, who is a full-time working professional and also a part-time graduate student, noted that:

I thought it was a really good way to learn more software programs and things of that nature that I don't have to go to the classroom one as a part-time student, full-time mother, full-time worker. It's just easier, and I can do it from home. You know, I don't have to be on campus, it just takes my user name and password, and I can do this from home without...anytime I want to. I mean, you know, I'm not restricted to time or anything, and I really like that. And if I don't have time to finish something, it will save my spot, and I like that a lot, considering my interruptions.

Motivational changes and learner persistence

Although the convenience and flexibility of self-paced online learning was the biggest motivator for them to choose self-paced online training options, it did not necessarily motivate them enough to persist in their learning. Participants' retention rates were investigated as an indicator of learner persistence (i.e., the motivation to persist). The results indicated that half of the participants did not complete the courses, as seen in Table 1. There were also a different range of retention rates across subject areas – i.e., 0% of those who took computer programming courses completed the course, whereas 100% of those who took soft skill courses completed the course (see Table 1).

Table 1. *Retention rates of the participants of self-paced online courses*

| Topics | # of Participants | # of Drop-outs | Retention rates |
|----------------------|-------------------|----------------|-----------------|
| Computer programming | 3 | 3 | 0% |
| Desktop applications | 7 | 3 | 57% |
| Soft skills | 2 | 0 | 100% |
| Total | 12 | 6 | |

When asked why they did not complete the course, three adult students indicated they did not complete the course because it was too boring. Two working adults indicated that lack of time was the main reason that they did not complete the course. One adult student even failed to start the instruction due to the difficulty of navigation.

When asked about their motivational change, eight out of the twelve people interviewed indicated that their motivational level did not change. Four of them stated that their motivation waned as they went through the instruction. The lack of interaction (both computer interaction and human interaction) in their learning was the major reason for them to get bored with the instruction, and ultimately waned their persistence. One participant described her motivational change as follows:

At first, I think that I'm really, really excited and I want to do this, and I get all into it, and then after when, I would say, half-way through, I get sort of not as motivated - maybe even a little bit bored with it to a certain extent... The convenience is nice, but that's not what keeps it. It makes you want to try it, but it's not what keeps you interested in it. It's got to have more interaction. It doesn't hold my interest as long as what I think it should, and I think if there was some more interactivity of a program, then it would really keep my interest more, and I would be more enthused about taking more courses.

Interactivity (human-computer interaction) during online instruction

When asked what motivated or demotivated them to learn while they took the self-paced online course, participants stated that animations and simulations in the online courses were interactive and that those interactive features helped them engaged in their learning. One participant who took an introductory course on a computer application (Macromedia Dreamweaver) stated that:

The one thing I did like about Dreamweaver (course) is it was very interactive and it would let you move things within while it's doing it, but the other one that I had tried to take before wasn't like there. Oracle (course) was the one I took before, that, it was just you read and then you try and answer the questions about what you read. If it was just read to answer questions, I mean, my interest in that subject went down within an hour. I didn't want to do it anymore. If it was interactive like the one with Dreamweaver (course) where it said to click the button and, you know, you could see what it did, then I was more interested in that. But if it was read to answer questions, I'd get really sleepy and bored.

As was illustrated in the participant's comment above, the lack of interactivity made them lose interest in the topic and was a major reason for dropping out of the course, in particular, among those who took

computer programming courses.

Human interaction during online instruction

The effects of human interaction on the learners' motivation appear to be different according to the context they are in. Most of the adult students (4 out of 6) participated in this study mentioned that human interaction is important for their learning and the lack of human interaction in this kind of online learning environment could probably decreased their motivation to persist in their learning. For example, a participant who is a part-time graduate student mentioned that:

I don't think that you have to have a classroom to have learning take place. You have to have interaction, though, whether it's through e-mails, whether that interaction takes place through phone calls, getting together at the coffee shop, however that interaction takes place, because it does, at least for my personality, it does, I think that interaction does help the learning process. It helps to motivate you. You're not like, you know, separate, you're out here in this little world and the entire world's over here, but being part of that group, it does actually help you in the learning process. You can see where you're going.

In contrast, working adults responded that human interaction was not important for their learning in this kind of learning environment and therefore the lack of human interaction had little impact on their motivation. To them, flexibility in their learning was more important than having an instructor for their learning, as noted by a participant who was a full-time working adult as follow:

It would depend on the time flexibility, the ability to do it at any time was probably more important in this particular case than having an instructor. If I could do the same thing as a structured class and had the time I would probably prefer having an instructor but this being a fairly small class, a fairly small unit of material and having the flexibility whenever I wanted to was definitely a plus rather than having to schedule a particular time to be at a particular place or be online at a particular time or whatever.

One interpretation for such differences between adult students and working adults on their perceptions of the lack of human interaction is that working adults seemed to be more independent learners than those in the school setting. Three out of six working adults interviewed mentioned that they would prefer to learn in a self-paced format over an instructor-led one. For instance, one working adult stated the reason that why she chose an online training option over classroom instruction as follows:

It (online training) was probably less boring. I could control, part of it is I can control my learning experience better. Take it in bits and pieces and not have to spend all day in one class with a teacher who might not be very good. I would just rather learn it myself.

In contrast, four out of six adult students interviewed mentioned that presence of an instructor would help their learning process (i.e., being able to ask questions). For example, a graduate student who took a course on statistical computer program mentioned that:

For instance, with in say a two-way ANOVA design or something like that and you're partitioning sums of squares a certain way you know I understand how to do it but I don't necessarily understand why I have to do it and a person could help explain to me why I had to do so perhaps structuring it that way where there is there is the, where there's the tools component and guiding me through how to do it and then a person kind of suggesting well this is why we're doing what we're doing. For me that would be really helpful and then since that wasn't there I was kind of left to my own devices to kind of try to understand why. Now verbally you could say why but perhaps for me it helps if somebody is telling me that.

Application and integration of content by the learner

In response to questions that what engaged or interested them in their online learning, the participants indicated that they were interested in activities that simulate real-world situations and give them hands-on experience, such as animations and simulations. These instructional approaches are known to be effective, and they also seem to motivate learners as well. One participant who took a course on computer application described his experience engaging in animations in the course as follows:

The thing I liked about the course was the fact that they had actual parts of the program in it. And I

think, it looks like they set it up, obviously it wasn't actually the program, but they just had areas where if you were as close to you if you were actually doing the work in the program and I actually opened up the program and did stuff that way, too. So I could actually find out how it worked. I thought it was good. I thought it was good that they went through and used the actual program.

In addition to animations, simulations also seemed to be engaging and interesting for the learners as mentioned by a participant, who was a full-time working professional and took a course on consulting skills:

The simulations were also very good. The, they're very rich in where you like if you're having a, you can have a conversational simulation with someone and actually sort of an intelligent conversation where you are asked to respond appropriately and then it scores you on how well you, which response was more appropriate. And I really, it's kind of like game playing. It was fun for me to try to guess what was a more appropriate response.

Learner control

Most of the participants indicated that they felt positive about being able to control the pace of their learning. One participant who was a part-time student with a full-time job and took a course on computer applications noted that:

...and the fact that it's work at your own pace is nice, too. Because there are some online classes where they do want you to be on a schedule, to have things turned in if you're being graded and so forth, but with this online course, it's nice to just find the time, find a half hour here or there and go in and work on it, and not feel that pressure of I have to do this right away.

Most of the participants also preferred the control over the sequence of instruction so that they could skip the part that they are already familiar with and spend more time on the part they are not familiar with. One participant stated that:

The one thing I guess I kind of preferred a difference between the two (face-to-face and online instruction) was that when we were covering sections that I was familiar with I was able to move through very quickly versus a classroom I would have had to sit through their lesson outline for them to get through that. I was able to skip over the easier things and go to the harder parts I really wanted to spend time on.

Conclusion / Discussions

Implications of the Findings

The results of this study confirm other research findings that the lack of motivation is the major reason for student drop-outs in online courses. It also provides empirical support for the claims by theorist that three types of motivation (i.e., motivation to start, motivation to persist, and motivation to continue) can influence learners' motivation in self-directed online learning settings, those motivation can change over time as learners go through instruction. Given the findings of this study that the learner's motivational level changes as they go through instruction, it is suggested that instructional designers need to put various factors into account that influences the learner's persistence and continuing motivation.

This study found several factors that Interaction is found to be critical for creating motivating online learning environments. The learners felt that computer-learner interaction is critical for motivating online learning environments. Yet, the lack of human interaction in the self-paced online learning environment did not seem to impact the motivation of adults in workplace learning settings.

The findings of this study also provide some implications for the design of motivating self-paced online learning environments. This study found that animations and simulations are beneficial in engaging learners in self-paced online learning environments. Also, the application of content to real world situations were found to be motivating to learners. Such an approach is regarded as effective instruction by many researchers and it is also seem to be an effective way to motivate learners.

Limitations of the Study

It should be acknowledged that there are some limitations to this study. This study adopted a case study approach in the sense that it investigated learners of online courses developed by a particular e-learning vendor. Since there are online courses developed by many other e-learning vendors and since their courses are

not designed in the same way, it is recommended that the self-paced online courses developed by several e-learning vendors are investigated to enhance the generalizability of the findings of this study.

Since this study examined on self-directed online course format, it is likely that the findings of this study might be limited to this particular type of online learning environments. Therefore, readers should caution not to generalize the findings to other types of online courses (e.g., formal distance education programs). Also, since this study was conducted of adult learners (e.g., adult students and working adults), their motivational needs might be different from those of school children or young adults, as suggested by several motivational theorists. Therefore, it is suggested that the findings of this study might not be generalized to younger age groups..

Recommendation for Future Studies

This study was a qualitative case study in which the aim was to explore the issues under study in details with a relatively small-sample of subjects. Therefore, it is recommended that a quantitative study be conducted with a larger sample to enhance the generalizability of the findings of the study. Also, it is my speculation that different factors might influence learner motivation in different types of online learning environments and with different kinds of learner characteristics. Since this study is conducted of learners who took a particular type of online courses (i.e., self-directed online courses), it is recommended that the studies are conducted on what influences learner motivation in different online learning environments. Such studies will provide insights on whether the findings of the study can be applied to other types of online learning environments (e.g., instructor-led online courses, online degree programs).

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Online Facilitation and Motivation in Online MBA Courses

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Introduction

Online teaching and learning is making a significant impact on the fabric of higher education. In particular, online MBA programs have seen a rapid rise in student enrollments in recent years while the student enrollments in traditional in-residence MBA programs are in decline (Hayward, 2004; Lorenzo, 2004). This appears to be due, in part, to the convenience and flexibility of the delivery of online education, which enable adults with full-time jobs to attend classes without having to leave their current jobs (Mangan, 2001). Accordingly, many institutions of higher education are offering online programs to serve the growing learner population. Despite such an increase in the popularity of online education, there has been a concern in the quality of online education (Diaz, 2002; Islam, 2002; Moore & Kearsley, 1996). Therefore, institutions of higher education have keen interests in offering quality online MBA programs. Moreover, educators need to be aware that student expectations on the quality of online education programs are rising rapidly (Bonk, 2004).

As online learning has gained its wide acceptance in higher education, there is an increasing awareness of the facilitative role of online instructors. While there is growing interest in examining instructor online facilitation roles in distance learning, few empirical studies have examined the issues and challenges the instructor are faced with when facilitating online courses. This gap in the research is especially apparent in facilitating online learning communities and teamwork. The results reported in this study extend previous findings regarding the moderating roles of online instructors (Anderson, Rourke, Garrison, & Archer, 2001; Berge, 1995; Feenberg, & Xin, 2002) and learning communities (Eastmond, 1995; Lave & Wenger, 1995; Oram, 1998). In addition, they represent initial findings obtained from a long term research project intended to enhance the quality of instruction in a fast-growing online MBA program.

This paper presents preliminary results of a study of an accredited online MBA program at a top ranked business school in a large Midwestern university. 323 students enrolled in the public online MBA program during the academic year of 2004-2005. This particular business school under investigation also offers corporate online MBA programs, which are offered in partnership with business organizations, and 403 students were enrolled in corporate online MBA programs in 2004. This online MBA program has grown to include hundreds of students in just a few years. Although this program has maintained a very high student retention rate over the past years since its inception, there was a need for a systematic approach to evaluating the program due to the low response rate of course evaluations from the students. The purpose of this study is to explore the impact of online facilitation as an effective instructional tool on several key components of online teaching and learning: online learning activities, social presence and learning community, and virtual teamwork. To this intent, this study will focus on the following research questions:

- What are the key strategies that instructors have used in facilitating online learning and motivating student learning?
- How do students perceive the effectiveness of instructors' online facilitations?
- What are the challenges and issues confronting instructors in facilitating an online learning environment?

The results of this study are expected to provide implications for the improvement of the online MBA program not just for the one under investigation but for other online MBA programs as well. In particular, it is

hoped that this study will help provide a better understanding of the issues related to teaching and learning in online MBA courses.

Literature Review

Despite the increased importance on the role of the learner in learner-centered approaches in online learning environments, many researchers suggest that the instructor still plays important roles in online learning (Arbaugh, 2000). Several studies have conducted of how online learning should be designed and facilitated. Many researchers posit that online discussions in asynchronous learning environments foster in-depth and critical thinking of students by allowing them the time to process their thinking when they post a message in online conferences (Duffy, Dueber, & Hawley, 1998). Bonk, Hansen, Grabner-Hagen, Lazar, and Mirabelli (1998) suggest that asynchronous conferencing was the preferable method for fostering in-depth student online discussions and rich interactions than synchronous conferencing among preservice teachers. Benbunan-Fich and Hiltz (1999) found in their study of case studies through asynchronous learning networks in an online MBA course that students participated in an asynchronous learning environment were able to produce better and longer solutions to the cases than the students participated in in-class discussions, but the online students were less satisfied with the interaction process. Several other studies also report positive results of using asynchronous online discussions to facilitate case studies in online MBA classes (Benbunan-Fich & Hiltz, 1999; Rourke & Anderson, 2002; Henson, Kennett, & Kennedy, 2003).

Nevertheless, past studies also suggest that there are challenges in facilitating student learning through online interactions. Computer-mediated communications, especially in text-based conferencing, seem to a limited mode of communication compared to face-to-face communications in terms of the richness of communication modes that can be used (Curtis & Lawson, 2001; Draft & Lengel, 1984). Also, Herring (1999) found that there is a high degree of disrupted adjacency, overlapping exchanges, and topic decay in computer-mediated communications both in asynchronous and synchronous conferencing settings.

The design of online courses is important for the success of online learners. Various methods of instruction have been applied to teaching business courses online. Case-based learning has been a dominant method of teaching in many of the courses. In particular, authenticity and relevance of the cases seemed to be critical for students' engagement in their learning through cases (Henson, Kennett, & Kennedy, 2004; Theroux, Carpenter, & Kilbane, 2004). Online MBA course can foster students' reflective thinking (Ascribe, 2004; Hay, Peltier, & Drago, 2004). Also, creating virtual communities among online MBA students and fostering interactions among them made a significant impact on the students' evaluation of the effectiveness of their online learning experience (Hay, Hodgkinson, Peltier, & Drago, 2004; Paltier, Drago, & Schibrowsky, 2004).

Creating virtual teams are also of concern in facilitating online courses. There is an increasing interest in the learning theory that stresses learning as a social activity (Barab & Duffy, 2000; Jonassen, 2002). Some researchers argue that knowledge is situated in social practices; therefore, knowledge can be acquired in the context that it is actually practiced. From this viewpoint, students can acquire the competence of experts by participating in the practice of the community by engaging themselves into the activity and culture of the group that the knowledge and skills are practiced (Barab & Duffy, 2000; Brown, Collins, & Duguid, 1989; Lave & Wenger, 1991).

Studies have been conducted on characteristics, needs, and concerns of online learners. Many studies suggest that learners can learn in online settings as effectively as in face-to-face settings. Many researchers argue that online learning is not for everyone and suggest that different learning styles need to be addressed. Self-motivated learners are more likely to succeed (McCall, 2002). Students' experience with online learning appears to be an important factor in their perceptions of learning and satisfaction. In a study of online MBA students, Arbaugh and Duray (2002) found that students who had more experience in online learning were more likely to be satisfied with learning over the Internet. Conrad (2002) also found from her study of undergraduates students that students who had more experience in online courses were less likely to feel anxious about online learning.

Methodology

A case study approach was used for this study. A case is "instrumental" (Stake, 1994) in providing an understanding of the issues of how to facilitate learning online. Data collected in this study included: (1) semi-structured one-on-one interviews with selected faculty members and students; (2) surveys of the instructors and students on their perceptions of the issues in online teaching and learning; (3) in-person focus group interviews with the instructors and the students; and (4) content analyses of course documents and class assignments

including student participation in class activities posted in the course management system.

Interviews were conducted of the instructors and the students of the online MBA program for an in-depth understanding of the issues under study. Subsequent surveys were conducted in order to enhance the generalizability of the findings of the study. In addition, a content analysis was conducted of the online courses in order to explore how the courses were designed and also to triangulate the data with those from the interviews and the surveys. More detailed descriptions of the methods of this study are presented below.

The Interview Study

26 faculty members of the online MBA program and 3 faculty members who taught traditional residence MBA courses only were interviewed in person. 25 semi-structured questions were asked and the interview was conducted in an one-on-one interview format. The interview questions included the participants' background information, their perceptions of the issues on delivering case-based learning online, interaction in online settings, learner control, collaboration and motivation, and the online learning environment in general. Each interview took 45 – 60 minutes.

In addition to the faculty interviews, 40 online MBA students were also interviewed. 20 of them were first year students who were participating in a one-week orientation program held on campus. The other 20 of them were second year students who were also participating in a one-week orientation program held on campus. Each interview took place in-person in a meeting room on the campus and took 30-45 minutes. In addition to the one-to-one student interviews, 20 students participated in four focus group interview sessions (e.g., five students per sessions) held during their orientation program. The focus interviews were also held in a meeting room on the campus and took 45 - 60 minutes. A different set of questions were asked to first-year and second-year students because first-year student were interviewed right before their first semester began thus had no experience with online MBA courses at the time of the interview. In contrast, the second-year students had finished their first-year of the program and was about to start their second academic year in the program. Therefore, the interview questions for the first-year students focus on their expectations on the online MBA program, whereas the interview questions for the second-year students focused on their experience taking online MBA courses. Every interview session was taped recorded and later transcribed for analysis.

For qualitative data analysis, a constant comparative method was used to triangulate the data from different data sources and to identify emerging themes. Multiple researchers were involved to test the coding reliability. Member checking was also used to ensure the trustworthiness of the study.

The Survey Study

First-year and second-year public online MBA students were surveyed. The survey instrument for first-year online MBA students consisted of 47 questions regarding their expectations on taking online MBA courses. This survey instrument included multiple choice questions, 5-point scale Likert type questions, and some open-ended questions. The survey instrument for second-year online MBA students consisted of 67 questions regarding their perceptions and attitudes toward the online MBA program.

The paper-based questionnaires were handed out to the students who were present at the one-week program orientation session held on campus in the summer of 2004. 162 first-year students and 102 second-year students returned the survey, which accounted for an almost 100% return rate. The students participated in this study had various backgrounds in terms of their age, gender, location, professional experiences, and online learning experiences. Among those students surveyed, 40 of them also participated in one-on-one or focus group interviews prior to or after the survey.

The instrument for faculty survey consisted of 65 questions and was divided into three sections. The first section of this survey instrument asked the participants' background information. The second section of the questionnaire consisted of 5-point scale Likert type questions about their overall perceptions and attitudes toward teaching online MBA courses. The last section included four open-ended questions soliciting the participants' general comments about teaching online MBA courses and how to improve the online MBA program. The faculty survey instrument was developed on the Web using a Web-based survey tool.

For data analysis, the survey data was entered into SPSS for analysis. Various statistical analyses, including descriptive statistics and correlational analyses were employed for the data analysis.

Content Analysis

27 online MBA courses across various business disciplines were selected for content analysis. The content of course Web sites were analyzed based on a coding scheme. The coding scheme included following 9 categories: (1) course structure, (2) interactivity, (3) social interaction, (4) instructional design support, (5)

instructor facilitation, (6) case type, (7) learner collaboration, (8) degree of learner control, (9) assessment. In addition, 10 subjective rating scales were developed to assess the level of interactivity in the online courses under investigation.

Descriptive data were obtained by counting the frequencies of occurrences based on the coding scheme. Two investigators analyzed the data independently and compared with each other later to check for inter-reliability of the data analysis.

Results

This study is still in progress at this point and analyses of student and faculty interviews data and student survey data are completed so far. The results of faculty interviews and student surveys are presented below.

Content Analysis

82% of the courses analyzed used asynchronous class discussions (e.g., discussion forums), whereas 44% of the courses had synchronous class discussions (e.g., chat rooms). 33 of those courses had both asynchronous and synchronous class discussions. A majority of the courses under investigation (81%) used team activities in their courses, whereas 19% of those courses did not use any team activities and had only individual activities. Students chose their team in 48% of the courses under investigation, and instructors assigned teams in 33% of those courses. 20 out of the 27 courses being studied used cases to support student learning.

Faculty Interviews

Online Facilitation through Asynchronous Interactions

The study found that the online instructors use asynchronous tools more often than synchronous tools to facilitate students online. The instructors mentioned that they used e-mail, announcements in the course management system, and asynchronous discussion forums as primary ways to facilitate students. They used discussion questions (open up a discussion by asking a question, prompting questions for further questions), recognizing good points, and summarizing discussions as the techniques that they use to facilitate online discussions.

Most of the instructors valued the immediacy of instructor's feedback to students to respond to the needs of the online learners' need promptly. Also, the instructors noted that it was critical for them to make sure the equal participation of the students in online courses for effective facilitate of online courses. The following is a quote from an instructor of an operation management course that illustrates the importance of providing guidelines to ensure students' equal opportunities in contributing to the discussion:

So this year, I said [to the students] you can only contribute on the first day to two of the cases; you can't contribute to all four. Because there were guys in the previous years that would try to beat everybody to the punch on the cases, and answer every question on every case, and it got some of the others upset, so I said, no, you can only post to two. And, I give them some suggestions on these things. You don't have to answer every question. I'm interested in quality, not quantity. This time, they were much more disciplined.

Online Facilitation through Synchronous Interactions

The instructors mentioned some barriers in using synchronous tools to facilitate their online course. Almost every instructor tried to use chat rooms in facilitating online discussion or holding office hours in the beginning. However, a majority of the instructors discontinued using synchronous tools for several reasons, which were found from the analysis of interview transcripts. First, the limited functions of chat room tools in the course management system presented a major barrier (e.g., small text input box broke a large chunk of text input by the instructors or the students). Secondly, it was extremely difficult to schedule a time for all group participants to attend a synchronous chat session when the participants were located in different regions of the United States or the world. Consequently, the participation rate of real-time chats was often fairly low and both the students and instructors were not satisfied with the learning experience. Finally, the instructors realized their lack of moderating skills and experiences when the size of the conference reached above ten people as well as the constraints of their typing speed, as an instructor.

However, a few faculty members who used chat room found it helpful. Two instructors mentioned the

convenience of bringing guest experts to the chat room, as noted in the following comment by an instructor:

What I try to do every week is have a chat session and I find those usually work pretty well and last semester when I taught this course, actually it's a different course in the winter quarter, I did something I hadn't done before which I brought in some outside speakers for the chat session. So since these guys can do this from anywhere I had the executive vice president of Intel online one week and I had the CFO of this company called Finish Line. So I think the students really liked that. I had never really thought about doing that before but it's very easy.

Needs for Better Technology and Tools for Online Facilitation

Approximately half of the instructors interviewed mentioned that they would be interested in trying some advanced technology tools. Some instructors noted that more real-time, visual-based learning tools with multiple modes of communication channels to enrich online learning environment and further improve the efficiency and effectiveness of online learning. With those tools, it was expected that it could help establish a better professional intimacy, realism, and real-world flavor for online learning participants. Such visual representation and hands-on tools were perceived lacking in existing online courses in this program, as noted in the following comments by two instructors:

For example, if I'm doing a lecture on inventory costs, I think it would be useful using whiteboard technology and a video camera to have me do what I would do in a classroom, maybe not for everything but for key points, actually go through things on the board, or go through a problem where the problem itself appears in a window on the video screen (Quoted from a professor who taught Accounting course)

I saw a training video that a large CPA firm created for their staff, it had three windows, it had a power point slide with the main points, it had a window with the actual person making the presentation, it had a window of that person's script scrolling, so you could actually follow what was being said, and compare it with what was up on the power point slide, you could stop it and replay it, key words were highlighted, I mean, it's extremely engaging in the sense that it's much closer to a classroom experience (Quoted from a professor who taught Accounting course)

However, accessibility and bandwidth were key issues that concerned the instructors in their adopting more visually rich and interactive tools. Some instructors noted that:

I think the idea of doing, there's a lot you could do but the constraint is the computers at the other end are not what they need to be. I'd love to get on a web cam and have a chat room with a web cam where they could get on and see me but most of them can't do that because they don't have the software or the hardware to do it.

I've have the advantage of being a professor and I'm on the land here and I have high speed in my office. I have DSL technology at home. I have on occasions had to travel and been in a motel room and had to connect over a phone modem and it's thoroughly frustrating to me any more. I think students who still have that technology it's probably thoroughly frustrating for them also.

Student Surveys

102 second-year online MBA students completed the survey of which 82.4% were males and 17.6% were females. About 80% of those responded were between 26 and 40 years of age. 90% of the respondents took more than seven online courses in the program. The coefficient of reliability was performed on the instrument to check for its reliability and the Cronbach's alpha, was .91.

The Level of Instructional and Social Presence in Online Courses

81.3% of the respondents reported that the instructors made announcement and gave feedback to students on a regular basis. Receiving such regular announcement and feedback seems to strengthen student feeling of being part of a learning community ($r=.46$). Receiving the regular announcement and feedback was also moderately correlated with the overall course satisfaction ($r=.47$) and negatively correlated with the intention of dropping out of the class ($r= -.51$). Male students tended to be more positive than female students on whether the online instructors foster student learning ($F=4.12$, $p<.05$). The ANOVA result indicates that there is a significant difference between students who are 31-35 years old and those who are older than 45 on

their perception of whether the amount of orientation they received on the electronic course management system (ANGEL) was sufficient. Students at age 31-35 said that they have had sufficient training on how to use ANGEL, while students age above 45 responded that the training was insufficient.

What Influences Online Students' Engagement in their Learning?

About 90 percent of the students reported that they were deeply engaged in their learning while they took the online courses ($M=4.17$, $SD=.77$). The correlation coefficient between learner engagement and the sense of a learning community was fairly high ($r=.62$). Student engagement was also moderately correlated with the student's feeling of how much the instructor's facilitation fosters learning ($r=.41$). The student learning engagement was also positively correlated with student satisfaction with the course quality ($r=.65$), feeling about learned a lot ($r=.56$), and intention of recommending this program to others ($r=.42$). In contrast, student engagement was negatively correlated with the student's intention of dropping out of the class ($r= -.40$). The feeling of being a part of a learning community was positively correlated with student overall course satisfaction ($r=.61$), feeling of learned a lot ($r=.60$), and their intention to recommend the program to others ($r=.54$).

Students' Attitudes Toward Virtual Teams and Online Interactions

Overall, the students had positive attitudes toward teamwork in their online MBA program ($M=4.27$, $SD=.72$). Approximately 93% of the respondents also felt that sharing information and giving peer feedback in team projects contributed to student learning ($M=4.17$, $SD=.63$). About 86% of the students surveyed agreed or strongly agreed that working in groups was helpful for their learning ($M=4.22$, $SD=.91$). However, only 49% of the students agreed with the statement that group work was more important than individual work when learning online ($M=3.42$, $SD=1.19$). About 94% of the respondents think that interacting with other students or instructors creates a more meaningful learning experience ($M=3.84$, $SD=.84$). Also, the respondents agreed that interacting with other students motivates them to explore knowledge more deeply ($M=3.84$, $SD=.84$).

Students' Satisfaction with Online Learning and Motivation

About 93% of the respondents agreed or strongly agreed that they were satisfied with the quality of online courses ($M=4.27$, $SD=0.72$). The results of correlational analysis revealed that students' satisfaction with the online courses was positively correlated with following factors:

- feeling of being part of a learning community ($r=.61$)
- engagement in learning ($r=.65$)
- instructor's use of various instructional techniques to foster student's critical and reflective thinking ($r=.51$)
- technological affordances ($r=.40$)
- effectiveness of instructor's facilitation ($r=.47$)
- feeling of being part of a community at the school level ($r=.46$)
- feeling of having learned a lot ($r=.73$)
- academic confidence ($r=.50$)
- prompt feedback from the instructor ($r=.50$).
- informative feedback from the instructor ($r=.43$)

In addition to their high level of satisfaction with their online courses, the students appeared to be highly motivated to persist in their learning. Only 8.8% of the respondents report that they have thought about dropping out of the class due to their disappointment with the course design. This intention of dropping out of the classes was negatively correlated with learner engagement ($r=-.40$), a sense of learning community ($r=-.47$), comfort level of reading messages and materials online ($r=-.40$), and helpfulness of the instructor's facilitation ($r=-.51$). About 96% of the survey respondents also intended to recommend this online MBA program to others, which was strongly correlated with the student's satisfaction with the program ($r=.61$).

Conclusions & Discussion

The findings of this study indicate that both the faculty students displayed a high level of satisfaction regarding the effectiveness of online facilitation. They also exhibited positive attitudes toward the online learning environment in general. Additionally, this study found that case-based learning was being used in a majority of online MBA courses and the instructors used various approaches to implement case-based learning in their online courses. Both the faculty and the students perceived case-based learning as an effective way to teach an online MBA course. Also, most of the courses incorporated a team-based learning approach students

interacted with one another also with the instructor. In terms of student motivation, the students indicated a high level of motivation for completing their program, which is due, in part, to their goal to obtain a degree as well as to the flexibility and convenience of an online program.

Both instructors and students of online MBA courses perceived that interactions among the instructor and the students as well as among students were not sufficient and the sense of community among the online students was not strong. Such issues raised from the findings of this study indicate that the faculty and students both need more guidance and support technologically and pedagogically to create a more engaging and meaningful online learning environment.

The results of this study on the effectiveness and issues of online facilitation will be useful for distance educators and policy makers of online programs who are conducting strategic planning, making educational policies, or refining practices for providing more satisfactory educational experiences in online learning environments. This study will also provide a set of assessment instruments, models, and guides for those researching similar programs. Yet, this paper reports preliminary results of an on-going research study, and the analysis of faculty survey and student survey data are yet to be done. Further analyses of data are expected to provide more in-depth understanding and implications for theory and practice from the findings of this study.

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Impediments to Faculty Engaging in Web-based Instruction: Clarification of Governing Policies

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Abstract

An exploratory study was conducted with faculty and administrators at Historically Black College and Universities (HBCUs) to determine the level of reported knowledge and experience with policies that govern Web-based instruction (WBI). Result indicated that faculty had little experience with the policies and many had not participated in policy development. Lack of communication of the policies was also reported to be a barrier to participation. Recommendations on policy information adoption and dissemination were made based on the findings of the study.

Purpose of the Study

Higher education is in continual transition and one cannot underestimate the influence of technology on everyday life of learners and educators. Web-based Instruction (WBI) is among the forces influencing higher learning and instruction and Historically Black Colleges and Universities (HBCUs) have not been left out. However, while technology offers new options, there is also the danger of losing some of the important attributes of higher education. These attributes include the commitment to providing the less advantaged with an opportunity for education, education's tradition of addressing student and societal needs, and the emphasis on learning and scholarship. There is a technology and information gap that is evident in the Black community and this gap has kept the poor, rural, and minority populations from participating and benefiting from the information technology revolution and this trend is inevitably carried on to the Black college environment (Hamilton, 2001).

While there are numerous studies examining older methods of distance education, few comprehensive empirical studies have provided evidence of the effectiveness of WBI in HBCUs. Little research has been conducted in the area of WBI focusing specifically on input from faculty. The purpose of this study was to explore the factors that influence faculty participation in WBI at HBCUs. This exploratory study was conducted to determine the factors that influence faculty participation in WBI at seven HBCUs, including determining the level of reported knowledge and experience with policies that govern WBI. In this mixed-design study, data used to investigate the research questions came from responses from one hundred and forty-nine faculty and administrators (deans and departments chairs) at seven public HBCUs that offer online curricula. An online questionnaire was designed to collect data using a four-point scale, open-ended items, and follow-up interviews.

Background

Lack of clarification of WBI policies is a barrier to participation for many faculty. These policies can be categorized into several areas: (1) Academic policies refer to quality, accreditation, grading, program evaluation, admissions, credentialing, mission compliance and curriculum review; (2) Fiscal, geographical, and governance policies cover fees, in-state and out-of-state relationships, consortia agreements, and contracts with collaborating agreements; (3) Faculty-related Web-based policies address compensation, workload, design and development, incentives, staff development, support, evaluation, and intellectual freedom issues; (4) Legal policies refer to intellectual property agreements, copyright, and faculty/student/institutional liability; (5) Student-related policies address support, access, advising, training, financial aid, assessment, access to resources, equipment requirements, and privacy; (6) Technical policies define reliability, connectivity, technical support, hardware/software access; and (7) Philosophical policies are developed to define a clear understanding of approach, faculty autonomy, organizational values, and missions, enhanced public access, organization, governance, partnerships, and financial support are all themes that should be addressed in the discussion on policy and Web-based instruction (Gellman-Danley, 1997, Hickman, 1999; Noble, 1998; Simonson, 2002).

Kinyanjui (1998) states that distance education is often criticized because governing policies are often not coordinated with provision of resources, development of supporting infrastructures, and training of users of distance education. He also indicates that distance education is introduced without adequate understanding of the organizational culture and context, and the political, physical, economic, social, and technological

environment. Kinyanjui further observes that distance education is sometimes introduced hastily or arbitrarily in a top-down manner. Inadvertently, decisions should be made as to whether a top-down or a bottom-up approach should be used to integrate technology. The top-down approach assumes that formulating goals, organizational structures, management approaches, implementing technological advancements should bring about change (Surry & Farquahr, 1997). On the other hand the bottom-up approach is one that should facilitate change from the point of view of middle-level administrators, faculty, and learners, who work directly with the technology (Fitz & Haplin, 1994).

Understanding the fundamental characteristics that shape HBCUs serves as a framework of analysis for equality and access to higher education. HBCUs are postsecondary academic institutions that were founded prior to 1964, and whose educational mission has historically been the education of Black Americans. Predominantly Black institutions of higher education are classified as non-HBCUs that serve a majority of Black students. Predominantly black colleges and universities are institutions that were not founded primarily for African Americans but have more than 50 percent black student enrollment. There are 103 HBCUs and over 50 predominantly Black colleges and universities located in twenty states, the District of Columbia, and the Virgin Islands (Brown & Davis, 2001). These institutions include accredited two- and four-year schools, and graduate and professional institutions. Forty-nine percent are public and fifty-one percent are private. and they generally face the same issues as HBCUs (Brown & Davis, 2001; Brown & Hendrickson, 1997; Evans, et al., 2000).

HBCUs encounter challenges pertaining to improving the technology infrastructure, training faculty for online teaching, and developing online content. These challenges are further complicated by the fact that HBCUs generally have fewer monetary resources, charge their learners less, and have to take their historical mission of cultivating a supportive atmosphere for their learners into account (Hamilton, 2001, Brown & Davis, 2001). The cost of technology is a barrier that has been an area of concern for some HBCUs, especially those who have limited financial resources. To address these issues, many institutions seek supplemental funding and many have formed consortia that create Web-based courses and programs Hamilton, 2001).

Design of the Study

This exploratory study was conducted using quantitative and qualitative data collection and analysis methods. Data used to investigate the research questions came from responses to an online questionnaire designed to collect quantitative data using a four-point scale. Open-ended questions were included at the end of each section and follow-up interviews were conducted with faculty and administrators via e-mail. Documents and official institution Web pages were also reviewed for addition information.

Institutions selected for participation in the study are all public four-year institutions located in the southern United States. The seven HBCUs were selected based on the following criteria. First, institutions that offer online curricula were selected. Second, all the HBCUs use Course Management Systems such as WebCT © and Blackboard © or have institution specific software for WBI. Third, they provide faculty support and development for WBI in various forms, such as workshops and seminars.

The participants in the study were faculty and administrators (deans and department chairs). E-mail with a link to the Website where the survey instrument was located was sent to 1125 faculty and administrators inviting them to respond to the survey. There were 152 (12.4%) valid responses with female participants accounting for 54% of the participants, while males accounted for 46% of the responses. Overall, 61% of the participants were Black or African American, 32.9% were White, 3.3% were Asian, and 1.3% were Native Hawaiians. Approximately 68% of the participants indicated their primary activity was teaching and 23% identified themselves as administrators. A majority of the participants (68%) were associate (32.2%) and assistant (31.6%) professors. Professors made up 21.7% of the total participants and instructors made up 10.5% of the responses. Four follow-up interviews were conducted with four administrators and faculty at participating institutions.

Findings of the Study

Quantitative and qualitative data were collected in this study. Participants responded to four questions about their levels of experience with policies that govern WBI at their institutions. They rated each of the questions using the following scale: (1) No Experience; (2) A Little Experience; (3) Some Experience; and (4) High Experience. The results are presented in Table 1. Out of 149 responses, 59.7% of the faculty indicated that they had some or high amount of knowledge about general WBI policies at their institutions. However, participants typically reported that they had not participated in the actual development of the policies, and only

6.7% indicated that their level of participation in policy development was high. One participant acknowledged familiarity with the policies at her institution and stated:

I am somewhat familiar with policies regarding Web-based courses; however I have yet to participate in the development of any of these policies here. We are currently developing Web-based courses for our electronic classroom (this Fall). However, we are bounded by the University policies governing WBI.

A participant at a different university indicate he was also aware of the institutions WBI polices but stated that he lacked time to be more active in the policy development process. He noted that a Technology Committee had been active for several years but due to other commitments he was not part of the decision-making processes. Another participant who indicated she was aware of the policies at her institution emphasized that “to know the policies is not the same as participating in the development of the polices.”

Looking at one specific area of WBI polices, 72% of the participants indicated that they had little or no knowledge of intellectual property rights policies at their institution and only 2.7% had high experience in helping develop these intellectual property policies. Participants indicated their institutions should have clear policies on intellectual property rights to encourage faculty to participate in WBI. One person expressed this concern as follows:

WBI was covered in an agreement. With the destruction of the governing organization there is now a question about the bargained agreement and the whole issue of intellectual property rights at my University.

In addition to lack of experience with policies, participants indicated that their institutions did not communicate the policies clearly but that they would be willing to develop Web-based courses with clarification of the policies. One faculty stated:

I have a reluctance to participate in WBI for various reasons. I am not sure of the intellectual property policies at all. I think there are some; however, no one has been able to clearly articulate them to me.

Several participants indicated that they had attended one or two seminars on intellectual property rights and were aware of guidelines. Another participant indicated that WBI was new at his university and that he was aware that the distance education department was in the process of developing policies in accordance with state guidelines.

Table 1 *Experience with and Knowledge of WBI Polices*

| Experience with Policies | No Exp | | A Little Exp | | Some Exp | | High Exp | | N | SD | M | Mean Rank |
|---|--------|------|--------------|------|----------|------|----------|------|-----|-----|------|-----------|
| | n | % | n | % | n | % | n | % | | | | |
| Knowledge of general policies | 26 | 17.4 | 34 | 22.8 | 73 | 49.0 | 16 | 10.7 | 150 | .90 | 2.53 | 1 |
| Knowledge of Intellectual Property Rights | 49 | 32.7 | 37 | 24.7 | 54 | 36.0 | 10 | 6.7 | 151 | .96 | 2.17 | 2 |
| Participated in Policy formation | 81 | 54.0 | 27 | 18.0 | 36 | 24.0 | 6 | 4.0 | 151 | .94 | 1.79 | 3 |
| Participated in Intellectual Property Rights Policy Formation | 97 | 64.7 | 30 | 20.0 | 19 | 12.7 | 4 | 2.7 | 151 | .82 | 1.54 | 4 |

Note: 1 = No Experience; 2 = A Little Experience; 3 = Some Experience; 4 = High Experience

The common threads of HBCUs discussed by Brown and Davis (2001) are social organization and Black cultural tradition which seeks to provide leadership for the Black community. HBCUs play a role in interpreting social, political, and economic dynamics and addressing overarching issues between the minority

and majority population groups. HBCUs also act as agents for specialized research, institutional training, and information dissemination for Black and other minority communities. Overall, faculty reported that they had little experience with general and intellectual property policies. Typically, they reported that they had not participated in either formation of general or intellectual rights policies. Lack of communication on the policies was also reported to be a barrier to participation in WBI by five participants.

Discussion

Faculty in this study generally reported that they had little experience and knowledge of WBI. Participants reported they had not taken part in the development of WBI policies, and many were not aware of efforts by their administration to communicate related information. Other participants indicated that while they were willing to participate in committees that addressed policy issues, they felt they had an obligation to attend to what they felt were far more pressing issues such as teaching, conducting research, publishing, and service. This lack of participation is contrary to recommendations by Czubaj (2001) who states that an area of particular significance is increasing the awareness and knowledge among faculty, staff, and students about educational technologies and methods that have the potential to enhance the outreach mission of the individual institutions.

Legal issues that included intellectual property rights and institutional, faculty, and student liability were an on-going concern with faculty. Unclear guidelines on intellectual property rights often serve as a barrier to participation in WBI for many faculty (Hill, 1997; West, 1999). Potential participants are apprehensive about developing coursework for the WBI environment until they have clear knowledge of who owns the material as it is often unclear as to who owns the rights to the instructional material.

With the exponential growth of the Internet and the Web, the challenge that remains is keeping the practices and guidelines current and accurate. While each HBCU has its own administrative approach, it is important for administrators and faculty to communicate with each other and to work together in policy development. Based on individual institutional missions, Czubaj (2001) suggests forming program evaluation advisory committees with representation from students, faculty, staff, and administration. Commitment should encompass academic affairs, information technology services, library services, and partnerships and liaisons who work with the programs.

Continuous development of leadership skills, development of innovative solutions to fulfill HBCU missions, serve students, and involvement of faculty in decision-making processes, are all important elements. Collins (2001) and Lape and Hart (1997) note that many tenets of educational technology integration are emerging thus the need for committed leadership in bringing educational technology into instruction. Hence, before institutional policies can be changed, each individual institution should determine what the administration knows about WBI and the importance that is placed on the policies.

To address policies for successful WBI integration, several approaches are recommended. First, policies should be integrated gradually and seamlessly to incorporate the concept of distant delivery of instruction. Second, learners should be defined by their enrollment in a course, not by whether they are distant or on campus. With the mission of many HBCUs being to provide a nurturing learning environment, designing a learner-friendly environment is important. Third, initially policies should be separate from existing policies. Ultimately, policies can be integrated to indicate that WBI is a regular component of instructional delivery, as faculty become more proficient with the technology.

When making recommendations for WBI policies, several questions should be addressed before faculty settle on developing and teaching Web-based courses. It is recommended that each HBCU respond to concerns, most of which were raised by participants in this study: Do faculty have portability rights to take the material with them when they leave? In the event that another faculty member teaches the course, does the developer receive compensation? Should copyright be in the name of the developer or the school? If these questions cannot be clearly answered, it is unlikely that faculty will be willing to participate in WBI.

Based on the above questions, the following is recommended: (1) Copyright ownership policies written to allow faculty to reasonably have latitude with their own work; (2) As with classroom-based courses, the extent that institutions have the authority to determine, suggest, or decide use of Web-based course material should be clearly addressed; (3) It is to the advantage of the HBCU and the faculty to define each participating member's ownership rights. Hence, all parties should know who owns the final product; (4) Compensation and workload, design and development incentives, support, and promotion and tenure should also be taken into account. When faculty have leverage with their work and they are part of the decision making process they will be more likely to take initiative and ownership of the Web-based course development process and end-product (Gellman-Danley, 1997).

The following recommendations are also made based on the concerns raised by participants regarding

the development and communication of WBI policies: (1) Building solid and diverse relationships across academic units to assist in policy issues; (2) Developing university-wide committees to review policies and communicates guidelines; (3) Publishing policies in institution documents, on relevant parts of the university Web site, and other visible locations in the college community; (4) Developing institutional expertise in policy issues thus developing collegiality and distribute appropriate training; and (5) Using the guidelines and policies to balance the interests of intellectual property rights of the faculty and institution.

Noblitt (1997) states that the key to collaborative decision-making, when incorporating technology into education is for both bottom-up and top-down administrators to ask the following questions when reviewing WBI guidelines: Are there mission-critical problems that are unresolved under the current practices? Do the problems affect a majority of the students? Does technology provide any real value educationally? Can the project be implemented with existing resources? Is technology a solution for these problems? If the answer is no, then perhaps technology is not the solution.

Conclusion

The area of integration of technology in education is a continuous effort that revolves around looking for factors and practices that can be applied to encourage faculty to integrate technology in their areas of teaching. Since the HBCUs selected for the study offered online curricula, this study focused on investigating the factors that influence faculty participation in WBI. Outcomes of this study indicated that faculty had little or no experience with Web-course policies and faculty were not actively involved in corresponding policy development.

The question of suitability of WBI for both their institutions and their learners is an area of concern for many. Is WBI policy formation an initiative of administrations or voluntary action on the part of the faculty? If it is voluntary, how much input from faculty was taken into account? Was WBI policy formation a top-down or bottom-up approach? When planning, implementing, and maintaining WBI, governing policies regarding the program must be carefully developed. Planning should include needs assessment, policy barriers, and evaluation. Because technology is constantly changing, the policies also require regular revision and updating. As technology continues to evolve, the policies governing WBI will become more complex and accumulative. Inadvertently, the policies will require continuous review to remain current and valid.

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How Do We Teach Research to Instructional Design and Technology Students?

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Abstract

This paper focuses on the research competencies of students in Instructional Design and Technology (IDT) programs. First, we describe how research is being taught to students enrolled in several leading IDT programs. Next, we present findings from a survey administered to determine what knowledge and skills are being taught to IDT graduate students. Implications for the design of courses that focus on research are discussed.

Introduction

The competencies of professionals in the Instructional Design and Technology (IDT) field continue to receive attention. In recent years, books, articles, and conference presentations have focused on the competencies of instructional designers (Richey, Fields, & Foxon, 2001), training managers (Foxon, Richey, Roberts, & Spannaus, 2003), instructors in face-to-face and online settings (Goodyear, et. al. 2001; Klein, Spector, Grabowski, & de la Teja, 2004; Spector & de la Teja, 2001), and performance technologists (Fox & Klein, 2003).

The current study continues a line of research conducted to identify the knowledge and skills that students in graduate IDT programs should obtain. An earlier study examined the optimal content and delivery method for a “foundations” course in Educational Technology (Klein, Brinkerhoff, & Koroghlanian, 2003). Another study focused on the skills that IDT students should learn related to performance improvement (Klein & Fox, 2003). The purpose of the current work is to answer the following two questions:

- How is research being taught to IDT graduate students?
- What research methods, processes, and issues are being taught to IDT graduate students?

Method - Phase 1

During this phase of the study, we obtained and analyzed the syllabi from research courses offered at several leading IDT programs to determine how research is being taught to graduate students in the field.

Participants

Our sample consisted twelve IDT programs listed in the 2002 Educational Media and Technology Yearbook (EMTY). We only sampled programs that EMTY listed as offering a Ph.D. degree in Instructional Technology or Instructional Design and Development. The following institutions were included in our initial sample - Arizona State University, Florida State University, Indiana University, Pennsylvania State University, Purdue University, Syracuse University, University of Georgia, University of Memphis, University of Northern Colorado, Utah State University, and Wayne State University.

Procedures

We conducted a web search of each IDT program at the institutions listed above to determine their research course offerings. Next, we obtained the syllabi for research courses offered by each program. Some of the course syllabi were found on the web, while others were obtained by making direct contact with individual faculty members at each program. Syllabi for research courses offered at 10 of the 12 universities were obtained and include in our analysis.

We then conducted a content analysis of the research course syllabi. Each syllabus was examined for the following: course title, credit hours, objectives, textbooks and other readings used, topics covered,

instructional activities, projects, and assignments.

Results

Several trends were identified by the content analysis. These trends are reported below.

- Most of the IDT programs in the sample offer their own research courses. Several programs offer more than one research course. A few programs rely on others in their college to offer these courses.
- Most of the courses examined focus on doing research. Many included requirements such as planning and conducting a research study. Some related to planning a dissertation study. Others focused on specific phases such as forming a research problem and conducting a literature search.
- A range of quantitative and qualitative methodologies is taught in IDT research courses.
- A wide variety of textbooks are used in IDT research courses. While several textbooks on research methodology have been adopted, preliminary analyses did not suggest any book as being most widely used. Several courses have students read excerpts from different textbooks.
- A few courses require students to read, interpret, and analyze primary source documents such as published research articles.

Method - Phase 2

During this phase of the study, we developed and administered an online survey to determine what research methods, processes, and issues are taught to IDT graduate students.

Participants

We sent a request for participation to two division listservs owned by the Association of Educational Communications and Technology (Design & Development Division and Research & Theory Division) and to a listserv owned by the Professors of Instructional Design and Technology (PIDT). In addition, a request was sent to consulting editors of *Educational Technology Research and Development* and to a sample of individuals listed on the website, *Who's Who in Instructional Design and Technology*.

Our request led to 50 graduate students and 50 faculty members who completed the survey (N = 100). Respondents represented over 35 IDT programs mostly located in the United States. Three programs were located outside the U.S. (Australia, China, the Middle East). However, not all respondents listed their program affiliation when given the option.

Survey Instrument

The first section of the survey provided a list of 15 different research methods (see Table 1) and asked respondents to rate the degree to which students learn about each method using the following scale:

- 0 = This research method is not covered in our curriculum.
- 1 = Students are expected to acquire knowledge related to this method.
- 2 = Students are expected to acquire skills related to this method.
- 3 = Students are expected to acquire both knowledge & skills related to this method.

The second section of the survey examined the degree to which students receive formal instruction on how to conduct a research study (see Table 2). Respondents used the following scale to rate ten research processes:

- 0 = Students are not taught how to do this research process.
- 1 = Students are taught how to do this process but never required to do it.
- 2 = Students are taught how to do this process and do it for the first time during their thesis or dissertation.
- 3 = Students are taught this process and do it before conducting their thesis or dissertation.

The third section of the survey focused on five issues related to conducting research (see Table 3) and asked respondents to rate the degree to which students acquire knowledge and skills related to each issue using the same scale presented in section one.

The fourth section of the survey asked respondents to identify whether they were a student or a faculty

member. Faculty were asked if they taught graduate-level research courses and if they supervised research theses and/or dissertations. An optional item asked respondents to provide the name of their university and program.

Results

Table 1 provides the rankings and mean scores for the 15 research methods included in the survey. These data show that five research methods (evaluation, qualitative, survey, experimental, & design/development research) received an overall rating between 2.06 - 2.32 indicating that most IDT students are expected to acquire skills related to these methods. Four other research methods (quasi-experimental, case study, mixed-methods, and descriptive research) received an overall rating of 1.76 - 1.94 suggesting that students in many programs are expected to obtain skills related to these methods.

The research method data were analyzed to determine if any differences existed between students and faculty members. A significant difference was found for quasi-experimental methods [$F(1,98) = 7.86, p < .01$] and action research [$F(1,98) = 14.29, p < .001$]. In both cases, faculty members rated these methods higher than students.

Table 2 shows that nine of the ten research processes included in the survey received an overall rating between 2.58 - 2.83 indicating that most IDT students are taught these processes and do them before conducting their thesis or dissertation. A significant difference was found for analyzing & interpreting research data [$F(1,98) = 7.76, p < .01$], writing research reports [$F(1,98) = 10.56, p < .01$], sampling participants [$F(1,98) = 8.46, p < .01$], and developing data collection instruments [$F(1,98) = 12.31, p < .001$]. In all cases, faculty members rated these research processes higher than students.

Table 3 provides the rankings and mean scores for the five research issues included in the survey. These data reveal that two issues (electronic searches & databases and analyzing research studies) received an overall rating between 2.43 and 2.36 respectively indicating that most IDT students are expected to acquire skills related to these issues. The three other issues (ethics, trends in IDT research, and professional contexts for research) received an overall rating above 1.50 suggesting that many IDT students are expected to acquire some knowledge about these topics.

Table 1 - *Rankings & Means for Research Methods*

| Ranking | Research Method | Faculty | Students | Total |
|---------|-----------------------------|---------|----------|-------|
| 1 | Evaluation | 2.54 | 2.10 | 2.32 |
| 2 | Qualitative | 2.34 | 1.96 | 2.15 |
| 3 | Survey research | 2.26 | 2.02 | 2.14 |
| 4 | Experimental | 2.18 | 1.98 | 2.08 |
| 5 | Design/Development research | 2.10 | 2.02 | 2.06 |
| 6 | Quasi-experimental* | 2.22 | 1.66 | 1.94 |
| 7 | Case study | 2.04 | 1.58 | 1.81 |
| 8 | Mixed-methods research | 1.88 | 1.72 | 1.80 |
| 9 | Descriptive research | 2.00 | 1.52 | 1.76 |
| 10 | Action research* | 1.72 | .92 | 1.32 |
| 11 | Ethnography | 1.32 | 1.08 | 1.20 |
| 12 | Meta-analysis | 1.18 | 1.10 | 1.14 |
| 13 | Narrative research | .88 | .92 | .90 |
| 14 | Historical research | .66 | 1.02 | .84 |
| 15 | Philosophical inquiry | .64 | .74 | .69 |

* A significant difference was found between faculty and students ($p < .01$).

Table 2 - *Rankings & Means for Research Processes*

| Ranking | Research Processes | Faculty | Students | Total |
|---------|---|---------|----------|-------|
| 1 | Specifying research questions | 2.94 | 2.72 | 2.83 |
| 2 | Conducting a literature review | 2.94 | 2.68 | 2.81 |
| 3 | Selecting a research topic | 2.86 | 2.74 | 2.80 |
| 4 | Identifying research variables | 2.90 | 2.64 | 2.77 |
| 5 | Constructing research hypothesis | 2.80 | 2.66 | 2.73 |
| 6 | Analyzing & interpreting research data* | 2.90 | 2.54 | 2.72 |
| 7 | Writing research reports* | 2.90 | 2.46 | 2.68 |
| 8 | Selecting a research design | 2.76 | 2.52 | 2.64 |
| 9 | Sampling participants* | 2.78 | 2.38 | 2.58 |
| 10 | Developing data collection instruments* | 2.74 | 2.14 | 2.44 |

* A significant difference was found between faculty and students ($p < .01$).

Table 3 - *Rankings & Means for Research Issues*

| Ranking | Research Issue | Faculty | Students | Total |
|---------|-----------------------------------|---------|----------|-------|
| 1 | Electronic searches and databases | 2.46 | 2.40 | 2.43 |
| 2 | Analyzing research studies | 2.60 | 2.12 | 2.36 |
| 3 | Ethics | 1.74 | 1.78 | 1.76 |
| 4 | Trends in IDT research | 1.78 | 1.64 | 1.71 |
| 5 | Professional contexts of research | 1.50 | 1.56 | 1.53 |

Discussion

The purpose of this study was to investigate the research competencies of graduate students in IDT programs by examining the skills and knowledge students acquire and how they attain them. The study was conducted in two phases. In Phase 1, we examined the syllabi from research courses offered at 10 leading IDT programs to determine how research is being taught to graduate students in the field. In Phase 2, we conducted an online survey to determine what research methods, processes, and issues are taught to IDT graduate students.

Results from both phases of the study revealed that a range of quantitative and qualitative methodologies is being taught to students enrolled in IDT research courses. An interesting finding to emerge was that IDT faculty and students rated evaluation, qualitative, and survey methods somewhat higher than experimental and quasi-experimental methods. This finding can be explained by the applied nature of the IDT field. It is likely that evaluation, qualitative, and survey data collection techniques are covered in multiple courses when students are learning about needs assessment, working with subject matter experts, or conducting formative and summative evaluation of intervention.

It is also possible that experimental and quasi-experimental methods may be receiving less attention in the IDT field than in previous years. This explanation is supported by a recent analysis of *ETR&D* (and its forerunners) that indicated the use of descriptive research methods has increased while the use of experimental methods has decreased in the last decade (Ross & Morrison, 2003). Other studies have suggested that consulting editors of *ETR&D* have a preference for applied research, case studies, and developmental methods over basic research studies (Klein, 1997). Furthermore, the use of developmental research methods has increased in recent years (Richey, Klein, & Nelson, 2003).

Turning to research processes, we found most IDT students are taught the typical steps for how to conduct a research study and are required to do them before carrying out their thesis or dissertation. However, we did not find that any one particular textbook as being most widely used to teach students about these research processes. An interesting find to emerge was that students who responded to our survey indicated a lower agreement than faculty for four of the ten research processes - analyzing & interpreting research data, writing research reports, sampling participants, and developing data collection instruments. These differences suggests that IDT faculty who teach research courses should examine their objectives and activities to be sure these steps in the research process areas are being covered in enough detail.

During Phase 1 of the study, we were surprised to find that only few courses require students to read, interpret, and analyze primary source documents such as published research articles. However, the results from Phase 2 suggested that most IDT students are expected to acquire skills related analyzing research studies. It may be that our survey item was unclear and that respondents interpreted it to mean they are taught to analyze their own study (or their students' studies in the case of faculty respondents). Regardless, our experience suggests that requiring students to read, interpret, and analyze published research articles is a robust instructional outcome and activity.

We also think that students should learn about the professional contexts of research in the IDT field. However, our results suggest that this issue may not be covered in much depth. IDT is an empirical field; students who graduate from our programs should be able to apply research skills to a variety of contexts including business, industry, military, and school-based settings.

Too often, research is thought of as the responsibility of academics that are required to do it to get tenure and promoted. Faculty who offer degrees in IDT should work to ensure that their graduates have competencies to be successful researchers. They should also push students to apply these competencies regardless of the setting in which they choose to work.

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Hairy Questions: The Difference a Bearded Instructional Character Makes to Middle School Students

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Introduction

There's no keeping up with what teenagers think is in or out; status changes by the minute. But when you develop computer-based instruction (CBI) for that population of users, you'd like to know with some reliability that the program is in. At the least, you'd like to know that users won't respond by rolling their eyes.

Such was the case with a CBI program designed for a nonprofit organization that demonstrates the firing of a civil war cannon for middle school and high school students. The organization wanted to distribute a CBI program to schools so students would have background knowledge about the cannon before watching the firing demonstration. The program designer decided on a character-mediated approach to instruction, with the character being modeled after the man who performs the demonstration. That man is a jovial older man who wears a beard and a replica of a Union uniform; the CBI program character, called Sarge, is a line drawing in his likeness.

Preliminary program reviewers—adults—hypothesized that Sarge's beard might negatively affect students' responses to the character. Tobin (2000) conducted a phenomenological study of children's generalizations about good and bad characters in the movie *The Swiss Family Robinson*. He found that children identified the movie's bad guys, in part, by their inferior personal grooming. However, within a Civil War context, the stereotypical good guy certainly might have grown a little scruff on his face after months on the march.

Stereotypes might be crucial to interpreting a character's purpose in a CBI program (Laurel, 1997). However, internalizing a culture's shared expectations for archetypical characters is a developmental process (Applebee, 1978; McKown & Weinstein, 2003). What might represent grizzly authenticity to an adult CBI designer might represent wizened obsolescence to a teenager. To investigate what a beard might mean to students both within a Civil War context and apart from that context, the researchers surveyed middle school students about their responses to both a bearded Sarge and a clean-shaven Sarge.

Research questions are as follows:

- Would students rather have a bearded or beardless character teach them about the Civil War? Are there any grade level or gender differences?
- Do students perceive a bearded or beardless character as more friendly? Are there any grade level or gender differences?

Research by Reeves indicates that friendliness is an essential dimension against which most people measure characters (Reeves & Greenberg, 1977; Reeves & Nass, 1996).

Method

Subjects

Subjects were 644 fifth- through eighth-grade students in a suburban middle school in an upper-middle class community in a northeast state.

Materials and Measures

This study used a two-item survey posing these questions: "Who would you prefer teach you about the Civil War?" and "Who do you think is the friendliest?" For each question, students chose between two drawings of Sarge that differed only by the presence of a beard (see Figure 1). In addition, the survey collected information about the students' grade levels and genders. The surveys included a written introduction explaining that a college student was designing an instructional program for the computer and that the college student needed their help in deciding on a main character for the instruction.

Four forms of the survey counterbalanced question order and the order in which the two drawings appeared.

Procedures

For grades six and seven, a school administrator distributed an envelope containing 25 survey instruments to teachers during a teacher meeting at the beginning of the school day. Survey instruments were arranged systematically so that the four counterbalanced survey forms would be dispersed evenly among students in each classroom. Surveys were distributed to students during the first class of the school day and returned to the school administrator after the first class. Prior to administering the survey, the teacher read aloud to the class the survey's written introduction. Students were given ten minutes to complete the survey.

For grades five and eight, the same school administrator distributed the surveys to each class and followed the same procedures as the sixth- and seventh-grade teachers. The administrator collected the surveys immediately after completion.

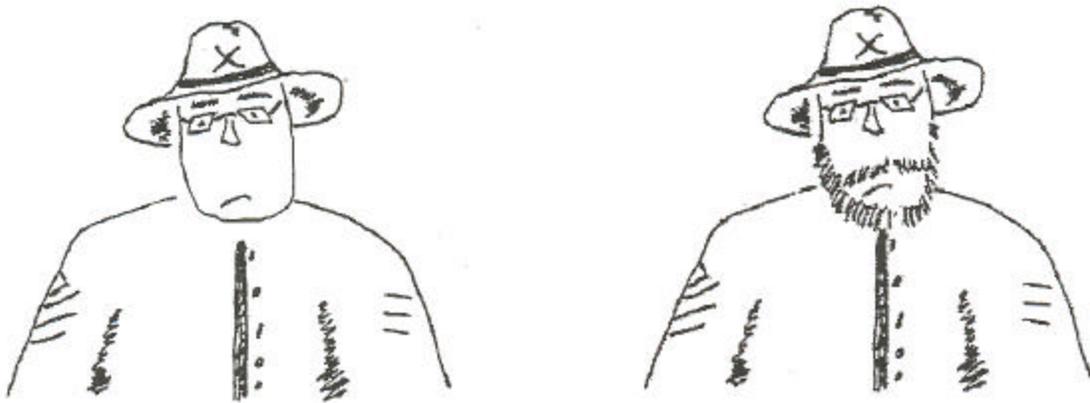


Figure 1. Beardless and bearded drawings of the computer character called Sarge.

Design and Data Analysis

This study used a two-way design, with gender and grade level serving as status variables. Character choices (i.e., bearded Sarge and beardless Sarge) were coded as zeros and ones, with a zero representing a preference for the character without a beard and a one representing a preference for the character with a beard. Therefore, mean scores for the dependent variable could be interpreted as the percentage of students selecting the bearded character. Binomial tests were run to determine if the preference proportions differed significantly from the chance level of .50. Binomial tests were conducted for the entire sample and for each level of the gender and grade level variables within the separate question contexts.

To assess the effects of grade level and gender on students' preferences for a bearded character, the researchers used 2 (gender) x 4 (grade level) analyses of variance (ANOVAs) with gender and grade level as between-subjects variables. Analysis of dichotomous data in this manner has been shown to be justified by the robustness of ANOVA (Glass, personal communication, February 24, 2004; Glass, Peckham, & Sanders, 1972). Those ANOVAs were run for each of the two survey questions. The inclusion of question context as an independent variable in those ANOVAs would have complicated the interpretation of any gender or grade level effects. Therefore, the difference between survey questions (or question contexts) was analyzed separately, with a paired-samples *t*-test. Because of the number of analyses, α was set at .01 for all statistical tests.

Results

Table 1 shows the mean proportions of all students choosing the bearded character overall, within each character context, and by grade level and gender. Table 1's totals column shows that for both questions combined students chose the bearded character more frequently than the beardless character. This overall preference—54 percent of choices for the bearded character—was significantly different from chance, $P = .54$, $p < .01$. In addition, a significant proportion of students chose the bearded character when asked, "Who would you prefer teach you about the Civil War?", $P = .74$, $p < .01$. Only 34 percent of students chose the bearded character when asked, "Who do you think is the friendliest?" Student's choice of the beardless character as more friendly also was significantly different from chance, $P = .34$, $p < .01$.

Table 1 *Students' choices for a bearded character as a Civil War teacher and as being friendlier than a beardless character: Mean proportions by grade level and gender*

| | Gender | | Grade level | | | | Totals |
|-------------------|--------|--------|-------------|-----|-----|-----|--------|
| | Male | Female | 5 | 6 | 7 | 8 | |
| Civil War teacher | .80 | .67 | .68 | .74 | .80 | .75 | .74 |
| Friendliness | .38 | .30 | .31 | .29 | .35 | .41 | .34 |
| Totals | .59 | .48 | .49 | .52 | .57 | .58 | .54 |

When asked to select which character was more friendly, both males (62 percent) and females (70 percent) chose the beardless character more frequently than the bearded character. All grade levels also more frequently chose the beardless character as being more friendly. Choice proportions for the beardless character ranged from 70 percent of sixth-graders to 59 percent of eighth-graders.

Within the context of selecting a Civil War teacher, both males (80 percent) and females (67 percent) chose the bearded character more frequently than the beardless character. All grade levels also preferred the bearded character more often than the beardless character as a Civil War teacher; proportions ranged from 68 percent of fifth-graders to 79 percent of seventh-graders. All grade-level and gender groups' mean preference proportions for both questions were significantly different from chance.

No significant differences were obtained for the grade level main effect. However, significant differences were found within gender on both questions. On the Civil War teacher question, males more frequently preferred the bearded character, $F(1, 636) = 13.11, p < .01$. Males also more frequently chose the bearded character as being friendly, $F(1, 635) = 4.12, p < .05$. No significant interactions were found.

Based on a paired-samples *t*-test, question context was found to have a significant effect on students' choices of the bearded character, $t = -15.76, p < .01$. Students more frequently chose the bearded character as a Civil War teacher than they chose that character as being the more friendly character.

Discussion

Interpreted simply, students prefer a bearded character over a beardless character when considering who they want to teach them about the Civil War (74 percent choosing the bearded character). However, when considering who is more friendly, students more frequently choose the beardless character (66 percent choosing the beardless character). Each of those preferences was fairly strong. An examination of the effect of context on children's choices of characters is helpful for interpreting what those results mean for instructional design.

Context Differences

The proportions of students choosing the bearded character were significantly different for the two different survey questions. "Who do you think is the friendliest?" asked for a more general indication of preference, an indication of which character was perceived as more affable, more likeable, more preferable. Most students chose the beardless character as being more friendly.

The question also aimed to explore the personality traits that students might associate with beards. The researchers hypothesized that there might be two bearded-men stereotypes on opposite ends of the friendliness spectrum. First, there's the Santa archetype: jolly, generous, and friendly. Then there's the mountain man stereotype: gruff, grizzly, and much less friendly. A beard likely carries connotations, the researchers just weren't sure what those connotations would be for this study's adolescent students, they weren't sure what stereotypes those participants held about bearded men. In contrast, the beardless character was relatively stereotype-free, meant to represent an "average guy."

The results do not permit a definitive statement that students perceived the bearded character as unfriendly, but the results do permit it to be said that friendliness was a personality trait that students associated the trait of friendliness less strongly with the bearded character than with the beardless character. Because facial

hair was the only attribute that varied between the two characters, the results seem to indicate that beards, in isolation from all other attributes of animated characters, do not strongly transmit an air of friendliness. That finding appears to complement Tobin's (2000) findings that children named less-than-perfect grooming as a sign that a character is a bad guy.

Where the friendliness question was context-neutral, the question "Who would you prefer teach you about the Civil War?" associated the character with a rich context, and the question elicited very different results: given that scenario, most students preferred the bearded character. Many approaches to design suggest placing students in authentic or simulated contexts (Choi & Hannafin, 1995; Cognition and Technology Group, 1992). In addition, some researchers and developers of animated agents suggest that agent characters look their parts, that they represent their role in the software (Laurel, 1997). A bearded character might have appeared more authentically Civil War era; students might have seen pictures of Civil War figures or movies about the Civil War and noted that many of the men in that time wore beards. A bearded character also might have better represented the Civil War context; beards typically are associated with older men and the Civil War is a historical (i.e., old) context.

If in fact students chose the bearded character because of his authenticity or because of what he might have represented, the results provide evidence that aspects of authenticity and representation are important to students. Given the context of learning about the Civil War, having an authentic-looking animated instructor (i.e., a bearded Sarge) appeared to be more important to this study's participants than having a friendly-looking animated instructor (i.e., a beardless Sarge).

Gender

For both questions, boys more frequently preferred the bearded character than girls. Previous studies have shown students to prefer characters of the same gender that they are (Barrett & Sullivan, 2004; Beyard-Tyler & Sullivan, 1980). In this study, female students did not have the choice of a female character. However, it might be argued that a beard makes a male character even more masculine. If that is the case, then female students more frequently preferred the less masculine character than male students, and male students more frequently preferred the more masculine character. That hypothesis suggests that prior studies of preference for character gender were too simplistic; preference might need to be studied for characters that fall on various points of a continuum of masculinity and femininity.

An alternate explanation might simply be that a beard represents a certain ruggedness, toughness, or masculine maturity. Those traits certainly would have been more appealing to male participants than female participants.

Implications for Design

Studies of gender preferences (Barrett & Sullivan, 2004; Beyard-Tyler & Sullivan, 1980) make this rule clear: When designing instruction for females use female characters; when designing instruction for males use male characters. However, instruction for users of only one gender is rare. This study suggests that characters might be perceived as falling on a gender continuum. Therefore, to appeal to users of both genders using characters who are extraordinarily girly girls or manly men likely should be avoided.

That context and character-authenticity appear to be important to students makes the designer's job both easier and tougher. When designing educational software in which an animated character will be used, the designer simply might need to consider the content and learning environment then create a character that fits both. Nevertheless, designers need to be aware that children might not share the same set of concepts and character archetypes that most adults of a culture might share (Applebee, 1978; McKown & Weinstein, 2003). In addition, the designer must be wary of reusing characters; contexts will vary from instructional program to instructional program. However, because developing animated characters for software is an expensive enterprise, designers might need to reuse characters. When this is the case, designing a character that fits only certain contexts should be avoided.

As suggested by this study, authenticity and desirability might not always work together; an authentic Civil War character might not be perceived as the friendliest of characters. If the designer is especially dedicated to meeting the needs of learners, experimentation must be done to find the right combination of character attributes to convey *both* authenticity and desirability.

Resources

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A cultural historical activity theory [CHAT] analysis of technology integration: Case study of two teachers

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Abstract

Classic research methods are ineffective in capturing the dynamic relationships among users, technology, and outcomes for technology integration research. Cognitive research attempts to eliminate environmental variability and test for recall and transferability of knowledge representations. Such approaches lead to arguably ineffective measures of learning. Activity theory provides a holistic framework to investigate relationships among the elements present in a technology integration activity. These research approaches are compared. A CHAT framework is suggested as an appropriate structure for analyzing technology integration efforts. This approach focuses on the dynamic relationships among individuals, goals, tools, community members, and mediating factors that are the elements of any human activity. An example of this framework in practice is presented. A research model generated from applying CHAT approach is proposed.

Introduction

As educational technology has become more prevalent in educational settings, research efforts have increased to study technology's uses and impacts. Although by nature technology is a tool used within human activity, the traditional research approaches tend to focus only on the user of the technology, specifically outcomes as a result of using technology (Matheson et al., 1999). In an attempt to eliminate the variability of the environment investigators ignore or control for key elements of the activity itself such as historical background and motivations of the subjects, the technology's role in achieving goals, and relationships among others within the activity. Activity theory is a socio-cultural and historical lens through which human activity systems can be holistically analyzed (Engestrom, 1999; Jonassen & Rohrer-Murphy, 1999). This approach focuses on the interaction of human activity and human thought within its relevant environmental context. Since learning is not a precursor to, rather it emerges from activity, research should attempt to examine the individuals(s) involved in the activity and activity elements such as the product of the activity, mediating tools, community members, and guiding rules while the individual(s) is/are acting on and attempting to produce an outcome. This paper provides a comparison of CHAT and traditional cognitive research methods and an example of how CHAT was used to analyze the impact of a technology integration intervention. A research model generated from this project is also proposed and discussed.

Brief Overview of Activity Theory

Activity theory adds value to assessment processes in that it suggests that the combined foundational elements of an activity are the unit of analysis that represents the minimum elements of an object-oriented, collective, and culturally mediated human activity (Engestrom, 1987). It is the internal tensions and contradictions within and among the elements of a human activity that lead to the transitions and transformation of knowledge. The basic elements of an activity include subject, object, tools, community, rules, and division of labor (Engestrom, 1987; Kuttii, 1991; Kuttii, 1996).

The main focus of any activity is in the production of an outcome (object), physical or mental. The subject, an individual or group, determines that there is a need or motive to fulfill, the object. Using the tools (e.g., technology, training, conceptual ideas, people) the subject moves toward accomplishing the object.

The community members set rules and norms under which the subject operates and establishes how the community members organize (division of labor) to meet goals. All of the elements influence the others and are influenced by social, cultural, and historical factors, such as background knowledge, personal bias, availability of tools, and other factors. Each individual activity is also affected by other surrounding activities that may have

a primarily tool, community, rule, or some other activity element focus. Thus, activity has motive and is complex, dynamic, historically-driven, and transforming. See figure 1.

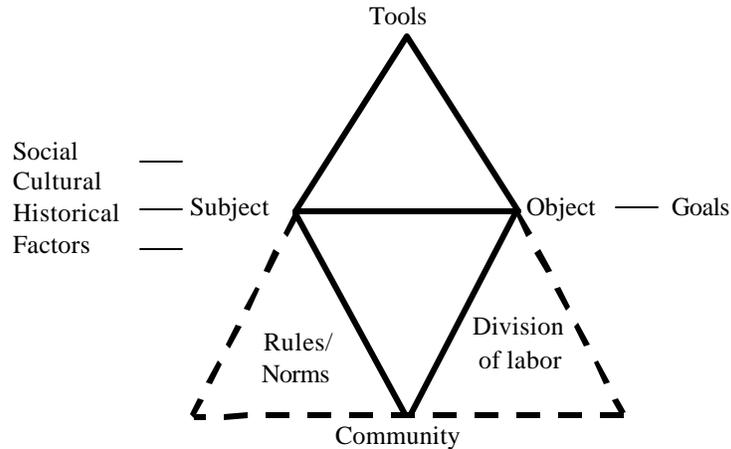


Figure 1. Activity Theory framework

Comparison of Traditional Cognitive Research and CHAT Paradigms

Traditional cognitive research paradigm. It is argued that most educational research focusing on cognitive development (learning) takes a narrow view that does not represent the true complexity of the learning process (Gay & Bennington, 1999). Learning is defined as a change in schema precipitated by sensory reception and active manipulation of new information until new information is memorized, stored, and readied for recall in existing mental structures (schema). During this type of research there is a struggle to reduce the environmental variables in the study environment that influence the hypothesized cognitive changes so that findings can be generalized to specific treatments or environmental variables. Such research has included investigating outcomes measures like attitudes toward use of technology in the classroom (Koszalka, 2000; Koszalka, 2001), teachers' views and beliefs of technology related to teaching practices (Dexter, Anderson, & Becker, 1999; Honey & Moeller, 1990), and teacher (e.g., skill level) and classroom factors (e.g., access) as predictors of technology use (Becker, 1999). This approach generally attempts to control the multiple factors that may have influenced, and are currently influencing, change and structure of knowledge (Mathison et al., 1999). See table 1.

Cultural historical activity theory research paradigm. In an activity theory approach each activity is analyzed as part of the collective and with a social-historical context of the individual and the collective, thus CHAT. This approach requires, at minimum, a shared understanding of the character and history of the subject, the object unto which the individual is attempting to reach, the characteristics of the surrounding community, and the tools available to the subject. The focus of the analysis is on the interaction of human activity and the whole of the individual's mentality as they interact within a relevant environmental context. Activity theory is thus a framework for understanding the totality of human activity in context (Bodker, 1991). Traditional cognitive and CHAT paradigms hold different points of views toward research related to human learning. Each suggests differences in the how they define (i) learning (ii) technology's role (iii) assessment focus (iv) assessment context (v) evaluator's role and (vi) data collection context. Those who use traditional cognitive paradigms believe that learning is a permanent change in schema that occurs through assimilating and accommodating external information into schema. During the learning process, technology provides the information that the learner acquires. Thus, this paradigm assumes that improving technology use can result in the facilitation of learning. Assessment research focuses on the changes in the subject as a result of using technology. Refer to Table 1.

The CHAT paradigm argues that learning is a process of constant interaction with the environment and others. Knowledge is constructed by individual learners, building on existing historical experiences, within the learners' context. Technology is a mechanism to actively engage learners in the learning process, the use of technology is influenced by the rules of and interactions with the community, and it is a tool that mediates learning activities with which to construct individual knowledge. Thus, the CHAT paradigm assumes that outcomes (knowledge) are constructed by interaction within an activity among users, technology, and environmental factors all within a context. CHAT assessment research therefore focuses on understanding the interaction process of the activity within the naturalist environment. Thus this research provides a more holistic

description of the knowledge construction activities.

Table 1. *Comparison* of traditional cognitive paradigm and CHAT paradigm*

| | Traditional Cognitive Paradigm | CHAT paradigm |
|-------------------------------|--|---|
| Definition of learning | Learning is permanent change in schema (assimilation and accommodation to existing memory structures). Knowledge is transferable from one individual to another. | Learning is a process of constant interaction with the environment and others. Knowledge is constructed by individual learners, built on historical experiences, within his or her context, knowledge is not transferred, rather it is constructed differently in all individuals |
| Technology's role in learning | The technology provides information by simulating the initial sensory perception in users' cognitive process and provides mechanisms with which the user can manipulate, organize, and represent information in ways that will prompt memory storage | Technology provides user with mechanisms to actively engage in the learning process, access multiple forms and perspectives of information, think critically, communicate during inquiry, and engage in other activities with which to construct own knowledge. |
| Assessment focus | Technology itself -- the evaluators are dedicated to improving the technology because they believed improvements in the technology will result in the high quality learning outcomes. | The interaction between users and technology -- the evaluators are dedicated to understanding and creating better interaction between technology and users because they believe that outcomes (knowledge) are constructed by an interaction among user and technology. |
| Assessment context | Assessment is conducted within the control environment, excluding any factor other than technology itself, reduce environmental variability | Assessment is conducted within the natural environment (same context as if the user were using the technology 'at work,') considering users' social-cultural, historical, and technology background. |
| Evaluators' role | Outsiders to objectively judge the evaluation results. | Facilitators in the assessment process and interactions among user and technology. |
| Data collection context | Controlled environments and interventions. Data collection techniques are used to gather information based on self-reports and participants' recall. Talk-alouds are used to gather data on the users thoughts during technology use (no interaction with evaluator) | Data collection occurs within the naturalist environment, using technology as a collection tool. Web logs, interactive talk-alouds, observations of technology in practice techniques are used to collect data on the natural interaction between technology and user. |

* Adapted from: Matheson et al., 1999

A Case Study of CHAT to Investigate Technology Integration

Research Context

The *Initiative to Develop Education through Astronomy and Space Science (IDEAS)* project was initiated to promote enrichment of science, mathematics, and technology education through the use of NASA's

mission-based, technology-based astronomy and space science research resources. The object was to help K-12 educators (subjects) develop computer technology integration skills and integrate NASA space science and astronomy web resources into their classrooms to enhance teaching and learning. As such a teacher academy was developed to (1) immerse educators in astronomy topics, (2) expose teachers to NASA space science and astronomy web resources, (3) train teachers in computer technology integration techniques, (4) help teachers develop strategies to reduce barriers for computer use, and (5) provide teachers with time to create lessons that integrated NASA web resources into their classrooms. The 4-day academy was followed by 2-years of observation and follow-up support for the first cohort and 1 year of follow-up for the second cohort, from which the data were collected on classroom environment, teaching strategies, NASA web resources use, and technology integration practices.

CHAT was used to both inform and create a research framework to facilitate collections and analysis of the data. See figure 2. For example, the CHAT framework helped to identify the factors that were measured including previous training and experiences of the subjects' before participation, interactions with peers and administrators during technology implementation, established policies and support structures for teaching and technology, and changes in availability of technology and curriculum resources throughout the data collection period, to name a few.

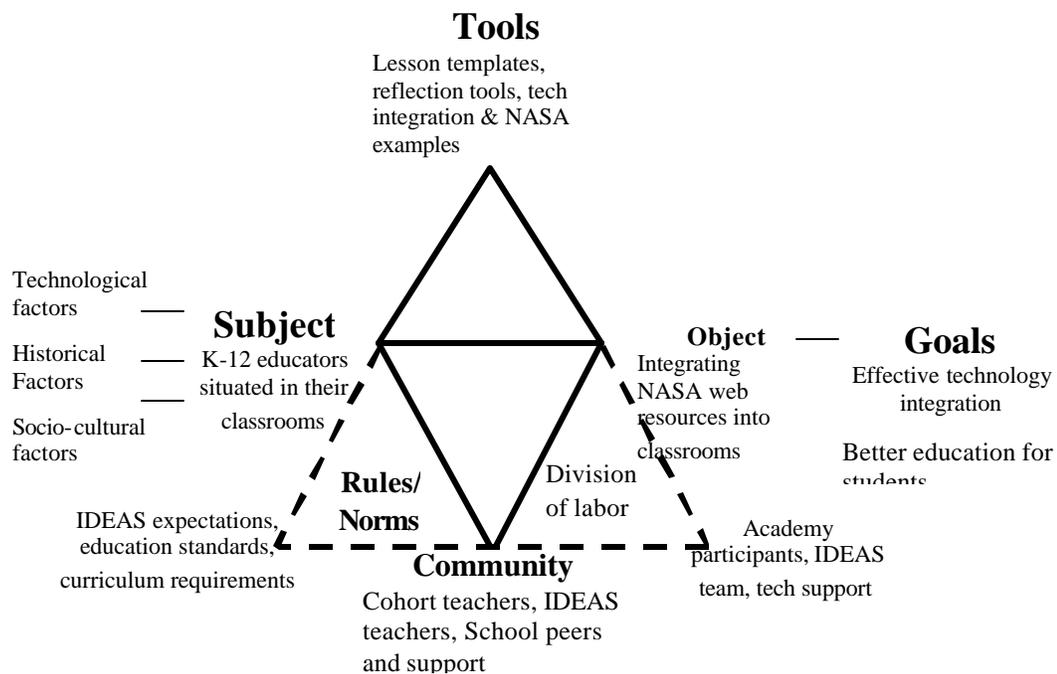


Figure 2. CHAT research and data collection framework

Methods

Research Questions

The following research questions were investigated using a case study approach:

1. How did teaching methods, technology integration strategies, and use of NASA astronomy and space science resources change over time?
2. What elements of the academy affected educators' teaching methods, technology integration strategies, and use of NASA resources overtime?

Subjects

The participating educators were from schools within an urban school district in upstate New York. School administrators were asked to help recruit middle and high school science and math teachers, of which the subjects volunteered to participate. In the first year 7 educators participated. In year 2 there were 11 new subjects from the district. The teachers were required to have at least 3 years science or math teaching

experience, basic computer and internet skill, and access to an internet-connected computer at school.

Data Sources and Analysis

Five sources of data were collected on each of the educators during the academy and in follow-up observations in the classroom: (1) initial background survey, (2) workshop evaluations, observations, and feedback, (3) classroom observations and photographs, (4) mid-year survey and (5) on-going interviews. The surveys probed for attitudes, perceptions, practices, and demographic information of the teachers. The observations focused on classroom environmental factors and teaching practices including technology and resources use, teaching methods, and classroom events. The interviews were used to solicit feedback on teaching technology, and resources uses and issues, as well as teachers' thoughts, ideas, and explanations of their practice. The researchers collected data both in the etic (as the outsider) and emic (engaging with the teachers and students in the classroom). These data points were used to identify the trends of changes in teaching and technology and NASA resource integration.

Quantitative data were organized to describe of the entire group of educators. The complete set of data was analyzed to identify interactions among the teachers, tools, community, and objectives identifying trends on both individual and group levels. Data regarding the educators' teaching methods, use of technology, and use of NASA web resources were tracked using a time series approach to capture temporal changes. A profile for each teacher was created and used to identify resulting themes.

Results

The two cases presented here were chosen from a representative sample of educators who participated in the initial year of the project. These two cases were selected based on maximal variety of participants' responses to the initial survey. The two cases described in this paper were selected to represent the extremes of teaching experience and web use. See Table 2.

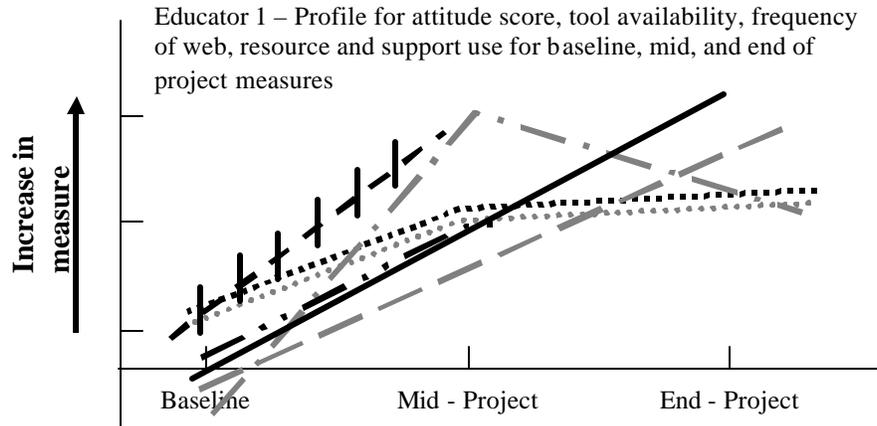
Table 2. *Baseline demographics for first year participating educators.*

| Educator | Initial Attitude score (-30 to +30) | Teaching exp.(<5 yrs / +5 yrs) | Self-rated computer expertise (low to experienced) | Self-reported web use (lesson prep, in class) |
|-----------------|--|--|---|--|
| 1* | -8 | +5 | Experienced | Weekly for prep/class |
| 2* | 10 | < 5 | Low | Rarely for prep only |
| 3 | 19 | +5 | Intermediate | Monthly for prep/class |
| 4 | 12 | +5 | Intermediate | No data |
| 5 | 10 | +5 | Low | Monthly for prep/class |
| 6 | 24 | +5 | Intermediate | Weekly for prep/class |
| 7 | 23 | <5 | intermediate | Monthly for prep only |

* educators included in comparison.

Educator 1 profile

Educator 1 participated in the project for two years. She taught 6th grade science for more than 5 years. She spent more than 60 percent of time teaching science and less than 20 percent of the time on mathematics topics. Teacher 1 self-identified her primary teaching strategy as inquiry and indicated that she also uses hand-on activities, collaborative work, and problem-based learning regularly. In the baseline survey, she rated herself as an experienced web user, holding a slightly negative attitude toward web use in education (-8 on a scale of -30 to +30). Data collected during initial observations indicated that her classroom environment contained one computer with web access, a printer, instructional TV, and an overhead projector. She indicated that she often used the computer and web to search for school-related information and to prepare lesson weekly, however rarely used technology in the classroom with students. See figure 4.



KEY

| Data | Scale / Scores or Level | | | Graph Symbol |
|--|---|---|---|--------------|
| | Baseline | Mid-project | End project | |
| Web use attitude Score | -8 | -30 ----- 0 ----- +30 15 | NA | - - - |
| Tool available in the classroom | Low Computer Internet Printer Overhead TV | → Computer Internet Printer Overhead TV SMARTBoard NASA web resources | High Computer Internet Printer Overhead TV NASA web resources Web-based reflection tools | ————— |
| Frequency and purpose of web use | Low less than monthly primarily to prepare lessons | → M | High daily to prepare lessons and use in class | |
| Strategies for technology use | Low None | → teacher use to present | High students use during learning | |
| NASA resources used | Low None | → M | High many types | ——— ——— |

| Level | <i>L</i> | <i>M</i> | <i>H</i> | |
|---------------------------|-----------------|----------|--------------------------------|---------|
| Amount & types of support | Low → High | | | |
| | No support..... | | frequently from IDEAS team | — . — |
| Level | <i>L</i> | <i>H</i> | <i>M</i> | |
| | No support..... | | frequently from school sources | — . . . |
| Level | <i>L</i> | <i>M</i> | <i>M</i> | |

Figure 4. Trends for educator 1

Educator 1’s frequently communicated with the IDEAS support team and other educators from the academy to share teaching information from the project and her new ideas for technology use. In addition, at her request, the IDEAS support team provided her with a portable SMARTBoard and projector and technology support to operate these new resources, additional NASA web resources for specific science topics, reflection tools to help her think more about how to use such technologies, and use of the IDEAS online lesson plan templates. She also shared examples of the lessons she created as a result of year 1, NASA resources and web resources she found most useful given her teaching objectives, and examples of student projects that were produced from her classroom with the year 2 participants.

The two-year observations, summarized in figure 4, indicated several changes throughout project participation. She developed higher attitude scores, used NASA tools and resources more frequently, and made changes in her teaching methods and the types of resources she used in her classroom over the two years. There was an increase in the number of NASA posters and other resources used to ‘decorate’ her classroom and that she used to engage her students in activities and discussions. In a final debrief educator 1 reported that she now begins all web searches, to support any science topic, at the NASA search site. Although rarely using this approach before participating in the IDEAS project, teacher 1 also began incorporating web resources more regularly into her teaching and engaging her students with the web to support their learning.

Educator 2 profile

A similar profile was created for educator 2, showing his activities within the academy and classroom and how his teaching, technology, and NASA resources practices and uses changed over time. These data also provide evidence of the factors within the activity may have influenced noted changes.

Summary of Results

Many changes were observed in both of the subjects with regard to teaching, technology, and NASA resources practices. These changes, and lack of changes, were traced to historical and activity factors from the academy and classroom environment. Factors included development of new knowledge of strategies and resources gained during the academy, project and school support mechanisms and resources, curriculum requirements, peer collaborations and support, sharing of ideas within and outside the subject cohort, classroom contextual factors such as room layout and technology access, school policy such technology rules and regulations, and teachers’ personal perceptions, attitudes, and experiences.

Discussion

The data collected was rich and full of illustrative stories that explained emerging patterns and how these teachers interacted with the resources, community, and objectives for which they were striving. Many examples described how teachers helped each other, reorganized their classrooms, accessed new technologies and resources they had not previously thought about, worked through issues of educational technology union rules, identified new support resources at their schools, and generally changed the way they were thinking about teaching and resources use. These two educators for example, similar to the other participating educators from both years of the academy, began to make changes in their teaching, technology, and NASA resources use strategies. The academy itself, and follow-up support, seemed to have set off a variety of activities and interactions that supported, or perhaps influenced, these educators’ changes over time. Four main themes emerged: teaching methods, technology integration, NASA resources are rich sources on information, and NASA resources as technology-based resources.

Theme 1 - movement toward more student-centered methods. The most commonly used (reported and

observed baseline) teaching methods prior to the academy were presentation and hands-on methods. Both inquiry and collaborative learning emerged after the academy in both of the studied classrooms. Both teachers began to use inquiry to prompt students to associate current events, daily life, and their experiences with new concepts. In addition, the educators prompted the students more to define important concepts and rephrase their understanding of the content in their own words. These inquiry sessions were often accompanied with discussions on examples of NASA scientists at work, for example why it was important for NASA mission scientists to understand weather topics, communicate during major projects, and use similar metrics. Thus the use of the new resources and technologies seems to have had some affect on the methods the teachers began to use to further engage students in the classroom.

Theme 2 – movement toward technology enhancements. These educators did not have the same technology available for use in their classrooms, yet both used the web to help them prepare for lessons. The data indicated however, that both also began to use technology as a media to present content and gather and print teaching resources. The web was used more often at the end of the project by both educators to search for additional resources that would be used to support their teaching and as a presentation, prompting, or exploration tool in their classroom.

Theme 3 – inclusion of ‘richer’ information resources. Both educators began to use NASA resources in three ways: teaching resource (supportive of presentation, inquiry, activity), motivational classroom decorations (supportive of explanation and inquiry), and as a sharing tool with peers (sharing new resources and lesson ideas). They incorporated more illustrative (pictures) resources in their teaching approaches to help students visualize content. They both began to use NASA resources and websites more frequently, including lesson plans, information related to the content, and vocabulary, when preparing to teach. Both educators also shared several web resources with peers and students across the school district.

Theme 4 – engaging with technology resources for teaching and learning. Both educators, provided with the NASA resources and technology by the IDEAS project, were motivated and increased their use of NASA resources and technology into their teaching. The NASA resources enriched both teachers’ access to scientifically accurate resources and their teaching methods. Additionally, both teachers made use of more technology to aid in their searching and preparation activities and in presenting information and activities to students.

The technology integration efforts resulted in a complex process of interactions with tools and community members. The use of computer technology and NASA resources seemed to provide motivational context for many topics from studying weather and measurement to creative writing. Many of the new ideas were inspired by examples presented in the academy or from collaborations with peers and the IDEAS support team. Yet, as illustrated by these two different educators one engaged a great deal with the IDEAS team and the other only slightly to allow classroom observations and brief interviews. Therefore, the influence of the IDEAS academy and personnel may not be the major factor in the changes observed. Introduction to the content and resources of technology integration models and NASA resources and the characteristics of the teachers and their interactions in their environment may have played a larger role in prompting them to engage in new behaviors.

Limitations

The CHAT approach, as opposed to a traditional cognitive research paradigm to study the impact of IDEAS on these educators provided a much richer understanding of the interactions among teachers, new content, and their environment as they made change in teaching methods and began to adopted new technologies and resources into their teaching practices. Given this was a pilot test of a new research and analysis methodology findings must be interpreted cautiously. Only two subjects were investigated and Davydov’s (1999) stages were not followed completely. As a result, additional analysis will be conducted to include the resulting lesson plans as data points, all of the participating educators will be included in the final analysis, inquiries will be made to other educators who were not directly involved in the academy, and significant features of the environment will be further explored. More observations and in-depth semi-structure interviews will also be conducted.

A Research Model Generated from the CHAT Case Study

CHAT research paradigm provides enlighten researchers with a more holistic method for exploring technology integration efforts. This requires a shared understanding of the character and history of the subject, the object unto which the subject is attempting or required to reach, the characteristics of the surrounding community, and the technology/tools available to the subject etc. A research model based on CHAT paradigm

and this research demonstrates how to explore the research context and review the literature to focus on the interaction of human activity and the whole of the individual's mentality as they interact with a relevant environmental context and ultimately finalize appropriate research questions and methodologies. This model also demonstrates how a research conceptual framework can be established to integrate research questions, data collection, analysis, and reporting.

Stage 1: Research Context Exploration. The CHAT framework reveals the holist research context. It helps researchers to conceptualize the complexity of the research context in terms of the characteristics of the technology integration activities, the factors that affect change, and the interactions among factors. In this stage, researchers need to explore (1) social, historical and technology attribute characteristic of the target population; (2) the environment in which the target population operates including community, rules, and division of labor; and (3) the goals the target population is trying to reach. Identifying the characteristics and issues surrounding these factors provides a research context.

Stage 2: Literature review. Based on understanding the general characteristic of the research context, researchers can begin to review the literature regarding (1) the relationship between the characteristics of the target population and the technology use (2) the interactions among target population and environmental factors, and other relevant relationships. The review should focus on such relationships and methods used to capture data and understand the complexities of the similar environments.

Stage 3: Define Research questions. Based on the results of the stage 1 and 2, researchers further define the impact of technology interaction and narrow down research questions to "what" and "how."

Stage 4: Establish research conceptual framework. A specific research conceptual framework is then developed based on the research questions guided by an analysis of the activity structure. Elements of the research process such as research design, measures, data collection instruments, data analysis and interpretation are defined based on current understanding of the activity framework. For example, in the aforementioned case study we identified (i) academy *tools* (ii) the establishment of *rules* of engagement and other factors as critical to this study. Thus, it is suggested that researchers integrate the finding of previous stages to establish a specific research conceptual framework, describing the research purpose, context and methodologies. Refer to figure 2 for framework.

Stage 5: Data collection. The CHAT framework is then used to design appropriate research methods and select an appropriate sample of representative participants that account for the attributes of populations and the contexts in which they are engaged. In the IDEAS case study we selected teachers that were representative of the target audience for the technology integration academy, who had a variety of experiences and different levels of attitudes toward the use of technology in the classroom and were currently engaged in a variety of teaching contexts. The variables for study, situated within the research framework, also need to be defined and the data collection methods established to effectively view the activity under investigation from multiple perspectives. In the IDEAS project data were collected at time intervals to investigate changes based on an intervention. Repeated measures methods were used to collect both quantitative and qualitative data, either of which could have been analyzed to show change over time, and both were used to show change and interactions at different times throughout the project.

Stage 6: Data analysis. Research conducted based on CHAT framework yield richer data, which provides more comprehensive results and a stronger "feeling" of understanding of the changes within the activity. The researchers are better able to picture a holistic view of the changes by investigating the relationships across different analysis results, using a variety of data. The profiles created for each educator, in this case study, presented a picture of how the individuals changed over time. Such data were also used to compare and contrast the change across several individuals engaged in the activities. In addition, as the change is dynamic, having measures of the multiple factors within the activity added to ability to identify causal and intervening variables. Such rich data however requires strong data analysis skills that inform the interpretation process.

Stage 7: Data interpretation and report. Technology integration activities are complex in nature and unpacking the factors that encourage changes, temporary and sustained, is a difficult process. Having richer data that provides insight on the foundational elements of an activity, e.g., subject, object, tools, and community, provides perspective on the whole activity. Gaining insight in a comprehensive and understandable manner is

still a matter of skillfully applying analysis and interpretation techniques, not unlike complex quantitative or qualitative data analysis. It is recommended that interpreting the results begins with basic analysis of changes between start and finish state of the subject moving toward a goal such as changes in attitudes, or measures of learning. The analysis then continues by looking at the relationships between the other elements within the activity. Either, or both, may be using quantitative or qualitative techniques, however the key is to work through the complexities of the entire activity and the factors that influence the ebbs and tides of changes. Therefore, it is suggested that interpretation begins in simple terms and eventually considers the wholeness of the activity and the interactions that occur among the different elements.

Conclusion

Traditional cognitive research approaches to technology integration research do provide valuable information, but generally lack the robustness to fully understand the dynamics of this activity. Conducting such research using a CHAT strategy helped to reveal technology integration activity's content, structure, organization and fundamental characteristics as they exist within the training and classroom context. Although much more complex design, such an analysis helped shed light on the complexities of technologies use to enhance teaching and learning and how such tools are adopted to meet instructional needs of educators. Developing this understanding will help in the development of more comprehensive research and evaluation methodologies as well as technology integration training and strategies.

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Appreciating Assets: Educational Technology Leadership and the Generation of Social Capital

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Abstract

In the information age, Educational Technologists exist in complex, codependent organizations where the information age is demanding changes to our theory and praxis (Reigeluth, 2001). In this paper, the author argues that advanced leadership theory and practice can be used to characterize and design educational technology R&D, along with praxis, to account for the relatively incredible potential of this field to add to the social capital of our institutions, states and nations. First, the paper presents the need for specialized educational technology leadership epistemology. Next, the macro concept of social capital is presented as a model for describing high level contributions from the field, focusing on identifying key elements educational technology leaders need to understand. Finally, high capacity network characteristics and examples from research are presented to inform ET leaders about what it takes to create and sustain the necessary high capacity leadership network in the information age.

Introduction: A Need For Leadership Knowledge in the Educational Technology Field

Traditionally, the assets of a commercial organization were measured in terms of plant and property as hard assets that were managed as relatively stable, reasonably predictable commodities. The most highly valued companies were the ones that kept production turn-around time to a minimum, balanced stock and sales, and got the best return on financial reserves to provide a prudent mixture of debt and equity for the future. In the new “information age” or “knowledge” economy, the most highly prized companies are the ones that manage intangible assets, such as an ability to generate value, to create and maintain social and intellectual capital for example, rather than to only account for hard assets (Kelly, 2004; Fullan, 2000).

This newer commercial paradigm has arguably not yet affected today’s education institutions – but it is a widespread condition in industry (Senge, 2000). Because schooling is a society sponsored activity, our intangible asset leadership is, indirectly, becoming prevalent and important as a leadership example across education and industry training sectors (Bennis et al, 2003; Helliwell, 2002; Bolman & Deal, 2000). Educational technologists work in both industry and schooling. Are we prepared, in ET theory and in practice, to answer to this critique from an educational technology (ET) field perspective? A common premise behind the government (grant offering) policy thinking may be important: If public and private organizations can not organize themselves to create appreciating (positive) social capital, the projects completed may have less value to society. Are we, as educational technology leaders, knowledgeable and prepared for these changing conditions? It is one thing to be a good instructional designer or developer – it is another to understand the impact of the projects we lead in institutions, partnerships, governments and society. This author posits that educational technologists have a tremendous contribution to offer in terms of social capital creation (appreciation), and that we need to learn new the ways of modeling and managing our ET work within a this larger policy sphere.

Government and industry view education as a significant potential contributor to social capital generation (Woolcock and Narayan, 2000), so educational technologists are directly concerned. This is not only because we practice in both industry and education sectors, but also because we are often responsible for large, expensive public projects that involve a lot of human and social capital. It is possible that under these conditions that without significant change, our field “could be relegated to its backwaters”, and that inertia could influence whether we as individuals are successful in our careers or find ourselves progressively less effective – much as the old tightly bureaucratic firms can no longer handle information markets and much change (Fullan, 2000). ET senior scholar Charles Reigeluth (2001) lists several organizational factors for educational technologists to consider as we adapt. As this paper will demonstrate, the macro concepts of social capital and networked organizations make reasonable new models for understanding and informing educational technology leadership to include finite characteristics such as autonomy accountability, cooperative relationship, networking and process oriented approaches necessary for the organization of the future (Dickson et al, 2003; Reigeluth, 2001). But it is not enough to know the conditions and constraints organizations offer us today – we must know more about how to lead educational technology both as a field, and in practice, in our increasingly interdependent

and partnered education, government and corporate settings (LaGrange, 2004; Hargreaves, 2001; Wheatley, 2000).

In this brief paper the author introduces the imperative for educational technology leaders to consider social and intellectual capital as macro constructs in our leadership, along with definitions of the terms. The important concepts of networks and network leadership are explored, with some examples of high, medium and low capacity technology leadership networks offered from recent research findings. The paper concludes with an argument to place educational technology in the 'dead center' of the recent trend to make social science matter today in high policy circles (Judge, 2004). A summary of the organization and structural characteristics inherent in high capacity social capital generating networks is then offered.

Social Capital: A Macro Level Concept for ET Leadership Today

The late American sociologist, James Coleman (1988) argued that social capital consists of those aspects of social structures and systems that facilitate the actions of actors within a structure. As such, social capital can be used as an important model allowing an aggregate measure or descriptor of complex systems of educational leaders who work together via network structures to improve education (Kelly, 2004). The concept offers an encompassing description of agencies, governments or entire sectors because the unit of study can be approached at either the micro (individual), meso (institutional) or macro (regional, global, economic) levels (Hall, 1994). Social Capital is a macro concept that can be defined in two ways. First, by its structural components (as networks of interacting individuals or organizations) and second by its cultural components (Bourdieu, 1986; Judge, 2004). The cultural components of social capital have long been the focus of social science work on social networks, concentrating on actor (leader) obligations and expectations, trust, information potential, norms and effective sanctions, authority relations, and appropriate social organizations. This kind of social capital cultural research is heavily dependent on actor contact time and other measures using social network theory – an intuitively pleasing idea which slipped into a bit of heuristic confusion in the 1990s (Rhodes, 1996).

Describing social capital as structural networks of people organizing their work, Bourdieu (1986) classified this kind of capital as an asset found in networks where three types of social capital are known to exist in pseudo-institutional environments. Such network types are: bonding (within homogeneous groups), bridging (networks where actor relations cut across diverse social cleavages horizontally) and linking networks (where ties are formed between different strata of status, influence or wealth). Describing intangible assets in this way, a process, involves studying flows of information and the types of relationships existent in both institutional and political terms. Recent policy network scholars have developed a set of network characteristics that allow us a model and describe the types of relations among many kinds of entities a wide array of contexts (Judge, 2004; Bourdieu, 1986). Strong relational links in these networks generally mean a highly capable system for generating social capital, but weaker links and bonds (like those used by job seeking individuals) can also mean much more social capital for individuals who must work across groups and fields, for example (Granovetter, 1978), so the network concept is not quite as intuitive as it sounds.

By applying more advanced political science derived constructs of policy networks to describe the relational (structural) networks in organizations (and between them), the process of interest organization (what matters to who, and how they respond to pressing issues within influence networks) can be studied to create an encompassing and discriminating method for understanding social networks because structures with specific taxonomies, capacities and autonomies can be identified by how folks organize their interests (Atkinson, 1996; Coleman, 1998). In 2003, Kowch modified policy network theory – an advancement on earlier social network theory to include influence and power. This extension allows the description of structural social capital elements (networks) more precisely at the institutional level. Kowch studied educational technology leadership (influence networks) across states, governments and large institutions to identify network philosophical, leadership style and educational technology actor ontologies as important sets of variables policy leadership systems that emerged across several universities, for example.

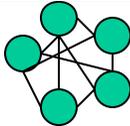
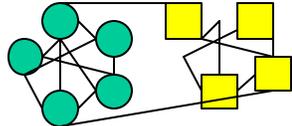
In his book "Bowling Alone", Harvard's Robert Putnam revealed a national study describing and explaining some of the reasons for a steady decline of social capital in America over the last 50 years, in social capital in America (Putnam, 2000). He measured social capital via social network analysis, including a deep analyses of volunteerism in America. He defined a sharp, continuing decline in American's participation in professional organizations and public institutions – a depreciation in social capital. Among his findings are revelations that education (capital) systems require more funding to increase education system performance, and that more children (learners) must be included in education networks. From these and similar findings arise powerful implications and models for the leadership of any educational technology R&D in both public and

private settings.

Educational technologists today are working more frequently within and across the domains of utilization, design, development, management theory and practice simultaneously in complex institutional settings and partnerships. These partnerships are often formed with with the state government or local governments, where a codependence often exists between the institutions working together on ET projects. It seems then, that a structural or network approach to understanding ET leadership could be very helpful as a way of interpreting and designing information age ET social capital generating projects in a time of great change and organizational/political complexity (Reigeluth, 2001), especially when codependent relations are essential to our ever increasing project complexity and size, and when the type and kind of network (bridging, bonding, linking) may need to be carefully designed and used to measure our successful ET contribution to social capital. This is an important statement when governments are generating policy to fund and to promote primarily high social capital education endeavors (Woolcock, 2000).

Effective leadership networks create a high social capital generating capacity. For example, across-school division improvements or pan-institutional corporate training through ET work is common practice for us in the design and development we do in the field. Can we account for this value-added intangible asset? Distance learning has increased our need for financial capital while at the same time it is easing us from geographically constrained relations – a factor that is still a condition constraining most fields in education . Think of this kind of ET asset or capital from a government granting agency perspective. Independent of the product of our usual project processes, can educational technologists claim increased social capital generation because of the processes we use to get things done? I think we can. This is because we link all sorts of experts and people in meaningful ways, across social strata, diverse social cleavages, institutions and governments – consistently. If a granting agency is considering the linking, bridging and bonding characters of a project as it creates links between and across organizations or entities, we among most educators create, design, maintain and yes, provide leadership for such work consistently. Compared to a project in counseling psychology for example, we generate far more social capital, by definition. We rarely document that contribution in organizational and social contexts.

As educational technology leaders, there exists little evidence that we have found a way to describe the benefit (appreciation), in terms of our organizations, of these intangible systems when they work. Yet there is little doubt that these systems add to the capital of the organization, state or nation (Kowch, 2003). If we can describe these network processes, we should also move to expand theory so that we can design and be accountable for the social capital generated by such capital generating networks. Figure 1 demonstrates the three types of (structural) social capital developed by networks.

| Type of Social Capital (Network) found in institutional arrangements (Kowch after Bourdieu, 2003) | |
|--|---|
| <p>Bonding</p> <ul style="list-style-type: none"> – Relations within homogeneous groups – Strong ties mean stronger capital (Putnam, 1998, Woolcock, 2004) – Example: Teachers Associations |  |
| <p>Bridging</p> <ul style="list-style-type: none"> – Relations cut across diverse social cleavages <ul style="list-style-type: none"> • Horizontally - key to exchanging new info <ul style="list-style-type: none"> – Useful for information diffusion • Weak ties mean low capital, and be an advantage for innovation / or organizational change (capacity) – Example: A distance education project consortia, led by a university organized to design and deliver technology leadership education to both school principals and home school parents in |  |

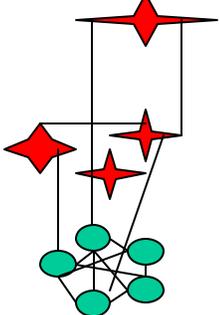
| | |
|--|---|
| <p>the Australian outback.</p> | |
| <p>Linking</p> <ul style="list-style-type: none"> - Ties between different strata of wealth and status (Woolcock, 2003) <ul style="list-style-type: none"> • Vertically - key to linking formal institutions - Ties between different strata of influence (Kowch, 2003). - Example: Educational Technology Leaders designing, creating and implementing state level distributed education procedures / policy, and expanding the partnership to include European states, universities and schools to do the same thing. - Example: ET leaders in multinational corporations leading consortia development of new satellite based education programs across the globe in several countries. |  |

Figure 1: Types of social capital with Educational Technology Field examples

Leading Educational Technology via Network Leadership: A Meso Level Concept

Developing and leading in the disaggregated or neo-institutional organization means knowing more about influence networks that get things done (policy networks) and the larger communities that these networks exist within. In this section, policy networks are presented as embedded social capital generating entities within larger communities, all spanning organizations and / or governments. This section begins with policy and network definitions, and closes with a description of the key variables in a high capacity network so that educational technology leaders can ponder those parameters - with an eye to generating robust organizations as they lead ET developments.

Policy Network

Originally, policy network analysis was created as a response to the limitations of public choice (competitive) hierarchical policy and organization models in efforts to better explain how people organize their interests in order to react and to get policy (making) work done (Wilks & Wright, 1987). Because older linear, rational choice institution-based frameworks were found lacking in their capacity to describe the reality of government / industry relations in an increasingly partnered government and institutional (information age) world, a new frame of analysis was needed (Lane 1995). Rather than conceptualizing government as a benevolent distributor of resources to competitors, network policy analysts accepted that government/industry or sectoral partnerships/relations today are the norm (Pal, 1997). The utility of traditional public choice, public policy or public administration models to describe how such interwoven, codependent governments, industries and sectors organize their interests was deemed deficient, so policy network research emerged (Atkinson & Coleman, 1996). Policy issues or problems are no different than strategic or operational problems in an organization, for policy is defined by the policy network framework theorists as a process – a reaction (or inaction) to an issue by a group of people (Coleman & Skogstad, 1990) who coalesce from a larger constellation of individuals (a policy community) to act on the problem (to solve it). Because networks are organizations, and since organizations are knowledge (Van Wijk, 2003), this author suggests that the process of interest organization is not far different from knowledge management (KM) (knowledge transfer and flow), and that policy network conceptual frameworks are very similar to knowledge management networks. In other words, knowledge management theorists may use policy network capacity models to define (or design) high capacity

knowledge networks. For example, consider the ET leader who must negotiate copyright protocols for a distance project that involves information that will be generated across several universities and states. The complexity of people and activity in a large project is huge, but if, as leader, you understand what moves people to work in vibrant, codependent networks across governments and institutions, that complexity is rendered simple if you consider the nature of high capacity networks (at the end of this section). Older bureaucratic and functional leadership requires a much more complex, incremental approach – today, network architects must understand KM too.

So we can consider the ‘organization’ of a big project to be a collection of actors who are reacting to a problem or challenge as they organize what they think is important (about the problem). We see study them as they subsequently go about the process of developing tangible, tactical or strategic responses to that problem (solutions). The exact interactions are not as important in a study of change-capable organization compared to the importance of knowing the type of process this group or network exhibits. In the neo institutional or codependent groups of today, Institutional actors do not identify, rank and solve problems in isolation, and they do not necessarily organize themselves hierarchical or bureaucratic structures. They can coalesce or come together from a constellation (community) of actors who have similar interests – in effect, forming a knowledgeable group of actors who create a network to get work done (Alvesson, 1996; Garcea, 1997). Do we organize our teams with this knowledge, considering these organizational factors in educational technology field?

To demonstrate: If water rights become an issue (or problem) for a collection of farmers, industries and governments in a region, you can safely bet that a collection of interested individuals will form (with management or perhaps without it) to generate a response and to push for solutions. What has been described here is the identification and ranking of a policy issue being across institutions, and then organized by people within a network or pattern of relations. These people may (or may not) successfully create a solution to the problem by working with actors across departments in a company, from various farms, and from across the government agency responsible for the sector, depending on their motivation, and common interest, and on their collective capacity to organize their interests in order to act (to solve the problem). This is complex activity to model, and network analysis allows us to render these types of emergent, pressing and sometimes quick-forming pan-institutional processes simply (Lane, 2000). There is value rendering such complexity simple. In a business or corporate setting, the same pan-institutional issues and resulting activities (processes) can occur when two companies merge. For example, say two different compensation schedules need to be negotiated because of a new partnership formed by merger. Some people in both the new organization will be motivated to achieve a certain solution over other possible solutions, and they will be motivated to work together to define, rank and organize their key interests or issues, to exchange knowledge, and to work to create a solution or response. This will occur no matter how far flung the various divisions or regions are geographically if the issue is important enough (Coleman & Skogstad, 1990). Because labor laws and government regulations may differ in different states, government may be involved in the solution as well. The capacity of the network to find and organize its interests will be important for all concerned, so that the process serves some end or solution (work). Wise Educational Technology leaders in the near future should be able to craft such a network for success, or at least to describe the parameters that characterize such a high capacity network.

In the next section, this paper demonstrates, briefly, the findings from a study on how three universities in two states organized their interests to set the educational technology (issue) directions, investing millions of dollars while indirectly affecting hundreds of thousands of students and many faculties. Policy network study is a study about what issues draw people to an action network, about why they were drawn to the issue, and about how they organize their interests, in patterns or structures (called networks) to make things happen. It is a study of the how of networks, not only of the whom and what of networks. In policy network study, individuals or actors are analyzed at the micro level, and the network (pattern) is analyzed at the meso or neo-institutional level. Because interest (knowledge) organization processes are studied and interpreted using an extension of the functionalist (descriptor only) policy network canon in this process, a post hoc analysis can interpret the nature of the interest organization process itself – and that information can inform network design for ET leaders who are engaged in creating high capacity or high social capital generating networks in similar situations (Kowch, 2003).

Viewed from an ontological perspective, the policy network canon still provides mostly functionalist sociology and organization theory frameworks too, but leaders need to consider the way actors view organization (and leadership) processes as well., as the author found that leaders who see organizing as a bureaucratic process are essentially left out of influence networks that are fluid and post bureaucratic. This is why very few educational technologists were nominated to the educational technology influence network in the

Western Canada study (only two were nominated from a possible sample of over 60). When designing high capacity networks (high capital networks) the concept of neo-institutionalism is helpful in breaking the bounded rationality proposed by internal/external institutional analysis (Lane, 1995). The neo institutional construct is particularly useful when designing or interpreting partnered organization processes (networks) that might not function entirely bureaucratically, hierarchically or even as closed systems (Kowch, 2003). Neo-institutionalism is the condition where, in a disaggregated state (where government and industry share in responding to issues), institutions have considerable autonomy to organize interests and to create strategies for problem solving. That autonomy is of course a function of the capacity of the institution to exchange ideas, and upon the pattern of relations by they choose to exchange the flow of ideas (Atkinson & Coleman, 1996). The basic unit of analysis at this institutional (meso) level is the pattern of relations between individuals who depend, to varying degrees, on each other to exchange (and to generate) information while they organize their (main) interests or problems (Howlett & Ramesh, 1995). Neo institutional interpretive frameworks allow us to characterize both internal and external (pan institutional and community invested) representations as one network and the concept maps well with the increasingly necessary flexible, recursive or constructivist ontologies found in ET praxis (Salomon, 2000).

Characterizing high capacity networks

According to Coleman & Skogstad (1990), high capacity issue organizing policy network actors possess the following characteristics:

- (1) a clear concept of role in the process or organizing things,
- (2) a supporting value system (supporting the network defined goal)
- (3) a unique, professional ethos,
- (4) an ability to generate information to answer unanswerable questions,
- (5) an ability to maintain cohesion within the network
- (6) an ability to organize and manage complex tasks, leading to a work output (result), and
- (7) the ability to rise above the (near term) self interest of the group (network).

In addition, Garcea (1997) notes that high capacity actors have three characteristics that affect the capacity of networks to get things done: (1) interests; (2) institutional contexts (programmatic or political, & managerial and financial management capacity) and (3) ideologies or ontologies. Subjective or objective ideologies or ontological stances to the organization task are important to know, as they are important factors in the interpretation of the capacity of the response networks (Kowch, 2003). By linking management models describing the capacity of networks to get things done (and to handle change), Kowch borrows from Ibarra (1992) to describe the dynamic potential of policy networks to get issue organization (knowledge) work done. Ibarra's model was based on previous work in social networks (Granovetter, 1973) and Kowch used it to add analytical validity at the meso level (network) analysis of policy networks to provide a complimentary description of loose or tight ties. Both methods yielded the same network descriptions for network change capacity and innovation capacity. So these are the criteria by which the process of organization, evidenced by policy networks, is characterized. The result, to long to mention here, is a method for characterizing the change capacity of networks that generate positive social capital in a neo-institutional or complex organizational setting. The type of organizing the network does (i.e. pluralist, corporatist, concertist, statist) can also be identified by doing an autonomy analysis (Lindquist, 1996). In this paper, only the network capacity determination will be demonstrated for parsimony reasons. From the previous literature, it is clear that high capacity networks also contribute to high social capital generation networks. From descriptions and analyses of these three policy network case studies, performed at the micro (actor), meso (network) and macro (environment) levels, the author then presents findings and a more detailed analysis of policy issue (knowledge) organization networks at the institutional level.

High and Low Capacity Educational Technology Leadership Network Examples (High and Low Social Capital Generators)

A Low Capacity ET Leadership Network Case – Too Many Interests, Some Codependence in a Workflow Network

In earlier research (Kowch, 2003) a low capacity case ET leadership network describes a closed system of faculty and administrators who came together with two issues or fundamental motivations to organize in

mind . This caused a cleavage to appear in the network diagram (Figure 2). One low capacity cleavage had weak ties to the other interest group, and collected because of self interest in distance education. The higher capacity cleavage (a larger group) came together to solve problems related to technology because they believed the institution required a progressive image. Both groups were unsure of their role in the network as policy makers, while all actors exhibited a supporting ethos and value system to serve students and the institution. The two interests in the influence network therefore decreased the cohesion and the organization capacity of the network to get policy done or to prioritize what (knowledge) mattered most (and they readily admitted this fact).

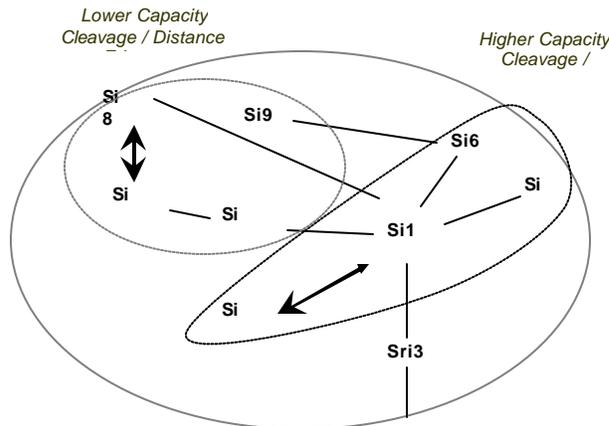


Figure 2: Low Capacity Educational Technology Leader Network Case

The “distance cleavage” emerged as a subsystem, and evidenced only a weak connection to the government through the other cleavage. All actors in the case were found to have a strongly bureaucratic or objectivist organization ontology, and most actors preferred to submit decisions to their respective committees (85% of the members sat on each other’s committees). Most actors knew that the super ordinate committees they chose to send policy creation (work) “up” to had no funds or policy instruments, and likely would not pass the recommendations. As such, this is a hierarchical work flow network that is tightly knit, impeding innovation and flexibility to respond to challenges (Ibarra, 1992). With weak ties to a government member who also looked to the committee for interest organization, this network was classified as a pressure pluralist organization, where both actors and cleavages created a low capacity issue organizing network with low social capital generation capability.

A High Capacity ET Leadership Network Case – One Interest, High Codependence, Loose Ties in an Non- Workflow (non bureaucratic) Network.

Figure 3 depicts the structure of the “Calliope” University case, which among the three cases showed the highest capacity to organize interests across institutional boundaries. In this macro environment, the government had strategic plans for the universities, and required the universities to generate plans that aligned with government plans about education and technology – and the government had in place funded policy instruments (grants) targeted at anyone in the university system, so the policy (macro) environment was far more organized than in the other two cases, where no similar government plans, policy or alignments with the institutions was evident.

ET Leadership Network Motivation: Overall, the reason for people coming to this to work out the problem responses was found to be a desire to increased market share for the institution, and every member indicated this one issue or interest driving their (network) organization. Though holding a predominantly determinist view of education technology, these people come together to set policy based on the generally understood idea that technology will give a market edge to the university. They came up with this understanding as a group, but held the ideal individually as well, and actors came to this network from across many faculties, government agencies and administrative departments. A key interest or common knowledge is what holds this network together - at the table so to speak. Everyone understands the issue and has “bought into it”.

ET Leadership Network Composition: These 9 actors have a central core of 4 service group experts, with the others being physical plant people and executives from the academic and administration chambers, also including people from the professorate and related (higher education) government senior officials. The core or non-workflow (non hierarchical relation – non bureaucratic) core of this group change depending on the ET

leadership task at hand.

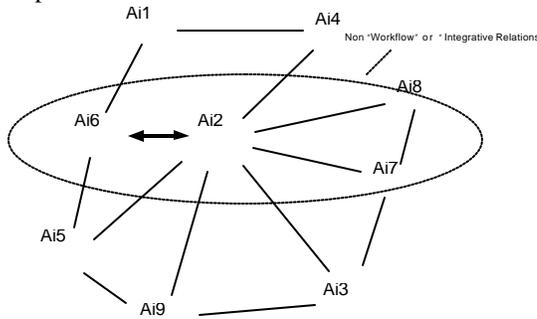


Figure 3: Network: High Capacity Educational Technology Leader Network Case

ET Leadership Network Capacity: In this network, people from across the institution share one interest with the government and they have the same joint concern, so both the government and the institutional network demonstrate a high degree of autonomy and capacity in organizing their interest (they are both doing what they want to do, depending on each other to organize the one main issue – market share gain), and they both are able to articulate and solve the problem independently (they cooperate in that process as a network, without hierarchical structure). An (aggregated) but more detailed description of the key capacity characteristics of this network follows, presenting findings and analysis for each criterion used in policy network capacity determination.

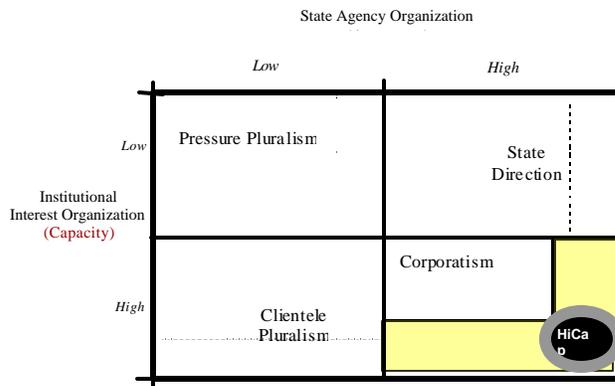


Figure 4: Network Type: High Capacity Educational Technology Leader Network Case

Though it is beyond the scope of this paper, it is possible to characterize complex network associations from across and well beyond what we think of as ‘the organization’. In the study of educational technology leadership, no one nominated by other influential actors thought that they were leading university education technology policy – but they were. By studying influential leaders who did not know all the participants in the network, this model permits us to understand the process of leadership, not only the product. Deep analysis of the leadership and organization capacity of these networks is possible by studying how they organize their interests by applying advanced organization theory. If we know how they organize, we can design for change.

How Can Educational Technologists Create and Lead High Capacity (Social Capital Generating) Educational Technology Efforts?

In this paper, the author argues that a new, information age (Reigeluth, 2001), neo institutional approach to understanding the processes whereby our organizations deal with educational technology issues is necessary. As an educational technology field, we need to bring our management domain theory up to today’s organizational theory, education administration and knowledge management (business school) levels. We also need to consider the organizational phenomenon and larger, macro issues like economics, politics and history in our plans to make our work sustainable and manageable within increasingly complex systems. We must pay

particular attention to the kind of purpose we communicate when we create educational technology projects, and plan to take a distinct leadership role in the generation not just of processes for implementation and management, but in the design and guidance of bonding, bridging or linking organizational networks that accomplish our projects. We must also consider policy and politics, like all education leaders – finding ways to render leadership of extremely complex phenomenon simple, as we can with the social capital concept. Educational Technology matters, and our community and field offer social capital generation in buckets to our governments – perhaps we need to account for that a bit more.

The ET field is increasingly in a position to provide very high social capital generating projects from our field, and we need to be able to account, and be accountable for such foresight, change and leadership. A good beginning is the inclusion of leadership theory and philosophy in the Educational technology graduate student programming, such as that under way at the University of Calgary.

Such changes may indeed reflect the recent changes suggested by social scientists at large in a plea to make social science really matter again (Flyvbjerg, 2001). Flyvbjerg suggests that as social scientists, we must move along among the three intellectual virtues Aristotle proposed, from episteme (scientific knowledge of our field) to techne (pragmatic, variable, context-dependent knowledge of our field) to phronesis (a values based, action oriented and variable rationality less instrumental in nature). Indeed, this author found that while some educational technology leadership networks governing over 200,000 faculty and students in two states had high and low capacity networks, both networks maintained a functionalist (techne) view of both educational technology in education and educational leadership. By broadening the field to include leadership and political science theory (social capital) as a model for describing complex issues, patterns and relations in the information era, perhaps we can strengthen our social capital capacity to account for our ET project successes in this information age.

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Collaborative Learning Experiences in Online Instructional Design Courses

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Abstract

Few universities are currently offering an online course with collaborative learning component in Instructional Design. This study shared information on an on-going evaluation of online Instructional Design courses from 94 graduate students who have taken this course, hoping to find out the most effective way to deliver similar courses. This research focused on how effectively the instructor integrated various functions of Blackboard and other teaching and managing strategies into the online course. Findings on students' attitudes toward this course and strategies for building online collaborative learning communities from both the students' and instructor's points of view were discussed and explored.

Introduction

Effective learning is not simply about the transfer of knowledge but about developing skills for life-long learning (Vargo, 1997). Although learning can take place in any environment, Ramsden (1992) suggested that effective education is based on deep learning that is learner-centered, active, and in context. Web-based courses claim to have moved learning from instructor-centered to learner-centered approaches and require learners to be self-disciplined to maximize their learning.

Distance education has developed dramatically during the past few years through the application of learning theory to the delivery of materials. Baker (1995) indicated that interaction is important for a variety of learning types, level of learning satisfaction, and persistence. Interaction is central to the expectations of teachers and learners in distance education and is a primary goal of the educational process (Berge, 2002). However, students perceived too much interaction as frustrating busy work, whereas too little interaction might cause isolation (Berge, 1999).

According to Moore (2003), there are four types of interaction identified in the literature: learner-content interaction, learner-instructor interaction, learner-learner interaction, and learner-interface interaction. This research study investigated all four types of interaction in online courses but specifically focused on the third type of interaction: Learner-learner interaction. In a study conducted by Northrup (2002), it was found that participants liked to discuss ideas and concepts as well as to share information with their peers. Participants considered promoting online collaboration and conversation an important attribute of distance learning.

Traditional pedagogical approaches in education have decontextualized knowledge and skills to real-world application (McLoughlin, 2002). Candy, Crebert, and O'Leary (1994) underscored that university education should develop a capacity for and understanding of teamwork along with critical thinking. This situation calls for educators to develop activities that support group collaboration (Bennett, 2004). Working collaboratively helps students to take into consideration different perspectives while building a deep understanding. It also reflects how people work in real-world contexts and how practitioners share knowledge within a community (Brown, Collins, & Duguid, 1989; Duffy & Cunningham, 1996; Lave & Wenger, 1991).

Collaborative learning refers to an instructional method in which small groups of learners mutually engage in the learning environment to accomplish a shared goal (Abrami & Bures, 1996; Bruffee, 1993; Murphy, Cifuentes, & Shih, 2001, Tu & Corry, 2002). Collaboration should at least contain sharing the learning tasks, combining expertise, knowledge, and skills, and building a learning community (Bernard, Rojo de Rubalcava, & St-Pierre, 2000; Slavin, 1995). The advantages of collaborative learning include the encouragement of active and constructive learning, deep processing of information, critical thinking, and goal-based learning (Bernard et al., 2000). Slavin (1995) asserted that collaborative learning enhances the opportunity to combine expertise, share knowledge and skills, and build a learning community. Despite these benefits and the massive literature base advocating collaborative learning, researchers have pointed out that

collaborative groups frequently do not work well (Salomon, 1992).

Online collaboration can be defined as the collaborative learning that takes place in a distance-learning environment. A critical factor to the success of online collaboration is the feeling of learners being engaged in a leaning community (Yang, 2002). Hasler-Waters and Napier (2002) contended that receiving support, getting acquainted, establishing communication, building trust, and getting organized are elements that foster successful online teams. Although online group collaboration can generate new knowledge, attitudes, and behaviors, it requires significantly more time and effort than traditional learning (Kulp, 1999).

Previous studies revealed both positive and negative student perspectives toward online collaborative learning. Students expressed that their communication skills and problem-solving skills were improved through online collaboration (Yang, 2002). In Kitchen and McDougall's study (1999), students reported enjoying the convenience and opportunity to collaborate online. However, some described their dissatisfaction regarding the instructional strategies and the delivery methods. Research also disclosed that learners tend to resist group collaboration because the outcomes depend on the input of other group members (Ko & Rossen, 2001).

Instructional Design is a compulsory course for graduate students in the field of Educational Technology, unanimously regarded as one of the most difficult courses. Students typically learn how to design an instructional lesson or module. From creating initial design documents to the ultimate actual lessons, it is not uncommon to hear students complaining how confusing the whole process is. In fall 2001, a university in the mid-western area of the United States offered this course online for the first time, using a delivery platform called Blackboard. The Blackboard program used to deliver online Instructional Design courses provided web-based tools that made communication and other collaborative exercises easier for online teachers and students.

There has been limited research that reports student perceptions and attitudes toward their online collaboration experiences as well as what factors students consider crucial in an online learning environment. What exists has mostly focused on student perspectives with their online learning experiences. This research intended to examine online collaborating learning experiences from students' point of view to provide a basis for evaluating the effectiveness of online instructional design courses and to provide suggestions and strategies that instructors could implement in their online courses. The following research questions were addressed:

1. What were student perceptions and attitudes toward taking an online course in instructional design?
2. What were student attitudes toward working in a collaborative setting in the online environment?
3. What elements did students consider critical for a successful online course?

Method

Subjects

The subjects were 94 mid-western graduate students enrolled in an online course in Instructional Design. Data were collected between the years of 2002 to 2004. Eighty percent of the subjects were either majoring in Educational Technology or Educational media. Sixty four females and 30 males participated. Eighty of the students were American and 14 were international. Less than five percent of these students had experience with taking completely online courses.

Online Course Format

The instructor delivered this course using a web-based course management system called Blackboard. The interface of Blackboard is shown in Figure 1. For important announcements, the instructor would post each announcement under the "Announcements" function as well as email the same announcement to each student in case students failed to login in Blackboard that day. To remind students of course objectives, activities, and requirements, a course syllabus was posted under the "Syllabus" function. To create online communities among students, the instructor asked students to email their biographies and pictures to the instructor before the end of the first week. The instructor posted each student's biography, picture, and contact information under "Faculty Information" function and encourage students to view other students' information on Blackboard and contact each other.

To keep students on task, the instructor used the "Assignments" function to post information and inform student what weekly activities and readings should be completed. To encourage interaction and build an online community, the "Communication", "Chat" and "Discussion Board" functions offer common places for the instructor and students to post questions and share ideas with each other.

To offer information other than readings from a required textbook, the instructor also developed weekly mini-lectures that synthesized important textbook information. These mini-lessons as well as examples of design documents and self-paced lessons were posted in a "Course Material" function. For additional

information that related to a specific topic, the instructor would post supporting web links under the “Web Sites” function. The instructor also posted the grade for each assignment under the “Student Tool” function to allow students to check grades online.

To encourage collaboration and increase interaction among students in this online course, the students were asked to form groups of three and to send the names of their group members to the instructor by the end of the second week. For students who did not send names, the instructor would randomly assign three people to form a group. Each group would then decide on a topic of interest and create a design document and self-paced lesson for that particular topic throughout the semester. The instructor used the “Groups” function and placed those students together as one group. From there, group members had access to participating in a synchronous group chat room, posting messages under the group discussion board, sending email to selected group members or the whole group, and posting assignments via file exchange. In order to encourage equal contribution among students, all students were informed in the beginning of the semester that instructor, self, and peer evaluation would be counted as 20 percent of their final grade.

In the process of creating a design document of the chosen topic, each group was required to work on the draft design document for three assignments. The first assignment covered needs assessment, learner analysis, contextual analysis, and task analysis. The second assignment contained instructional objectives, questions and feedback. The third assignment included instructional sequencing, instructional strategies, and message design. Each group would provide feedback to and receive feedback from their group members, revise their first drafts based on the peer feedback, and post their revised drafts online via file exchange under the “Groups” function. Posting assignments on the file exchange allowed the group members and the instructor to access documents for reading. Following the posting of these drafts, the instructor would look over the revised draft of the assignment that each group produced and provide feedback to each group. Students would then modify drafts based on the instructor’s feedback.

The same procedures were repeated for each assignment and students would compile all revised assignments together into a final design document. After all sections of the design process were covered, students would develop a self-paced lesson based on the design document that they had been developing. Students would then conduct a formative evaluation to test the draft of the self-paced lesson to its target audience and write up an evaluation report. Students would then use the evaluation results and learner feedback to revise their self-paced lessons and design documents. Finally, students submitted the final version of the design document and self-paced lesson during the last week of the semester.

Materials

During the last week of each semester, students completed a 20-item Student Attitude Survey designed for this study to indicate their attitudes toward the online learning environment and their general attitudes toward this course. These items were 5-point Likert-scale items that ranged from 1 (strongly disagree) to 5 (strongly agree). The KR-20 reliability coefficient for the 20 Likert-type items was .87.

The second part of the survey was comprised of five open-ended questions dealing with student perceptions toward online learning environment, online collaborated setting, working on group projects, and suggestions on the important elements that a successful online course should comprise. These questions were: 1. What did you like most about the online setting? 2. What did you like least about the online setting? 3. Did you like or dislike learning in an online collaborative setting? Why or why not? 4. Do you think you would have learned more in this class if you had done your project alone?, and 5. You have just lived through a fully online course. In your opinion, what do you consider as a successful online course? What elements should be there?

Procedure

Data was collected from the Student Attitude Survey across five semesters of a graduate level instructional design course. In these full-semester courses students worked in small groups to collaboratively create instructional units. The process of teaching this online course has been observed and recorded in detail by the first author. The Student Attitude Survey was sent out as an email attachment to students during the final week of the each semester. All participants filled out the 20-item Student Attitude Survey and responded to five open-ended questions and sent their responses as an email attachment to their instructor by the last day of the semester.

Data Analysis

From the Student Attitude Survey, student responses were calculated and ranked for each survey item. From the five open-ended questions, a thematic analysis was conducted to identify emerging themes and patterns for

responses of each question. Furthermore, the recurring responses were categorized and counted and provide the framework for discussion.

Results

Student Attitude Survey

The means and standard deviations for the 20-item Student Attitude Survey were calculated and reported in Table 1. The overall mean score across the Student Attitude Survey items was 3.86, a rating indicating agreement with positive statements about this course. The five highest-rated statements on the survey were “I like the mini-lectures provided by the instructors” ($M = 4.43$, $SD = .65$), “I liked the File Exchange function on Blackboard” ($M = 4.42$, $SD = .66$), “I like to see the short biography of my instructors and classmates on Blackboard” ($M = 4.40$, $SD = .66$), “I liked the Announcement function on Blackboard” ($M = 4.39$, $SD = .66$), and “I liked the feedback that my instructors provided” ($M = 4.32$, $SD = .69$.)” The five lowest-rated statements were “This course was easy” ($M = 2.20$, $SD = .91$), “I liked the textbook that we used in this course” ($M = 3.41$, $SD = .92$), “I liked the group format in this course” ($M = 3.45$, $SD = 1.31$), “I liked the online environment of the course” ($M = 3.46$, $SD = 1.19$), and “I would take this course as an online course again” ($M = 3.52$, $SD = 1.26$).

Table 1 *Student Attitude Survey Scores*

| Statement | <i>M</i> | <i>SD</i> |
|--|----------|-----------|
| 1. I liked the mini-lectures provided by the instructors. | 4.43 | .65 |
| 2. I liked the File Exchange function on Blackboard. | 4.42 | .66 |
| 3. I like to see the short biography of my instructors and classmates on Blackboard. | 4.40 | .66 |
| 4. I liked the Announcement function on Blackboard. | 4.39 | .66 |
| 5. I liked the feedback that my instructors provided. | 4.32 | .69 |
| 6. I like to see pictures of my instructors and classmates on Blackboard. | 4.27 | .72 |
| 7. I learned a lot from this course. | 4.11 | .77 |
| 8. I like to receive feedback from my group members. | 4.09 | .86 |
| 9. I would like to meet with my instructors and classmates face-to-face some day. | 4.06 | .89 |
| 10. The grading was fair in this course. | 3.99 | .80 |
| 11. I liked this course. | 3.97 | .89 |
| 12. I spent more time working on this course than my other courses. | 3.76 | 1.02 |
| 13. I like to provide feedback to my group members. | 3.68 | 1.05 |
| 14. The amount of the work required was fair. | 3.65 | .90 |
| 15. I would recommend this online course to others. | 3.53 | 1.13 |
| 16. I would take this course as an online course again. | 3.52 | 1.26 |
| 17. I liked the online environment of the course. | 3.46 | 1.19 |

| | | |
|---|------|------|
| 18. I liked the group format in this course. | 3.45 | 1.31 |
| 19. I liked the textbook that we used in this course. | 3.41 | .92 |
| 20. This course was easy. | 2.20 | .91 |
| Total | 3.86 | .49 |

Note. Responses ranged from 1 (Strongly Disagree) to 5 (Strongly Agree).

Attitudes Toward Online Course (Likes and Dislikes)

When asked what students liked most about this online course, flexibility, convenience, easy communication, semi-constructive nature of the course, group member and instructor feedback, weekly mini-lectures, project examples, face-to-face meetings with group members, and studying at their own pace were the what they liked the most about this course. They also liked the fact that instructors posted each student's picture and biography on Blackboard in order for them to know each other and to cultivate an online community.

When asked what students liked least about this course, some of them indicated lack of immediate interaction and feedback, isolation during the learning process, the fact that some group members failed to provide constructive feedback on time, coordinating with group members, technical difficulties, the textbook, and inadequate computer knowledge diminished their enjoyment of this course. They also expressed that they missed the active class atmosphere where they were able to raise questions in class to discuss with classmates and instructors.

Attitudes Toward Online Collaborated Setting (Likes and Dislikes)

When students were asked whether they liked or disliked learning in an online collaborated setting, 32 students (34%) liked learning in an online collaborated setting, 47 students (47%) disliked learning in an online collaborated setting, and 14 students (16%) had mixed feelings.

Students who liked learning in an online collaborative setting appreciated having group members that they could bounce ideas with and having opportunities to provide and receive feedback from others. In that way, they felt that they were "forced" and had responsibilities to read the chapters and course materials thoroughly so they could provide constructive feedback to their group members. Some positive comments from students regarding learning in an online collaborated setting were:

I really enjoyed working with partners as we bounced ideas and feedback off of each other to create, what I feel, is a quality project. We worked well together and came up with ideas we could not have if we were working independently. Our willingness to work together, combining our resources, greatly helped our overall product.

The collaborative piece of this of this course was critical to avoid total frustration and annoyance. Initially, I found the information and language very confusing. With a group to bounce off of, it didn't feel quite so hopeless. The exchange of ideas led us to a much better product than any of us would have created alone. Also, this approach mimics team teaching which is the environment most of us inhabit in our schools making it more authentic.

For those students who disliked learning in an online collaborated setting, some of their reasons were the ineffective and inefficient communication, uneven workloads and efforts, difficulty adjusting to each other's schedules, the time consuming nature of the class, and arguing with group members on ideas. Some negative comments from students regarding learning in an online collaborated setting were:

I normally work very well in groups and enjoy the group setting. However, it is very hard to be in a group with complete strangers just over the Internet. I felt at times that I was doing most of the work and they weren't putting as much effort into the project as I was.... Communication was also difficult because I couldn't explain my ideas in the way that I would have been if we were to meet face to face. The whole process was very frustrating!

I liked the online setting, but disliked the collaboration. If you are teamed with people who are shooting for a 'B' or just to pass the class, it is difficult to get an 'A' for a group assignment without taking on the majority of the work. I feel that I shouldered the vast majority of the work for the group. In this way, this online class was

far more work than a traditional class. I do not know how I would feel if it was an online, non-collaborative class. It is hard to distribute the work evenly in an online class...

Some comments from students with mixed feelings regarding learning in an online collaborated setting were:

I dislike having to rely on others (and their schedules) to complete assignments, especially when it impacted my schedule and my grades. On the other hand, I do like getting feedback from others and being able to work at my own pace at times that are convenient for me.

I must admit, at first I absolutely hated it. (I know that's a strong word, but I did.) If the course had not been a requirement, I would have dropped it. Communication felt exasperating. But with time, and getting to know my teammates, it got easier. We worked out the kinks. I had great teammates. (I don't believe that is always the case.) When one of us was stuck, one always came through. (I can't imagine what this would be like if there was someone not doing their part!) Now, I miss them. I wrote them yesterday to tell them I thought I was having ID withdrawals!

Attitudes Toward Online Collaborated Learning

When asked whether students would have learned more in this class if they had done their project alone, 70 students (75%) said "No", 14 students (15%) indicated "Yes", and 10 students (11%) kept their opinion as neutral. From student responses, we also discovered that in order for students working well in groups in an online collaborative setting, the five Cs (Communicate, Cooperate, Compromise, Compliment, and Commitment) need to be included.

The first C is to *Communicate* and students mentioned, "We instantly established a routine that was very focused on the task at hand; we were able to be honest in working with each other and truly developed a cordial, often fun working relationship." and "...by having to work with others, I had to exercise people skills and learn to get along and say things in persuasive rather than confrontive ways..."

The second C is to *Cooperate* and students expressed, "It's always great to have someone else be the sounding board, especially when they have just as much ownership in the assignment.", "Having group ideas and a checks and balance system really worked well. I learned more hashing out the details with my group than I would have on my own.", and "I really feel our final product was better for the added insights and creativity of three minds instead of one.... I think each of us benefited from the camaraderie we experienced, and the support."

The third C is to *Compromise* and students stated, "It meant compromise, especially in the area of topic selection as we all had our own content we wanted to deal with..." and "I think being forced together in a group, not of our own choosing, best simulated the business environment. We were forced to cooperate, compromise and communicate with each other in a way that working alone would not allow."

The fourth C is to *Compliment* each other and students indicated, "We all really complimented each other. I must admit I was stuck two times while doing this project. One of the other teammates got the ball rolling and I think they would say the same thing about me at times when they were stuck.", "We had strengths that complimented each other, so we got to see the whole picture and fill in the gaps", and "...when working in a group you can draw on the strengths of the individual group members. In our group one member was a better writer, one had more experience with power point, etc. Plus we could all draw from personal experiences."

The fifth C is to *Commit* to the team and student commented, "...having members that work as hard as you and are as committed makes all the difference" and "Having the advantage of each teammate contributing his/her different perspectives for the project was terrific. Moreover, we supported each other both academically and emotionally, since taking an on-line course was very challenging to us novices."

Critical Elements in an Online Course

When asked about what students considered as critical elements in a successful online course, their top ten comments included: 1. Frequent instructor-to-student and peer-to-peer communication (55%), 2. Clear objectives, materials, and course outlines (33%), 3. Useful mini-lectures (20%), 4. Strong instructor support (18%), 5. Opportunities to access and view previous project examples (18%), 6. User-friendly features on Blackboard (12%), 7. Superior organizational skills (12%), 8. Just in time resources (11%), 9. Proficiencies in technology (10%), and 10. Periodic online discussion (10%). In addition, posting pictures and bios of students and faculty, clarifying project deadlines, mastering better self-regulation and self-efficacy traits, and having the

opportunity to see other groups' projects (> 7%) were important attributes that student considered as crucial elements in a successful online course.

Discussion

This research focused on how effectively the instructor integrated various functions of Blackboard and other teaching and managing strategies into an online course in Instructional Design. Findings on students' attitudes toward this course and strategies for building online collaborative learning communities from both the students' and instructor's points of view were discussed. Although many of the findings are similar to previous studies, less frequently observed in the literature are the actual comments that indicate a dislike of group activity while admitting the importance of it.

According to Simoff and Maher (1997), a successful online learning course depends on (1) delivering course materials to students in time and (2) providing effective communication between students and instructors. The instructor in this course concurred with this statement and posted timely mini-lectures and project examples. The instructor also incorporated online group activities to encourage communication between students (peer feedback) and instructors (instructor feedback) via announcement, email, discussion board, file exchange, and chat functions. Interestingly, the students also ranked the "I like the mini-lectures provided by the instructors" and "I liked the File Exchange function on Blackboard" as the two highest-rated items on the Student Attitude Survey.

Similar to other research findings (Hiltz, 1998, Howland & Moore, 1998; Yang 2002), our results indicate that convenience, flexibility, and easy communication were common themes in the positive student responses regarding the online setting while communication difficulties, lack of face-to-face interaction, and sense of isolation were the overriding negative themes regarding the online setting.

When asked whether students liked or disliked learning in an online collaborative setting, different opinions were noted. Half of students (50%) indicated they disliked learning in an online collaborative setting while one third of students (34%) held opposite opinions. The finding that 50 percent of students disliked the collaborative setting corresponds with the statement of "I liked the group format in this course" on the Student Attitude Survey ($M = 3.45$) that was rated as the third lowest items on the Student Attitude Survey. Contrarily, when asked whether students would have learned more in this class if they had done their project individually, three out of four students (75%) felt that the collaborative environment produced greater learning. Such findings emphasize the usefulness and importance of online collaborative learning.

From student reactions to the fourth open-ended question, we find that the five Cs: Communicate, Cooperate, Compromise, Compliment, and Commitment need to be incorporated within the group setting so group members can have better working relationship with each other to produce quality projects and greater learning in an online collaborative environment. From their responses to the last open-ended question, we also identified the top ten critical elements that students considered in a successful online course. Overall, students concurred that a solid course structure (the ten critical elements), as well as encouraging and supporting collaborative project development (the 5 Cs), leads to effective learning and better quality of the final project. We have provided a model for online collaborative learning plans as shown in Figure 1.

Distance learning is gaining in popularity because of the convenience it brings and many academic institutions place more and more emphasis on developing online learning. However, the preparation for teaching online classes takes time, detailed thought, lots of patience, and adequate computer and communication skills. When designing the online teaching materials, instructors have to take interaction and collaboration into consideration and encourage interaction and support communal scaffolding throughout the collaboration process. Hopefully, such acts will motivate students in the online collaboration process and will make the collaboration a worthwhile learning experience for them.

The results of the study have practical significance for helping the department in which this study was conducted. Guidelines are offered for instructors planning to implement online collaborative learning components as well as students required to work collaboratively in the online environment. Furthermore, it may help the instructor to have a more systematic understanding of the pedagogical, technological, and administrative approaches to distance learning. Future research can explore various online teaching strategies to help student work well collaboratively and produce better outcomes in an online learning environment.

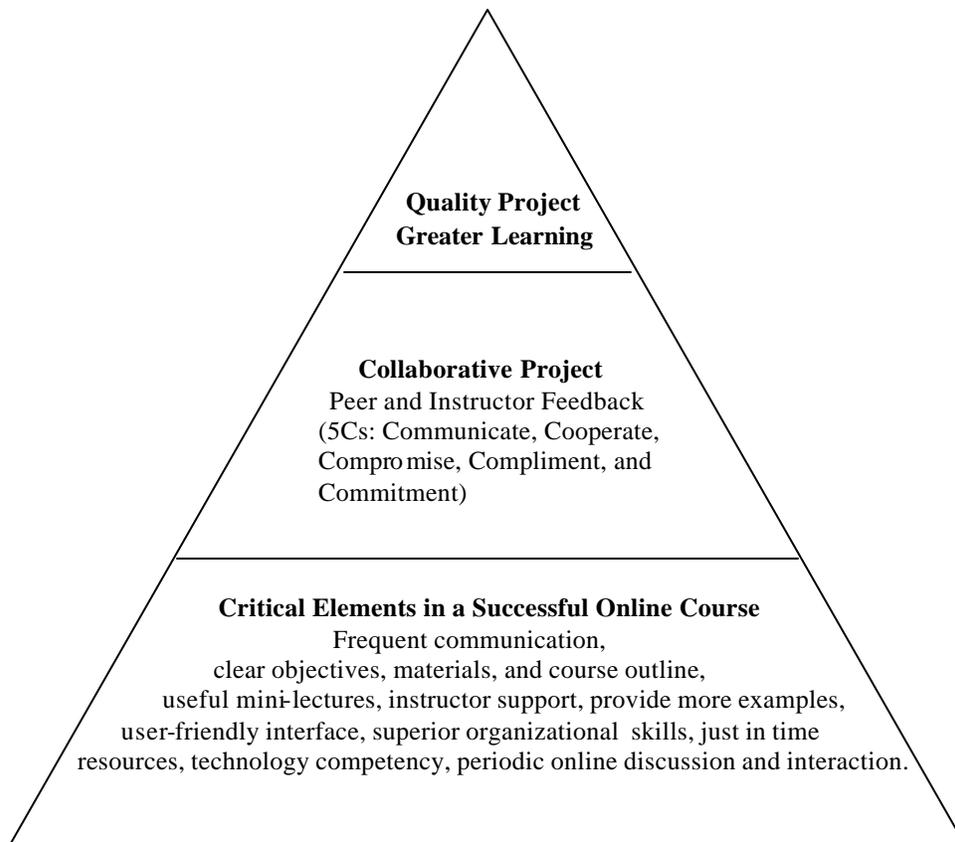


Figure 1. Online collaborative learning model.

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Exploring the Potential of WAP Technology in Online Discussion

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Introduction

The intent of this study is to explore how WAP (wireless application protocol) technology mediates online discussions. The key focuses of this research are on the implications of WAP technology for online discussions, the types of discussion topics that are most suitable for WAP-based discussions and the finding of the combination of WAP- and WEB-based discussions.

Multiple methods of inquiry were employed in this study. A survey, face-to-face and focus group interviews were conducted to find out the participants' perceptions of using the WAP-enabled mobile phone as a communication tool, and how such a tool has facilitated or impeded their learning processes both technically and cognitively. A content analysis was made on the postings generated from WAP- and WEB-based forums.

This study is one of the very first attempts at investigating the use of WAP-enabled mobile phones for online discussions in one of the higher education institutions in Singapore. By exploring the potential of this newly developed technology, it is hoped that this study may provide guidelines to educators as they reflect on the way online discussions can be integrated into a course and also laying a foundation for future development of a mobile online learning environment.

Online Discussion as a Sociocultural Tool

In this study, participants were requested to participate in asynchronous online discussions. Asynchronous communication refers to anytime-anywhere communication between two or more individuals. In such a communication, participants are unrestrained by space, time and pace. They may read the messages that are posted in a central location or delivered to their email box at their own convenience. Wireless technologies can free learners from the need to be tied to a particular hard-wired location to access information (Gunawardena & Msisaac, 2004). There are several common forms of asynchronous communications. These include e-mailing, threaded discussion and newsgroup. In this paper, online discussions refer to the use of a web-based application that enables participants to create and edit messages that are stored in an area that is accessible to group members who organize messages into "threads" of conversation (Curtis & Lawson, 2001). In this study, the participants were given the option to participate either in the WAP- or WEB-based forums via WAP-enabled mobile phones or their own personal computers.

Asynchronous online discussion offers a range of advantages to learners such as self-paced participation and reflective thinking. In an online discussion environment, students are likely to obtain more experiences managing their interactions with the content themselves. Online discussions require learners to manage their own learning, free from the teacher-centered settings; this then provides an opportunity for learners to progress independently (Lee, 2002). Researchers also found that online discussions are more task-oriented than face-to-face discussions. Also, reading and writing are employed discursively as a means of focusing members of a classroom community on matters of joint interest (Lapadat, 2000). Moreover, as asynchronous discussion is text-based, the meaning of a text-only message is divorced from the sender's physical presence and verbal delivery style and all that remains is what the person actually says (Altanus, 1997).

This study does not intend to make comparison between different technologies on how they perform in online discussions. Rather, it seeks to explore how the various technologies compliment each other and mediate online discussions. When engage in online discussions, learners should be given more avenues to log on to participate. Web-based course when combined with other CMC tools such as email or bulletin board allows the learners to learn and follow their own path, enriching the exchange of ideas among learners (Box, 1999).

One of the key concepts in Vygotsky's work is the zone of proximal development (ZPD). The ZPD is the range of difference between what an individual may accomplish in an activity or task alone and what he or she may accomplish in the company of others (Althausser & Matuga, 1998). It is in the ZPD that scaffolded learning takes place to support learning. Scaffold assistance can come from both cultural tools and more knowledgeable peers or experts in one's learning environment (Jarvela & Hakkinen, 2000).

Sociocultural researchers point out that instruction should take place in an environment in which learners use socially mediated and intellectual tools to achieve cognitive development (Rogoff 1990; Salomon 1993). Bonk and Cunningham (1998) comments that collaborative technologies can offer opportunities for both peer and mentor electronic guidance and feedback that stimulate student discussions and internal reflections in a

scaffold learning activity. It is through online discussion that they may “voice their opinions and reflect on their learning, thereby increasing inter-psychological and intra-psychological activities to promote individual’s cognitive development” (Zhu 1998, p.234). Online discussion is a key mediational tool for “external display of students thinking processes and interchanges” (Jarvela and Hakkinen 2000, p.8). It promotes “exciting online learning communities” (King 1998, p.368).

Discussions on brainstorming and case studies were adopted in this study based on the rationale that both types of discussion could enrich the online discussions by offering students opportunities to engage in higher levels of thinking such as critical thinking. Chong (1998) reported in her study that participants claimed that they have learned tremendously from the magazine articles and that authentic cases taken from real-life provided the complexity necessary to encourage critical thinking and logical argumentation. Authenticity in case studies did provide a challenging and real life learning environment. Also, empirical investigations have found that electronic brainstorming groups have generated more ideas than verbally brainstorming groups, particularly for larger group sizes (Gallupe, Bastianutti & Cooper, 1991; Gallupe, Dennis, Cooper, Valacich, Nunamaker & Bastianutti, 1992). According to the study carried out by Dennis (1993) and colleagues, electronic communication among members has improved the idea-generation performance of large groups.

Methods of Inquiry

The participants in this study were the pre-service teachers who took the course ‘Instructional Technology.’ In this course, students learn how to effectively integrate IT into their classroom practices. To create a constructivist learning environment, the institution adopted Blackboard, an online learning delivery and management system that allows students to learn independently and instructors to customize the e-learning packages according to their students’ need.

This research program was embarked in 2001. A class of twenty pre-service teachers, each with certain characteristics that might represent the target population was selected to take part in this research program. On the other hand, as they had a common teaching subject which was Chemistry that would make the discussions more subject-focused. All the participants were given WAP-enabled mobile handsets for their participation in the online discussions. They could access the online threaded discussion forum using the given URL anytime and anywhere via their WAP-enabled phones or the web-based forum via home computers. The participants were required to take part in all the 6 forums which consisted of 3 case studies (with one as a pilot test) and 2 brainstorming discussions.

A pilot test was carried out to test the application and also to explore the implications of the discussions generated within that week. During this pilot test, pre-service teacher and their course instructor participated in the case study online discussions. The information gathered and the preliminary analysis was of great value as it helped to identify some possible obstacles and helped to refine the design of the application. Also, it helped to refine the structure and content of the discussion forums.

A survey for the pre-service teachers was conducted at the end of all 6 forums in order to obtain statistical evidences and also to generate deeper understanding of the study. A focus group interview with the pre-service teachers and a face-to-face interview with the class instructor were also conducted to gain an in-depth to the phenomena surfaced from the study; the transcripts can also be used to check the accuracy of interview records. The messages posted on the WAP- and WEB-based forums collected in the form of spreadsheet were then translated and analyzed into simple message maps that showed the flow of messages.

To analyze WAP- and WEB-based discussions, Jonassen’s (2000) rubrics for quality discussions and Järvelä and Häkkinen’s (2000) classification of such discussions were adopted and modified in this study. The messages posted in the both forums were categorized into five different types of discussions (suggestion, comment, elaboration, information-seeking and information-sharing) under four criteria with three levels of participation (high-level, progressive-level and low-level). These four criteria included accuracy, relevance, coherence of the messages, and the levels of perspective taking of messages. Postings that were irrelevant to the discussion topics were considered as redundant messages and were not analyzed.

Findings

The result of the survey revealed that 65% of the pre-service teachers thought that brainstorming questions were more suitable for WAP-based discussions. The pre-service teachers felt that brainstorming questions would generate more new ideas, and since short messages were needed, it would be easier to share ideas in a more efficient way. The other 35% thought that case study questions were more suitable for WAP-based discussions because they were more focused than brainstorming questions. The results suggested that

majority of the pre-service teachers thought that brainstorming questions were more suitable for WAP-based discussions. However, the findings from the messages posted on the forums and the transcripts from the interviews revealed another set of findings.

The percentages of messages in both forums were low. Quantitatively, this suggests that regardless of whether it was a brainstorming discussion or a case study discussion, it does not affect the percentage of WAP-based messages posted in these forums. This outcome suggested that the nature of brainstorming discussions and case study discussions might not determine the discussion outcome. The discussion questions might throw some light on this phenomenon. During the focus group and face-to-face interviews, the pre-service teachers and instructor mentioned that the topics and the way the questions were phrased did determine the pre-service teachers' responses. One pre-service teacher mentioned: "I think it's the discussion topic that matters. For the discussion on school experience...I have experience to share with them (the other students) so I would create a thread, if not, I would just see what people have to say." Similarly, another pre-service teacher said: "for the school experience, I know the kind of environment so I can comment in that forum." Their class instructor also emphasized that "the factor that determines the participation is not so much of whether it is case study or brainstorming, rather the nature of the discussion question itself. If the nature of the question can appeal to them, it will generate greater interest and thus they will participate more." This might explain why some pre-service teachers preferred brainstorming discussions while others found that case study discussions more challenging. The more the students could relate the discussion topic to their own personal experiences, the higher the level of interest they would have and naturally the level of participation would increase.

As shown in table 1, both WAP-and WEB-based forums produced limited number of high-level quality messages. However, WAP-based forums had yielded more low-level quality messages and less progressive-level quality messages than WEB-based forums. The physical and technical constraints of WAP-enabled phones might not have supported lengthy messages. Although statistical results suggested that WAP-based forums have produced more low-level quality messages than WEB-based forums, the usefulness and the contributions of WAP technology should not be ignored. In the survey that was conducted at the end of the course, 65% of the pre-service teachers agreed that WAP technology has helped to build a learning community. They believed that the WAP-based forum has formed a closely knitted group, and everyone was able to participate and learn from each other.

| Quality messages | High-level quality messages | Progressive-level quality messages | Low-level quality messages |
|-------------------------|------------------------------------|---|-----------------------------------|
| Types of forums | | | |
| WAP-based forum | 6% | 29% | 56% |
| WEB-based forum | 7% | 63% | 29% |

Table 1. *Percentages of Quality Messages for WAP-based and WEB-based Forums*

WEB-based discussion was introduced in the midst of forum 3. The introduction of the WEB-based forum encouraged online participation and it did not negate all WAP-based postings. Five students continued to visit the WAP- and WEB-based forum at the same time. This suggested that the WAP-based forum complemented the WEB-based forum. The pre-service teachers were able to use WAP-enabled mobile phones or computers to participate in the WAP- or WEB-based forums. In this case, the advantages of both tools could optimize and enhance the online discussions. In other words, WAP technology provided another alternative to the online discussions, allowing opportunities for further collaboration and social interaction. During the interview, one of the pre-service teachers commented that she could better contribute to the discussion forums when she had a choice to use WAP-enabled phone if she was on the move or use her computer to log on to WEB-based forum when at home. The other pre-service teachers said: "when you are on the move, at least you have the WAP-enabled phone to view the unread messages." Generally, the discussions in both the WEB- and WAP-based forums were rather subject-focused, content-related and constructive. Irrelevant messages were minimal.

The language that was used in the WAP-based forum discussion was a unique one. It was a feature found in neither formal writing nor does it resembled the messages found in the WEB-based forum. In WAP-based message, the number of short forms used was more frequent and perspective taking was not obvious. Although statistical results suggested that WAP-based forums produced more low-level quality messages than WEB-based forums, the potential and the contributions of WAP technology should not be ignored. In the survey that was conducted at the end of the course, 65% of the pre-service teachers agreed that WAP

technology helped to build a closely knitted community. They believed that the WAP-based forum has formed a closely knitted group, and everyone was able to participate actively and learn from each other. By looking into the language pre-service teachers used in the WAP-based forum, we might be able to understand why WAP-based forum helped to build a closely knitted community. Some of the common short forms that were used in WAP-based forums were: “stu” for “students”, “n” for “and” “chem” for “chemistry” and “2” for “to” etc. For someone to be able to understand the syntax of these messages, one must be part of the community long enough to learn how to represent own ideas in such unique ways that only members of this community could understand.

Another interesting phenomena found in this study was that pre-service teachers and class instructor, adopted different roles subtly. In many other situations, pre-service teachers in the class also played the role of a mentor by giving constructive suggestions and comments. One of the pre-service teachers created threads in order to better guide the rest when discussing. Although their class instructor did not assign such roles to the students, they have adopted diverse roles subtly to facilitate their online discussions. The majority of the pre-service teachers also agreed that the class instructor played a crucial role in the online discussions and that he had fulfilled his job as mentor, guidance and listener.

Conclusion

Learners' changing characteristics prompt us to look into other new modes of course delivery. This study revealed the potential of WAP technology as an effective online communicating tool when coupled with other tool. It also documented the pioneering efforts of using WAP technology in the online discussions. More studies are needed to explore the possible ways of making WAP technology a successful social and intellectual tool for mediating individual learning and enhancing the social construction of knowledge.

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A Learning Process in Resource-Based Well-Structured Instruction in Web-based Distance Learning Environment

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Abstract

This research is to articulate a learning process in resource-based well-structured instruction in web-based distance learning environment. To explore the learning process, a web resource-based self-learning program, which is highly structured with structuring elements from literature review, was developed as a college level course. Sixty-seven junior students at a cyber university in Korea, aged from 20s to 50s, were required to learn the program given for eight weeks. Students' perceived learning processes from Questionnaires, achievement scores, satisfaction levels, interview data, were collected and analyzed. As a result, an observable action model and a conceptual model of the learning process were derived, which students and experts verified. Cognitive achievement factor and satisfaction factor were also considered in the learning process model. Consequently the learning process constitutes a major phase (initiation ? contact learning material ? internal process ? individual understanding ? externalization ? internalization) and a minor phase (minor informal offline interaction among students) in resource-based highly structured self-learning. Implications of each stage in the model and recommendations for further study were suggested.

Context of the Research

Web and multimedia technology is changing the way of teaching and learning. There is also an increasing demand for a flexible learning framework that does not tie the learner, especially adult learner with full time job, down to a specific time or place. This is the very need for distance education. In distance education, people cannot interact well because of the 'distance'. For thousands of years, learning and teaching always took place in close proximity, and this has become firmly anchored in human consciousness. Learning and teaching at a distance has been therefore regarded as something extraordinary and as a defect. Because of the distance, educators have tried to make every effort to get over this spatial separation. The first pedagogic approaches specific to distance education aimed at finding ways by which spatial distance could be bridged, reduced or even eliminated. The question was asked (Peters, 1998): what must be done to make distance equivalent to proximity in distance education? The pedagogics of distance education is derived basically from the efforts to answer to this question.

One of the try to answer to this question is making and managing learning materials as best ever as possible, which almost does not need teacher's interaction. Educators at traditional distance university used most funds and most efforts for the professional development and production of qualitatively excellent teaching materials for the purposes of self-study, which are then distributed by post in early distance education and by web-based cyber instruction program in these days. They tried to include teacher's interaction into the well-structured material for self-learning. Moore(1993) conceptualized these characteristics as 'structure', because he regarded the main characteristic of the making and managing programs as the structuring of the learning and teaching. Also researches have presented elements and rationale of course/contents structure as well as instructional strategies for structuralization. Researchers emphasizing structure in distance learning seem to believe that well-structured material can get over the absence of teacher. Based on this belief, educators in Korea have provided mainly structure dependent program a lot, which are for self-learning with little interaction.

Unfortunately, however, it is not easy to find how the structure influences on learning process. Although majority of the literature on web-based distance education focuses on the effectiveness of web-based distance education or educational medium, and emphasizes structuring (converting existing, traditional course materials to a web-based format), they don't show how student's learning process is going in highly structured

instruction.

Therefore, the purpose of this research is to articulate the learning process in resource-based, highly structured instruction in web-based self-learning environment. The learning process model from this research will be able to explain how students learn with highly structured web materials and how course and contents structure influence on distance learning. And it will also provide better understanding of structural instructional strategies' mechanisms as well as practical implications for distance instructional program design.

Literature Review

There is physical separation of teacher and learner, which is 'distance', in distance education. One of the efforts of reducing the distance between teachers and students was taken when people started to interpret distance education as the simulation of a conversation between teacher and student. They recommend that the contents be displayed in the form of a written dialogue. When writing teaching texts, teachers must imagine that they are speaking to someone, and this is supposed to make them use a spoken language wherever possible. The way in which the contents are shown must enable students to imagine the teacher in person while they are reading and to carry on quiet dialogues. Reading teaching texts and assimilating their contents is thus transformed into an internal or virtual dialogue (Holmberg, 1983).

The term of 'structure', Moore (1993) defined, is contrast to dialogical learning. It is consistently planned on a targeted basis and with small steps, therefore being closed to spontaneous interventions, its time is regimented and it is uniformly controlled and evaluated. The main instruments of this learning and teaching are printed courses or multimedia learning packages which contain carefully developed and optimized courses and set learning into motion and control it. Moore(1993) chose the brief description of 'structure' for this concept, because he regarded the main characteristic as the structuring of the learning and teaching - right down to the last detail. He used the example of a teaching film for television to show just how far this structuring could go: in the film 'literally every word, every action of the teacher, every minute of the available time and even the tiniest detail of the contents were laid down beforehand'. This kind of reduction of structuring program is on the basis of criteria from educational technology. The structure is seen most clearly and most densely in programmed instruction. It was the representative of an instructional theory in which each word, each learning step, each teaching strategy was planned and developed with the greatest care in order to simplify learning and to make teaching more successful.

The structuring of learning and teaching is in fact nothing new and certainly not unique to distance education. Presenting knowledge through books has usually been broken down by means of components such as a foreword, an introduction, chapters, a summary and a conclusion. And in the last two centuries, the articulation of instruction has been a central theme of pedagogics, especially in the field of instructional design. What is nevertheless new in Moore's suggested concept is not structuring in itself but the extreme extent of its application (Peters, 1998).

This 'structure' discussed here, is about the elements in the course design and contents design. A course consists of such elements as learning objectives, content themes, information presentations, case studies, pictorial and other illustrations, exercises, projects, tests. All these may be very carefully composed, very carefully structured. In addition, we need to consider another type of structure especially in web-based environment, which is interface structure. Interface structure is related to site structure, navigation structure, or screen design structure on the screen that students face directly(Lee, 2004b). Therefore, highly structured instruction in this research means that the extent of structuring is quite high in terms of course, contents, and interface structure for self learning without teacher's interaction. Structural elements in detail, modified from Lee(2004a) and Peters(1998), are shown in Table 1.

Table 1. *Modified structural elements (Lee, 2004a; Peters, 1998)*

| Structure | Structural elements |
|------------------|--|
| Course structure | <ul style="list-style-type: none"> • Dosing • Course orientation: welcoming, characterizing the course contents, description of the required preliminary knowledge, indications of correlations to other areas of knowledge and possibly to job practice, description of rough learning and teaching objectives, naming advantages obtained by reaching and learning goals... • Scheduling • Self-tests • Peer evaluation • Assignments and pre-scheduled deadline |

| | |
|---------------------|--|
| | <ul style="list-style-type: none"> • Systematic management of course pace and learning speed • Strict grading according to notice announced in advance |
| Contents structure | <ul style="list-style-type: none"> • Portioning • Contents, lists • Indication of learning and teaching aims • Sequencing • Stressing what is important • Showing perspectives for further study • Branching • Cross-references • Arrangement in blocks and characterization by marginal notes • Summative map, structural site map, procedural map • Concept map, concepts tree • Comparison/Contradiction • Abstracts • Index • Instructional methods: questions for repetition, questions for training, simulated dialogue • Writing contents with spoken language, like conversation style |
| Interface structure | <ul style="list-style-type: none"> • Spatial layout to avoid cognitive overloading • Search index function • Emphasizing by spaced printing • Marginal notes • Visualization with graph, table, or figures • Frames, underlining, bold, italic print, decimal numbering • Use characters like avatar for students not to feel isolation |

Research Method

In order to articulate the learning process in structured distance instruction, we developed a resource-based highly structured web-based distance instructional program as college level. The program was developed and implemented mainly with resource-based highly structured self-learning mode. Structuring elements in course/contents/interface from literature review (Lee, 2004a; Peters, 1998) were applied to the program. We designed and developed the instructional program according to traditional ISD(Instructional Systems Development) model, considering structural elements from the literature. Three WBI(Web-Based Instruction) experts and practitioners verified the program on and off throughout the development process. The subject of the program was about general social science.

Sixty-seven junior students at K Cyber University in Korea, aged from 20s to 50s, randomly assigned, were required to study highly structured web material for eight weeks and to undertake assignments given every week. Instructor's feedback was provided as little as possible. Instead, most possible instructor's feedbacks were structured into the web materials. The instructor was trying to neither encourage nor discourage interactions among students. Throughout the course, students' perceived learning process from questionnaires, cognitive achievements, satisfaction levels, online messages, interview data, and participatory investigation data were collected and analyzed. Various statistical analysis methods such as correlation analysis, contents analysis, t-test, frequency analysis, were applied to the data.

For evaluation reliability, three evaluators' gradings were correlated (Pearson $r = .84^{**}$). In terms of satisfaction level, a satisfaction measurement tool (Kim & Ryu(2000) were developed and validated) was used after modification (reliability $\alpha = .93$). Twenty students were interviewed at the end of each course to verify all quantitative data and to provide more detailed information to the researchers regarding the factors of learning process.

Modeling procedure of learning process was following Rubinstein (1975)'s perspective. According to him, modeling procedure is for simplifying and abstraction. So the procedure in this research was as follows: Development of treatment instructional program ? Implementation of the program and collecting data ? Coding questionnaire data ? Deriving rough pattern of learning process ? Analysis of learning output variables ? Correlation of learning output variables and learning process ? Interview ? Analysis of interview data ? Verification learning process action model by learners ? Conceptualization of learning process and its visualization ? Verification of conceptualized learning process model by experts and learners ? Production of finally verified conceptual diagram of learning process in resource-based well-structured WBI learning environment.

Results and Discussion

Learning process; an action model

To explore a learning process in resource-based structured distance self-learning, we coded sixty-seven students' perceived learning processes in questionnaires and derived rough average pattern of the students' learning process. The students' perceived learning procedure after first coding was composed of 11 stages as follows: reading notice & information provided, reading free board, reading Q/A board, posting messages on free board or Q/A board, studying web-based material, editing and printing web text, doing assignments, making reference to other materials through on/off line, off line interaction (telephone or offline meeting), assignments submission, check individual learning pace in learning management system. Among these items, activities less than 10% frequency were removed, and the learning procedure was recoded again. Also all stages were analyzed and correlated with learning output variables such as cognitive achievement or satisfaction. Throughout this procedure, a learning process, in which all stages were rearranged with logical sequence, was finally derived (see Figure 1). Figure 1 shows an observable action model of learning process in resource-based highly structured instruction in web-based distance learning environment. Subscript 1) represents cognitive achievement factor and subscript 2) indicates satisfaction factor.

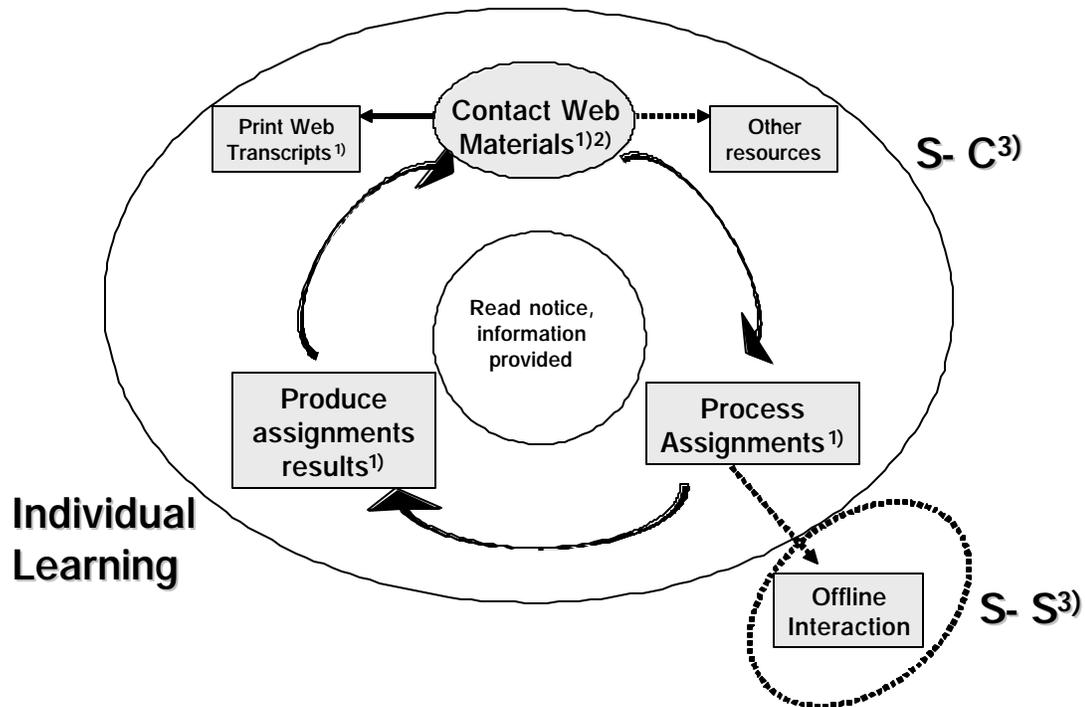


Figure 1. An observable action model of learning process in resource-based highly structured instruction in web-based distance learning environment; 1) Cognitive achievement factor, 2) Satisfaction factor, 3) Interactions (Students-Contents(S-C), Students-Students(S-S)).

The learning process in this research constitutes a major phase and a minor phase. Major phase is about individual learning and the minor phase of the model is about minor informal offline interaction among students. In major learning process, students [contact web material], which is highly structured, and then are involved in [undertaking assignments]. After the process of their assignments of each web lecture, students finally [produce results]. While undertaking assignments, some students (33%) informally interacted with other colleagues. This interaction was offline out-of-class communication, by telephone or face-to-face meeting. Although asynchronous bulletin boards were provided during the course, students' interaction was not so activated. Instead, students interacted informally outside of class, mainly about social or procedural topics, far from academic discussion. This interaction, therefore, didn't seem to be main learning process. Interviewee indicated that students studied alone but sometimes they were hungry for social relationship with classmates,

especially in distance learning environment.

One of the significant findings in this model is that the stage of [print web transcripts] is found to be a learning achievement factor ($p < .01$). Students who printed web material showed higher achievement score than those who didn't print. The interviewee said that they printed web materials because it was easier to read printed text on paper than to read the text on the screen, and it is easy to take a note on it what they learned. Apparently this could mean that reading texts on paper would be more effective than reading texts on screen. But the effectiveness in this context could be from well-structured contents in the material, not from printed format itself. That is, structuring, rather than printing, could be main reason for the effectiveness. So we suggest that the exact critical success factor in achievement be further researched. Anyhow, printing activity in this research was used for studying more intensely and for externalization of what they understand.

In terms of satisfaction level, the structure of course and contents was found to be a critical factor. Upper 30% of achievement group showed significantly higher satisfaction on the course and contents structure than lower 30% group showed ($p < .01$).

Learning process; a conceptual model

The action model of learning process was abstracted to a conceptual model (see Figure 2), with considering previous literature (Lee, 2004a; Stahl, 2000). In Figure 2, bold solid arrow shows major learning process and fine solid arrow shows back process or minor process experienced by some students. Dotted line represents partial experience of some students, not a major process.

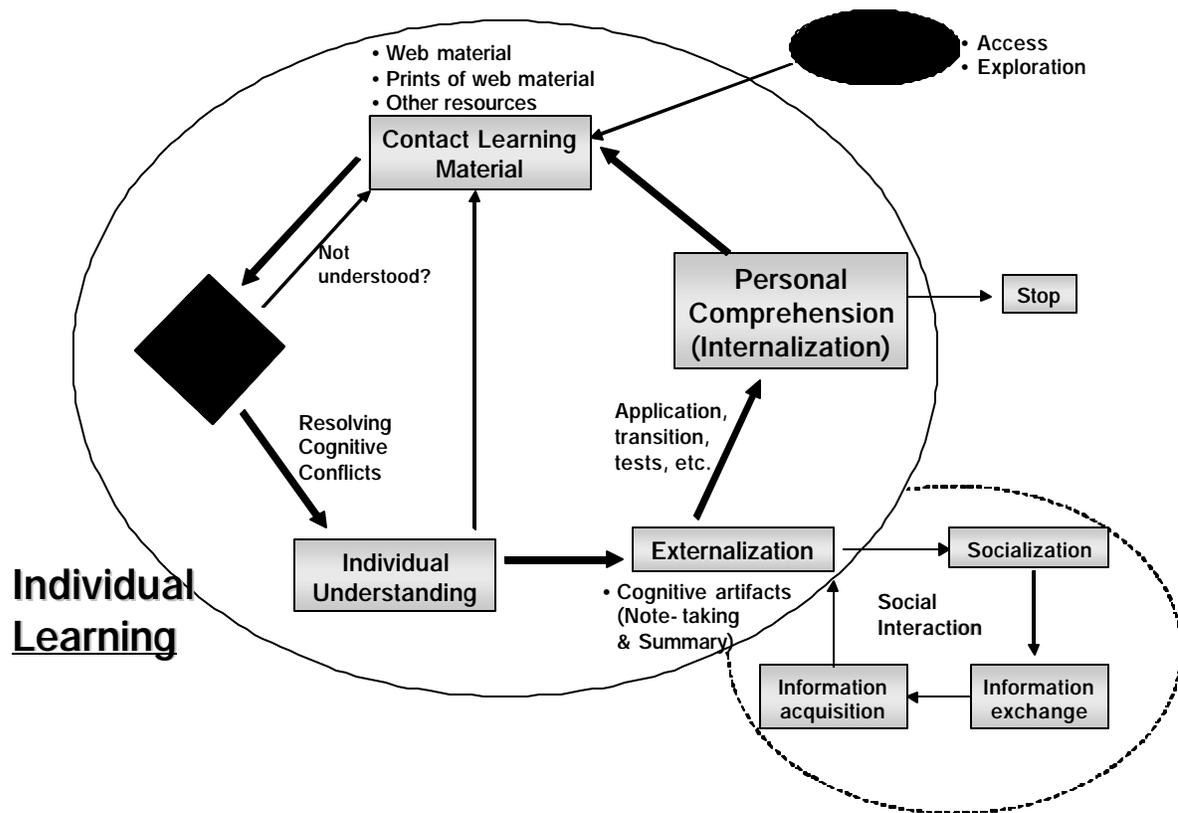


Figure 2. A Conceptual model of learning process in resource-based well-structured instruction in web-based distance learning environment

In the conceptual diagram of learning process, there are two phases. One is about 'individual learning' and the other is about 'social interaction', which is differentiated from 'social learning'. In individual learning phase, the process is beginning with [initiation] at first. [Initiation] includes access, reading notice or announcement, clicking menu, exploration on web-based class sites. This activity is not exactly main learning process, rather pre-activity before learning process. So it is shown outside of the learning cycle.

After initiation, learners [contact learning materials], which were highly structured web-based

instructional program in this research, printed materials of web-based instructional program, and other resources. At this point, students printed web materials for reading more intensely and for note-taking. Making printed material was found to be a critical achievement factor and satisfaction factor in this research as mentioned in Action model section.

When learners contact learning material, there must be [internal process] in their brain, which is many learning theorists have concerned about. At this stage, students are trying to absorb knowledge into their own cognitive schema over reflection. This is occurred in one's brain for self-asking or intrapersonal communication, which is not observable but explainable by learning theories of cognitive scientists. But we don't discuss how the internal process is going on here because it is beyond this research.

If students understand the contents well enough throughout the internal process, they arrive at [individual understanding]. Otherwise, they get back to [contact learning material] and repeat this cycle until they understand it. [Individual understanding] is differentiated from 'shared understanding' presented by Stahl (2002). Whereas 'socially shared understanding' is from consensus among interactive team members, [individual understanding] is the arrival stage of the process from individual learner's cognitive structure through internal process to resolving cognitive conflicts. This [Individual understanding], which is temporary understanding but not externalizable, is also different from final [internalization] that is personal comprehension of knowledge.

To get to [internalization], it is found that students summarize or take notes of what they understand. This activity is conceptualized as [externalization] in this research, which is found as a critical cognitive achievement factor. The observable behavior in this step was printing web-text and utilizing it. This means that physical behavior of printing represents significant cognitive activity in learning process.

After this whole cycle, a learner eventually arrives at [internalization] that is personal comprehension of knowledge. Then you have to decide to continue or stop learning. This whole process can be visualized as a conceptual diagram of learning process (see Figure 2). The conceptual model presented in Figure 2 was verified by five distance education experts and 10% of students in this research. Respondents used a 5-point Likert scale (5 = fully verified, 1 = not verified), which was referred to previous literature (Choi, 2002; Rha & Hong, 2004; Rha & Jung, 2001), to rate validity, explicability, usability, generality, and comprehensibility. Average rate of experts was 4.28 and average rate of students was 4.10.

Conclusion and Recommendation

This research is to articulate the learning process in resource-based well-structured instruction in web-based self-learning environment. To explore the learning process, a resource-based self-learning program was developed. Quantitative and qualitative data were collected from the implementation of the program and an action model and a conceptual model of learning process were derived. In conclusion, the learning process in resource-based structured distance learning constitutes a major phase (initiation ? contact learning material ? internal process ? individual understanding ? externalization ? internalization) and a minor phase (minor informal offline interaction among students).

The findings in this study provide some significant implications. One is that this study provides a conceptual framework to understand how the learning process is going in highly structured, web resource based distance instruction with little interpersonal interaction. This article also contributes to understand how the course and contents structure influence in distance learning. The other is that we can suggest some instructional strategies in self-learning mode, such as externalization strategies or design of appropriate social interaction. Printing and note-taking turns out to be a critical success factor in this research. So externalization tips like trying to require students to submit reflection note for assignments could be a good strategy for better cognitive achievement. Also social interaction among students needs to be encouraged in especially distance learning environment. We may design this to be structured in a course. Historically educators have tried to include most possible student-teacher interaction into a learning material. But findings in this research show that now we need to consider structuring student-student interaction, as well as student-teacher interaction, in instructional design of web-based distance learning program.

Finally recommendations for further research to get over limitations in this research are suggested as follows: a) This research is a case study, based on Korean context. There could be difference in other cultural context. So we suggest that similar research in different context as well as in different learning subject be studied to enrich the implications in this article. Besides, learning process study in mainly interpersonal interactive learning environment or their comparative study can be proposed for further research. These researches providing quantitative data from more cases with various learning contexts could verify and generalize the findings of this research. Also researches considering emotional or social evaluation as well as

cognitive evaluation on various learning contents could be recommended for more comprehensive understanding in web-based distance education. b) This research did not consider each structural element's effect or influence on learning, although many structural elements from the previous literature were applied to structured instructional development. But there could be many different design types among structured instructional program. Analysis and comparison of each element's influence on learning would be a good theme for further research. c) Learner analysis in each group might contribute to elaborate the implications in this research. We didn't analyze learners' characteristics with objective measurement tools. Rather we simply checked perceived learners' characteristics. More objective analysis of learners' characteristics with verified measuring tools, including special characteristics such as learner autonomy or self-regulating ability, would give us significant and more articulated implications.

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Analysis of essential skills and knowledge for teaching online

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Abstract

This study identifies and posits guidelines for assessing the skills and knowledge of online distance educators. Findings derived from Cooper's (1998) synthesis research method reveal sixteen skills that may be grouped into six areas that are thought to be essential for educators to teach successfully online. The study also shows that factors, like discipline, delivery mode, learning outcome, and instructional strategy, may affect the application of those skills. Moreover, the findings suggest that educators can greatly benefit from training, support, and faculty development to make the transition from teaching in a face-to-face setting to an online setting, even though most skills are thought to be similar and applicable across settings. The findings also indicate that further studies are needed to establish the validity and reliability of self-assessment instruments and to connect theory and practice.

Introduction

Online distance learning has become a very popular mode for learning in higher education during recent years. However, some online educators claim that they were forced to teach online (Cooper, 1998), or they lack the knowledge or skills to teach successfully online (Bailey & Chambers, 1996; Clark, 1993; Flottemesch, 2000; Inman & Kerwin, 1999; Karsenti, 2001; Wallace, 2003). Do distance educators need any special skills or knowledge to teach effectively online? If so, what are they? Moreover, is there any valid, reliable, and efficient way to determine whether an educator is suitable for teaching online?

The purposes of this study are to (a) determine whether online distance educators need special skills or knowledge to successfully teach online, and (b) determine whether any valid, reliable and efficient ways to assess the essential skills and knowledge of online distance educators.

This study synthesized the skills and knowledge for online distance educators from a review of literature and an analysis of existing self-assessment instruments. The research questions that guided the study were:

1. What are essential skills of a successful online distance educator in higher education?
2. Is there difference between teaching in face-to-face and online environment?
3. Is a self-assessment available for educators to determine their capability and suitability for teaching online?
4. What elements in existing self-assessment instruments were used in higher education?
5. Is there an alternative way to determine whether an educator in higher education is suitable for online teaching?

For the purposes of this study, Hirumi's (2002) definition for e-learning is used to describe online distance learning that, "... is facilitated predominately through the use of telecommunication technologies such as electronic mail, electronic bulletin board systems, inter-relay chat, desktop videoconferencing and the World-Wide-Web"(p.17). Online courses are increasing dramatically across higher education. According to the Statistics from U.S. Department of Education, National Center for Education, the percentage of all 2-year and 4-year institutions that provided distance education courses for any level or audience doubled from 1997-98 to 2000-2001 academic year (Lewis, Alexander, Farris, & Greene, 1997; Livingston & Wirt, 2004; Waits & Lewis, 2003). However, online distance learning also presents issues.

The problem is the overall quality of online courses is still questionable (Johnson, 2003). Even though many educators see the importance of online education, many still lack the experience or knowledge to teach online effectively (Bailey & Chambers, 1996; Clark, 1993; Flottemesch, 2000; Inman & Kerwin, 1999; Karsenti, 2001; Wallace, 2003). Do educators need any special skills or knowledge to successfully teach online? If so, are there any effective and efficient ways to measure or determine if an educator has the skills and knowledge necessary to teach effectively online?

Published studies use different techniques to delineate essential skills for distance educators. A number of studies use Delphi techniques to identify roles or skills that distance educators should possess (Thach, 1994; Williams, 2003). Some studies use quantitative methods to examine what educators face and feel about online

teaching (Clark, 1993; Inman & Kerwin, 1999). Others focus on the shift educators make from teaching in a face-to-face environment to that in an online environment (Conciecao-Runlee, 2001; Coppola, Hiltz, & Rotter, 2002; Easton, 2003; G. G. Smith, Ferguson, & Caris, 2002). Many authors expressed concern for terminology in the field (Easton, 2003; Flottemesch, 2000). To gain insights and a better understanding of the research results, it is helpful to look at the “big” picture by synthesizing findings from previous studies.

Method

This study used the research synthesis method developed by Cooper (1998) to identify fundamental skills and knowledge of successful online teachers in higher education. Cooper (1998) states that research syntheses emphasize “...empirical studies and seek[s] to summarize past research by drawing overall conclusions from many separate investigations that address related or identical hypotheses” (p.3). Compared to the meta-analysis method which is commonly used to synthesize research findings, Cooper’s method focuses more on the similarities and differences across research studies to enhance shared concepts and terminologies as well as to facilitate the transition from research to practice (Cooper, 1998; Hare & Noblit, 1983).

Coding sheets were generated to organize and compare research findings according to the following guidelines posited by Cooper (1998). The coding sheet should:

1. Include detailed information about each study that is related to the topic.
2. Include seven categories of information (i.e., report identification, study setting, subjects, methodology, treatment features, statistic outcomes or effect size, and the coding procedures).
3. Be standardized to contain the main comparison of study interests.
4. Provide space for descriptive note for each study in order to find the interaction between main effect and other variables.
5. Be pilot tested and revised to precisely define necessary categories and unveil further ambiguities.

This study used the studies by Thach (1994) and Williams’s (2003) to form initial coding columns (essential skills and outputs), then modified columns by using the other eight randomized studies. Since the topic of distance education skills can be viewed from different perspectives, researchers used the following criteria to select research for inclusion in the study:

1. Research studies should cover overall skills or outputs which educators can teach in online environment successfully.
2. Research studies should mainly focus on higher education.
3. Research studies should mainly be conducted in the English speaking countries.
4. Findings should be proved by half of the studies.

A total of twenty studies were used to create the coding sheet (see Appendix A for coding references), including thirteen empirical studies and seven position papers published between 1994-2004. This study focused on skills and knowledge mainly found in the higher education among English speaking countries. Therefore, the results may not represent findings from other areas. In addition, some studies do not specify the type of distance learning they conducted. Therefore, those findings may also be affected.

Findings

What are essential skills of a successful online distance educator in higher education?

Based on the synthesized results, there are six essential skills and sixteen outputs for performing those skills:

1. Interaction
 - Guide and maintain interactive discussion
 - Provide timely feedback
 - Encourage peer learning
 - Advise and counsel students
2. Management
 - Monitor and evaluate student performance
 - Facilitate presentation
 - Introduce support services to students
3. Organization/ instructional design
 - Provide clear learning outcomes, objectives, and expectation
 - Organize materials and activities clearly and well

- Identify students' learning styles/needs
 - Conduct instructional design effort
 - Present materials and activities
 - Provide a variety of learning activities
4. Technology
 - Utilize technology in a competent manner
 5. Content knowledge
 - Master in content area
 6. Teamwork skills
 - Collaborate with technical/support skills

The skill areas are ranked from 1-6 in order of importance. The outputs are grouped by area first, and then by importance. Not surprisingly, the ability to stimulate and facilitate interactions is the most important skill that online distance educators should possess. Even though many educators urged the competency of technology in online teaching, this ranking also presents a trend that online education is driven by pedagogical concerns instead of technological concerns. Another interesting finding is the relative importance of content knowledge. It seems that in an online environment, educators' mastery in the content area is important, but their ability to organize and present content information to students is more important.

From the review of literature, we also found factors that may affect the essential skills of successful online distance educators in higher education:

1. Supporting system of the institutions (Berge & Muilenburg, 2001; Dzuiban, Shea, & Arbaugh, 2004). The better supporting system is, the less essential skills those online educators need.
2. Delivery methods of the online courses. Some online courses also require partial classroom attendance; therefore, the essential skills and the outputs will be varied (Pyle & Dziuban, 2001).
3. Learning outcomes of online instruction. Essential skills and outputs for conducting online courses with higher thinking skills will be different from those with fundamental operation skills (Pyle & Dziuban, 2001; Southern association of college and schools, 2000 Dec.)
4. Instructional approach and epistemological beliefs. Different instructional approaches will affect online distance educators' teaching strategies, and different teaching strategies will affect what kind of skills they need to possess in order to teach online successfully. It also means that what educators' epistemological beliefs will direct them to choose different instructional approaches. Therefore, the skills or knowledge for teaching online successfully might be different (Gagne, Wager, Golas, & Keller, 2005; P. L. Smith & Ragan, 1999).

Is there difference between teaching in face-to-face and online environment?

To examine the difference between teaching online versus face-to-face classroom settings, we identified key competencies specified for conventional classroom educators and reviewed literature discussing the paradigm shift from traditional face-to-face classroom to online settings. Like others, we found that most skills are similar (c.f., Coppola et al., 2002; Easton, 2003; Palloff & Pratt, 1999). However, a number of studies also stated that skills, like content and activities' organization, interaction and communication, evaluation and assessment, office hour maintenance, and teamwork, need to be adapted to meet the requirements of an online environment (Berliner, 1988; Dzuiban et al., 2004; Easton, 2003; SACS, 2000). For example, in conventional classroom settings, the primary role of educators is to instruct, but in the online environment, the role changes to an instructor and instructional designer. Another shift has the educator's presentation style changing from a lecture orientation to a Socratic approach. It is important to note that many of the recommended adaptations for teaching online are also being adopted for teaching in conventional face-to-face classroom settings even though they might be less emphasized.

Even though many of the skills are similar, research suggests that educators need training, support, and faculty development to make the transition from teaching in conventional classrooms to teaching online.. The training and support may or may not be housed in the educators' home institution. If an institution asks educators to teach online, but does not provide adequate training and support, the quality of online course materials and delivery may be jeopardized. Moreover, the institution may frustrate their educators without assisting them through the transition

Is a self-assessment available for educators to determine their capability and suitability for teaching online?

Several self-assessment instruments have been reported for determining whether educators in higher education are suitable or capable of teaching online. Some of them have an online version for educators to test by themselves. Reported self-assessment instruments include:

1. Are you ready to work online? (Salmon, 2000)
2. Is online teaching right for me? (University of Central Florida, 2003)
3. Is Online Teaching for Me? Self-evaluation Quiz. (Onlinelearning.net, n.d.)
4. Personality traits and teaching style preferences for online instructors (Fuller, Norby, Pearce, & Strand, 2000)
5. Self-assessment of Readiness for creating or teaching an online course (Gumness, n.d.)
6. Teaching Styles and Web Pages (Indiana State University, 2004)

What elements in existing self-assessment instruments were used in higher education?

Nitko (2004) points out that an authentic performance assessment should include two essential elements: (a) a performance task which learners can demonstrate by producing an extended written or spoken answer, and (b) a clear rubric or criteria for grading that performance. By examining the elements of the existing instruments, we found that most focus on specific perspectives, such as technical (necessary computer skills), psychological (personality traits) and pedagogical (teaching style). Even though some of the instruments provide other elements which are included in our list of essential skills and outputs (e.g., “Is online teaching right for me?” or “Is online teaching for me?”) such elements do not appear to be grounded in learning theories or supported by empirical studies. In addition, we did not find evidence for validity, reliability or follow up studies reported on most instruments. The review of literature did reveal several guidelines for generating self-assessments :

1. The instruments should be aligned with available training and support. For example, the faculty support center at the University of Central Florida provides several consultations for faculty members to assess their skills followed by training and support services to address identified areas of need (Dziuban et al., 2003).
2. Assessment items need to be aligned to learning objectives and cover cognitive (Bloom, Englehart, Furst, Hill, & Krathwohl, 1956) and affective (Krathwohl, Bloom, & Masia, 1964) domains.
3. The instruments should be treated as one sources of assessment data. Nitko (2004) states that assessments should be conducted from multiple perspectives to reduce potential bias.

Is there an alternative way to determine whether an educator in higher education is suitable for teaching online?

Our findings show that there are some alternative ways to determine whether educators are suitable and capable of teaching online:

1. Be evaluated by professional organizations: Some creditable organizations provide course or certificate evaluation services. For example, the National Board for Professional Teaching Standards (NBPTS) provides many services to assure the quality of education. Educators can submit their course materials, students’ works, even videos of their class activities to NBPTS to get feedback for their teaching performance as well as their course content. This kind of service is not mandatory, and they evaluate the course as well as the certificate by using multiple resources. The advantage is that the evaluation result is relatively creditable, coming from an independent source. On the other hand, the process takes considerable time and effort from both ends and may not be practicable as standard practice, particularly for larger organizations.
2. Participate in assessment centers. Compared to the previous option, this is also a formal way to access educators’ capability of teaching online. However, the assessment materials are from the center, not from educators themselves. Moreover, educators may need to go to performance assessment centers to complete simulated teaching activities like inferences, peer collaboration, or staff development. Therefore, this kind of performance assessment is creditable, but again, may not be practicable as standard practice.
3. Follow checklists, best practices, and benchmarks from creditable organizations. There are many checklists, best practices, and benchmarks from scholarly journals, books, or organizations developed by experienced online educators or experts. Even though those materials may not have been developed for your exact environment, they may still provide useful guidelines for general assessment purposes.

4. Have a good mentor in the same field. It is always a good idea to have a good mentor in the same field (Perreault, Waldman, Alexander, & Zhao, 2002). He or she can provide suggestions which match the environment you have, even though sometime his or her suggestions may be somewhat subjective. .

Recommendations

Based on our findings, we recommend that:

1. Researchers conduct additional studies to determine how specific disciplines, delivery modes, and learning outcomes/strategies affect the skills and knowledge necessary for distance educators to teach successfully online. Even though some speculate that skills and knowledge vary by domain, course delivery mode, and desired learning outcomes, there is little empirical evidence to support such claims .
2. Researcher and partitions determine and report the validity and reliability of self-assessment instruments. Even though we found many self-assessments to help distance educators determine if they are prepared and/or suitable to teach online, the validity and reliability of such instruments are rarely reported. Additional follow up studies are needed for the self-assessments.

Appendix A: References of the coding sheet

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An Exploratory Study for Building a Conceptual Framework of Customized Training

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Introduction

The term “customized training” has recently been used often when discussing training. Many training development companies and community colleges selling their training programs use it frequently for engaging prospective customers and companies considering purchase of their products. So, what is customized training?

Definition of Customized Training

A shift has emerged in corporate training¹ from a training-driven approach to a human performance-driven approach. In other words, people want the training to impact the bottom line by enhancing performance, not just for the training to occur for the sake of training itself. In order for training to influence business significantly, it needs to be closely aligned with business goals and also be designed to address these goals from the beginning. To fulfill corporate leaders’ growing need for training, it is critical that training should be customized for a specific company and for specific target audience and customization be embedded in the design and development of training products. So what do we mean by customization?

According to the definition in a dictionary, the term “customize” is to *make or change something to suit the needs of the owner* (Oxford Advanced Learner’s Dictionary, 6th Ed.). By employing this definition, customized training can be defined as training made or changed to address the needs of the target learners.

One training development company website defines customized training as follows:

“Customized training is the process of tailoring training to organization’s needs either by adapting an existing program or developing a new program....We can customize one of our existing programs or develop a course for you from the ground up.

(<http://www.corexcel.com/html/customized.training.contact.hours.htm>)”

In addition, New York State Department of Labor defines customized training as training “that is designed to meet the special requirements of an employer or group of employers.” (<http://www.workforcenewyork.org/qaojtctrng.html>)”

In the two definitions, one from a training development company and the other from a department of labor, customization requirements of employers and interests of organizations is emphasized since they regard customized training as products in high demand. In these definitions, both consideration for employees and the emphasis on the end user’s needs are invisible. Blackmon and Rehak (2003) put much more weight on trainees than employers in the definition of customized training.²

They described a model for role and competency-based customization by using learning technology standards (e.g. learner profiles, competency definitions, sequencing rules, learning objects). One of the most salient characteristics of the model lies in dynamic assembly of content objects extracted from content repositories to enable the creation of customized learning, and dynamic creation of optimal learning strategy that suits the needs of the learners. We can learn several ways to customize learning by considering roles and competencies of the target learners while customizing content and learning activities.

The characteristics described in the definitions presented so far are not sufficient to grasp a whole picture of customized training.

Purpose of Study

Throughout all these definitions (both of training and customized training), it is very clear that there are two different perspectives on customized training: employer’s vs. employee’s standpoint. However, in this study, these bipolar standpoints may not be differentiated under the assumption that all the training is intended and designed to impact the bottom line in the long run.

The purpose of this study is to explore the building blocks of the concept of “customized training” beyond its conventional definitions and to form a comprehensive conceptual framework³. Furthermore, the

current practice of designing and developing customized training in corporations is explored and investigated to answer the following research questions, which are two-fold. For the product dimension of customized training, reasons and ways for customizing training will be addressed. For the process dimension, major issues faced and activities involved in the design process of customized training will be identified.

For the product dimension, the four questions will be addressed:

- There must be assumptions about training. These can serve as rationale for customization. *Why is training customized?*
- The objects that can be customized may vary from content to methods to resources. *What is customized in training?*
- Training can be customized with regards to individual role and competency or current level of skill and knowledge. Sometimes, individual attitude or learning style can be considered for customization. *What do they consider for customization of training?*
- In addition, *how can the current customized training be improved for better quality?*

Description of the current process of design and development for customized training can give practical guidelines for practitioners. It is possible that any specialized process of customized training exists. For the process dimension, three questions will be addressed.

- *What are the major elements of design process for customized training?*
- *What are the major issues instructional designers have faced in the process of design for customized training?*
- *What is the ideal process of designing customized training like? How should your current design practice be improved?*

Answers to the questions will provide building blocks that can describe the current practice and systems for customized training. Understanding these components and their relationships can give insight to training designers on how to approach and actually develop customized training. Design and development for customized training needs a conceptual framework which can include all relevant elements and can depict relationships among those elements. The conceptual framework will help training designers to understand elements to be considered in training design and to see those elements from a systemic point of view. The value of this study may lie in explicit visualization of building blocks of design and development of customized training residing tacitly in training designers' mind.

Method

Research Design

Due to deficient amounts of corporate research on customized training, it is necessary to meet practitioners who have experience in designing and developing customized training and to hear their narratives in order to understand the current practice and to investigate the research questions.

As Yin(2002) reported, "the case study has peculiar advantages when research questions are related to how and why, when the investigator has little control over events, and when the focus is on a contemporary phenomenon within some real-life context (p.1)." In order to utilize the full advantage of the case study, multiple methods were integrated. Hence, seven face-to face interviews as well as rich and in -depth document analysis of web sites and documents acquired from the interviewees were employed. When necessary, a follow-up interview was conducted via email or on an online synchronous chatting tool.

Cases

The units of analysis were seven training designers (developers) who have experiences in customized training. Real names of the interviewees are replaced by pseudonyms.

Kevin has 10 years experience as a training developer and is working as vice president in a custom training development company located in the mid-western part of the United States. Michael has 2 years experience as a training designer and is working for the same company as Kevin. Stella is working as a task analyst in a pharmaceutical company which is also in the mid west. Brad has 5 years experience as a course developer and is working for the same company as Stella. Eugene has 2 years experience as a training designer, working for a family restaurant company in Korea. Mira is working as a training designer in a company that produces food and animal feed additives in Korea. Susan is a training designer in a company providing information technology services. Kevin and Michael are working in a company that develops customized training for the client companies. The remainders are developing in-house training programs. In summary, three

male and four female, ages ranging from twenties to thirties were interviewed.

Data Collection

The Interview protocol was developed by adapting research questions for a more communicative style. The protocol was pilot-tested with peers to identify unforeseen problems and was revised based on the results of the pilot test. For face validity of the instrument, two experts reviewed the protocol, which was then modified according to their comments. All questions were open to allow new or modified questions as the interviews progressed.

Four interviewees in the U.S. were interviewed face-to-face. Three of the interviews took approximately 60 minutes while the one with Brad took 30 minutes. All the interviews were recorded with a digital voice recorder after acquiring permission and later transcribed word by word. The interviews with the other three in Korea were conducted through an instant messaging tool. All the texts of the interviews were saved as text files for further analysis. For validity, the researcher explained the scope and the purpose of this research to the interviewees to make sure that both sides interpreted the research questions in the same way.

Based on data from the first interview, the follow-up questions were sent via email to the interviewees in cases where further elaboration or clarification was needed. Through the follow-up interviews, additional in-depth and data were gathered.

During the interview, the researcher took notes that were utilized for asking more in-depth questions and for clarifying interviewee's answers.

Data Analysis

After completing data collection, the briefly summarized extracts of the interviews were sent to the interviewees to ensure reliability as a means of member checking. The transcripts were reviewed several times in order to find emergent themes.

Extensive literature was reviewed for gathering data to establish the conceptual framework of customized training. Considerable amount of web documents related to customized training were collected through the Google search engine and were later analyzed. Additionally, a recorded presentation by Kevin and Michael, a corresponding handout, and a whitepaper of their company were analyzed.

Results

Why is training customized?

Training should impact the bottom line From the organization's perspective, training should be a means for increasing profit. In order for training to address this need, it is required to be tightly aligned with business goals. As a rule, HRD strategies are established in conjunction with business strategies. Therefore, training, one of interventions driven by the strategies, is also expected to play a role in accomplishing business goals. Without considering business outcomes or having clear output images of training, training might be implemented in vain. In this sense, training should be customized to meet defined corporate business goals.

"I think all training in my company is customized. From the company's perspective, training is used as one strategy that helps employees accomplish short-term and long-term goals of the company. Therefore, unless it is not optimized, people complain about the training. Unlike schools, corporations have very concrete objectives and targets and require visible outcomes. We try to avoid unnecessary training that does not lead to business results. Therefore, business goals, business strategies and HRD strategies that inherited from the top management should be aligned with all training (Eugene)."

Business goals keep changing according to market trend, emergence of new product lines, change of management lines and environmental disruption. Training should be very keen to those changes and should respond to them aggressively. Most of the interviewees agreed that if it is separated from ever-changing business goals, training cannot satisfy the company or target learners.

The characteristics of the target audience are very diverse Just like other higher education fields, corporate training is very likely to encounter diversity in the target audience with regards to skill and knowledge level, learning style, and prior experience to name just a few. Especially if the company has several sub-industries and needs a training program to teach all employees across the industries, customization is crucial by taking into account the target learners' diverse characteristics, contexts where the training would take place, and the way that trainees would apply what they learn to their jobs.

We have our own way Every organization has its own procedure and learning culture. Of course all training cannot be developed by the organization itself. A considerably large proportion of training is supplied by vendors and neighbor universities. However, those training programs produced by others may not address all organization's unique procedure suitably nor care about the contexts. Therefore, training designers who build up in-house training programs feel that they need to provide customized training that fully attend to their own training needs and touch on their own unique way of doing things, especially if there is no adequate training material on the market.

"We customize because no materials exist either internally or on the market place. In our field there isn't a lot of pre-built training on sophisticated lab techniques or procedures. Also, 'the [pharmaceutical company name] way' is usually a little more stringent than standard practice because of FDA guidelines. So, a university course on how to perform a technique wouldn't be adequate (Brad)."

"The sort of business needs that they're addressing for companies or organizations. They cannot be adequately fit by a standardized generic training or books... often times their organizational problems that are very specific to [their] organization..you have your own culture and your own systems and so you need someone who can learn about and understand your specific challenges and then create training that addresses those specific challenges and in your context (Michael)."

If not customized, training doesn't work Compared to training designers for in-house programs, training program development companies might be more sensitive to the degree of customization of the programs they sell to the client companies because training in business settings never takes place in a vacuum (Molenda & Pershing, 2004, p.26) and the context where training would occur is hard to grasp at a glance from outsiders. Kevin and Michael stressed consideration of contexts where a specific company is located when they design and develop customized training. Also, they believed that there should be diverse versions of training customized to different target learners. They asserted that any training that does not consider the contexts is likely to fail. They reported that they need to understand what the target learners' jobs are and how they apply what they learn. Kevin stressed that training is not training at all but just information if it does not consider the context. Training designers should tailor training programs to address the context.

"As a matter of fact, it doesn't work if you don't customize it. I think so much instruction doesn't work. They try to address too broad audience and to fit in many organizations... You can write one book about management. But too many times, people don't learn from that book. You have to create an opportunity to learn from the book. You really want me to apply management back in my job. You need to understand what my job is. Need to understand how I apply. That's the principle. (Kevin)"

"I don't think that's instructional design inherently unless it focuses on customization. That's the design of our instructional design. Without it, it's just information. It's the instruction that doesn't take learners, context and business into account (Kevin)."

What is customized in training?

Based on data collected from the in-depth interviews with the seven training designers and document analysis, a taxonomy for what to customize in training is built in terms of what to learn, how to learn, when to learn and where to learn. By incorporating all the results, a provisional conceptual framework (see Figure 1) was constructed.

What to learn All the interviewees reported that they customize content to specific target learners. They adapt the scope and the depth of content. Sometimes they reorganize the content by adding real cases that help learners' understanding. Based on the result of front-end analysis, they customize the scope and the depth of content by taking the level of current knowledge and skill related to the content into account.

When there is a broad range of target learners, they create multiple versions of the same course by customizing the content.

"If we have a wide audience or a split audience with different needs and skill levels, we consider if multiple versions of a course would be the best solution. Recently we had a procedure that everyone in my department was required to be trained on. However, non-chemists didn't require as deep an understanding of the details of the procedure. So, we tailored the learning to the audience's

skill level and made the non-chemist course a little more basic with different learning outcomes and more background material. When appropriate we used course materials from the chemist course, which was more in-depth (Brad).”

So far the designers have reported that they customize what is to be learned by target learners during the design and development phase. However, there is another phase where customization frequently takes place. Training designers and supervisors of employees arrange and assign training programs to specific persons by considering their responsibilities and jobs. This phase comes after all training materials are already developed.

“Everyone has individual training plan. The training plan lists the classes and courses they need to take. Matching classes with job category is one of my tasks. This is considered customization. We have the courses like pieces, now we place those pieces to address job category needs. The object of customization is primarily about the content (Stella).”

“We defined general competencies that our company expects all employees to have. But they are not job or task-specific competencies. Anyway, all employees can access a tool that diagnoses their own competencies. According to the results, the tool would prescribe training solutions including other resources for enhancing their competencies to the specific learner (Eugene).”

How to learn Once the topic, the scope and the depth of the content are determined, the designers customize instructional strategies or learning activities related to “how to learn” along with the selected content.

“In order to get performance, you want to focus on wonderful performance, then you have to develop, you can keep content system. It’s the context that you are to customize. How am I going to apply this information? Not what is the content? So I talked to my clients. You keep the basic management content. But what you need to change is the context in which I apply. (Kevin)”

Customization of the learning process involves considerations on the sorts of content and accessibility of target learners to the training such as infrastructure, time availability and their understanding of instructional strategies and learning activities.

“Also, we customize mode of delivery. By taking into account the characteristics of individual task, we select the most effective mode of delivery. For example, there is a topic that cannot be trained through off-the-job training. Ultimately, the reason why we optimize the mode of delivery with the training content and objective is to maximize the effect of the training. Also we customize learning activities and other instructional strategies (Eugene).”

When developing a training program for all employees across the departments of a company, training designers consider characteristics of industries because certain employees in a specific industry have preference to specific instructional strategies. They also customize performance support strategies including EPSS (Electronic Performance Support System), job-aids, and informal mentorship programs according to the characteristics of training topics.

When to learn This facet of customization depends heavily on organizational learning culture and availability of employees to be trained. If your organization encourages self-regulated learning, overall training would be provided with a form of printed-self-study materials, job-aids, EPSS, and web-based instruction. In order to allow flexibility, the training designers select appropriate mode of delivery.

They also customize the timing of training in order to assure effectiveness and transferability of what they learn from the training.

“It is not reasonable to train people on something that they are going to perform in 6 months from now. It does not make any sense. You will forget everything. I think that we are making a change on their individual training plans that will address their needs. Instead of assigning them training that is not relevant right now, we just assign the training when they are close to performing the task. We are calling it just-in-time training. When a maintenance guy receives a work order (request to fit something), he or she will request training on the task that the work order requires. He or she will take the training right before to performing the task so that he or she does not forget the information (Stella).”

Timing is one of the aspects that training designers invariably customize in their practice.

Where to learn _There are several options on where to learn. In previous years, training usually took place in an instructor-led classroom. However, the places for training can be customized by taking into account sorts of topic, time-availability and effectiveness of training. In order to avoid unnecessary discontinuity of jobs and to reduce expenditure on travel costs required to send employees out of the workplace, on-the-job training, printed-self-paced materials, and corporate universities are options for customizing the location of the training.

What is considered for customization in training?

The items answered to this question were interpreted as factors that training designers focus on during the analysis phase as well as align with training programs. The quoted factors by the interviewees must play an important role in current practice of design of customized training.

Business needs Business needs determine the direction of overall HRD strategies. Training is one of the interventions to increase employees' performance and to reduce performance gap between the current status and the desired. Performance is expected to be evaluated with measurements of tangible contributions to business outcomes. Therefore, training designers should assure that their products are addressing ever-changing business needs by aligning training programs with such needs. All participants reported business needs as the most important aspect they tried to align with training. These business requirements drive training development more strongly than any other needs. They take precedence over individual learner's needs or department's needs.

Organizational learning culture _Organizations have their own unique cultures in many regards. The company where Eugene works has stressed self-regulated learning culture in the last few years. Therefore, the training designers have designed and developed training to leverage its learning culture. They focus more on the flexibility of timing and location of training to target learners. They also developed self-paced materials rather than instructor-led in-class training programs. This is one example of customization of mode of delivery of training to fit organizational culture.

Collective learner characteristics All interviewees invariably reported that they align the characteristics⁴ of the target audience with training programs.

Other participants also reported that they analyze the comprehension of instructional strategies or learning activities, educational background, and training preference.

Individual learner profile In addition to collective consideration of learner characteristics at design and development phases, training designers also consider the individual learner profile including his job, tasks, required competencies, history of training, and his career plan during the development phase of an individual training plan.

“All employees can access a tool that diagnoses their own competencies. According to the results, the tool would prescribe training solutions including other resources for enhancing their competencies to the specific learner. We also have a plan to develop a diagnosis tool for job-specific or task-specific competencies (Eugene).”

Content Characteristics Depending on the given content characteristics, training designers try to align the topic with appropriate instructional strategies. The characteristics include content domain (e.g. affective, cognitive, and psycho-motor), complexity, and volatility (e.g. stable or unstable).

Context in which learners apply what they learn In order to transfer what is learned from training into job performance, training designers need to understand contexts in which the target learners apply what they learn. Even with the same skills, learners have different environments, different tasks to do, and different ways to apply what they learn. Therefore, training designers try to align this context with training programs by thorough analysis of the job and the environment.

All of the themes and factors identified through interviews and document analysis were integrated into a single conceptual framework which describes the concept of “customized training”.

How can the current customized training be improved for better quality?

Most participants shared the sense that they are not fully satisfied with their current customized training and that there is room for improved customization. Even though they customize training by considering principal playing factors identified from needs analysis, learner analysis, and environment analysis, they all reported they are still lacking comprehensive and rigorous analysis owing to time and cost constraints. They all agreed that the more time they can spend on analysis and the better customized product they will be able to create.

One interviewee reported that it is very important for him to understand the client's business and learning objectives. Also, accessibility to subject matter experts (SMEs) that can provide what he wants is necessary. Close communication between training designers and SMEs should last until they ship deliverables to the client.

“Having a clear understanding of what their business and learning objectives are, having access to SMEs that actually are experts and can review. Making sure that they give you content you need. Having SMEs review your work and give feedback in timely manner, because we need to translate them into instruction properly and accurately. That's very important as well. (Brad)”

What are the major elements of a design process especially for customized training?

In contrast to prior expectation, all the interviewees did not distinguish the design process for customized training from the process for one-fits-for-all training because they all felt that what they work on is to design and build up customized training.

“I guess most training programs that companies develop by themselves are customized. It's very common practice in the corporate sector. So, it sounds a little bit awkward to label our practice especially as customization. Customization is being regarded as a must-have in all training design practice (Mira).”

All respondents followed Analysis-Design-Development-Implementation-Evaluation (ADDIE) process model. A prominent point drawn from the interviews is that they all put substantial weight on the analysis stage of customization.

Michael stressed iterative processes through recurrent and very close communication between the clients and the designers from the very beginning of the design process. All of the processes include the initial design of the company and approval from the clients iteratively.

“We followed ADDIE model...For new clients, to develop one hour of online training, it may take me 16 weeks to develop a course. For 16 weeks, maybe 4 weeks are for analysis and design. Another 6 weeks [are] for development. Another 2-3 weeks [are] for implementation and evaluation. At the end of the analysis and design phase, you have what you want to have. In the development phase, you have prototyping. During the prototyping, you will get feedback from the target audience to see if our assumptions are true and our design matches what we're looking for. We're not going to be 100% right but as we develop it we're still asking the same questions again. Is our assumption true? Is this a right balance between media and content? We keep asking these questions until we ship it to the clients (Kevin).”

In Kevin's case, they spend one quarter of the whole development process in analysis and design. Actually, the reason why he did not separate analysis and design into two seemed that two phases take place at the same time and they are very closely interwoven. Also, he stressed that they continue to show interim outputs to the clients and the target learners in order to assure they are on the right track in design and they are meeting the client's expectations. All feedback from the clients is used as a formative evaluation for revision.

Training designers who develop in-house training stated that almost all training programs are customized to address specific business needs, organizational traits and target learners' characteristics. They mostly build up training programs from the ground up. It is very rare to produce training by modifying or adapting existing training programs to specific needs or different target audience. The process does not significantly differ from what training designers in training development companies do. Differences lie in that in-house training program developers only contacted internal customers in their own organizations. Before entering the development phase, they tried to make sure that it makes sense to all related stakeholders.

However, most interviewees did not mention using a summative evaluation to see if the training is effective and lead the business outcomes. Brad admitted that evaluation is the weakest point in the whole training production process.

What are the major issues in the process of designing for customized training?

Getting help from stakeholders Most participants reported that they definitely need to involve interested parties such as management, target learners, decision makers and subject matter experts in the whole process of designing and developing customized training. They asserted that it is critical to get SMEs, management and target learners to help them identify true training needs and to understand the context, learners' characteristics is really critical to their practice.

However, stakeholders reported that they are so busy with their own work that they cannot spare the time to provide the necessary information to them and to establish a long-lasting relationship with HRD people. There is a shared sense among developers that if they acquire commitment and support from management and target learners, their work would be much more successful than it is now.

Design trade-off Training developers strive to find equilibrium between investment in customization and its outcomes. With the limited time and budget, they are asked to produce training to maximize profits.

“More customized? No, it's already customized... I think there should be limitations in our process where we make certain aspects of the courses that are very similar to each other. To do a completely different style of course for every client would be less efficient. There is always a design trade-off. (Michael).”

“Invested time and efforts for customizing training should turn out to be a result (Eugene).”

What training developers usually do is to portray “persona”, that is, collective characteristics of target learners from the learner analysis and to customize training programs to the persona's needs for the pursuit of efficiency. These days, however, there are a system and technology standards (e.g. Content Structure (CP 2002), Competency Definitions (RCD 2002) Learner Information Package (LIP 2002), and Sequencing (SS 2003)) to prescribe required training content and optimal learning strategies to a specific individual on demand with the aid of technology (Blackmon and Rehak, 2003).

Don't assume and be ready to listen Customization always requires comprehensive and thorough analysis of learners, contexts, organizations, and environmental factors that influence the effect of training. Therefore, most interviewees agreed that more thorough analysis can critically enhance the quality of customized training.

As Susan reported, having subject matter experts or trainers review and confirm the identified needs from their perspectives is very critical in customization. Verification from diverse perspectives on training needs should be done before stepping into the design phase.

“I learned that the most important [thing] in customizing training is to listen. People tend to assume what others need and want without listening (they may ask though). This is what has historically been happening in the Performance Improvement group...I learned that if I have not asked people what they need, if I have not understood what they do, if I have not met people in their work environments (e.g. buildings, offices, manufacturing areas)... I would not be able to customize their training because I would not know what their wants, needs and frustrations are (Stella).”

Most participants emphasized that making assumptions regarding training needs, learners, environments, and contexts, should be avoided. They knew very well that training designers tend to start working on training design with rough assumptions which are often not based on real data due to time constraints and heavy workload.

Furthermore, all organizations keep changing in all aspects, including organizational hierarchy, strategies for market, and job description. Therefore, training designers should be very sensitive to all of these minute changes within the organization. If not, they may overlook critical factors to consider.

Discussion

By using semi-structured interview protocol, the researcher improvised questions to clarify or to ask more about unexpected answers from the participants. Here, the things that deserve attention are discussed.

Design from scratch & low rate of reuse of existing training All the participants reported that they usually design from scratch and it is rare to reuse or adapt existing learning objects. Even though they said they are using learning management systems in their companies that are compliant to learning objects standard (e.g. SCORM), they do not design and develop learning objects at present.

Evaluation, the weakest point Both Michael and Brad reported that evaluation is the weakest part in the whole process of customizing training. They had a sense that true evaluations should take place on the job a certain amount of time after a training program is completed.

“I think a true evaluation would be six months to year down the road on how the person’s performance on the jobs changed to reflect on what they learned. So that would entail some follow-up survey or interviews. I don’t know they do that. From the whole point of training I would say down the road. Probably that happens very rarely now (Michael).”

When customization takes place? There are two phases where customization takes place. Design and development phase is one and implementation phase is another. The participants reported primarily about design and development of customized training. However, Stella and Eugene mentioned that customization can occur when individual learners plan individual training plans based on diagnosis or assignment from supervisors.

In the latter case, there is customization of training plans based on learner’s profiles including required job competencies, training history, educational back ground, and so on. In Eugene’s company, there is a learning management system (LMS) that has a competency diagnosis tool for assessing the gap between the current competency and the expected competency, as well as for prescribing learning solutions to fill out the gap based on the diagnosis. At this phase, training programs in training repositories can be combined dynamically to customize their learning plan relevant to their needs.

Conclusion

Through in-depth interviews and follow-up interviews, several noticeable facts were identified. First, corporate training designers customize training because 1) training should impact the bottom line, 2) target audience of training is very diverse, 3) each organization has own ways that cannot be addressed by external training solutions and 4) training will not work unless it is customized.

Based on collected data from the interviews and from document analysis, we identified four different themes to describe aspects of training that training designers customize. They are content, learning/instructional strategies, timing for training, and location.

In order to maximize customization of training, training developers consider business needs, and workgroup’s needs, organizational learning culture, collective learner characteristics, individual learner profile, content characteristics and context in which learners apply what they learn.

Most of the participants shared the sense that they are not fully satisfied with their current customized training and that there is much room for more successful customization. Even though they customize training by considering principal playing factors identified from needs analysis, learner analysis, and environment analysis, they all reported they are still lacking comprehensive and rigorous analysis owing to time and cost constraints

As the major elements of design process for customized training, they mentioned typical ADDIE steps. However, they emphasized a comprehensive and thorough target audience and stakeholder-involved process and front-end analysis.

Training designers seem to have common issues in developing customized training. They stressed that it is really hard but critical to get help from stakeholders and there is always design trade-off by means of seeking equilibrium between investment and return. Also, they stated that they should avoid assuming what variables are at play in training since assumptions are not the result of analysis.

Limitations

This study adopted case study research methods proposed by Yin (2003) for inquiring unexplored questions. Since the number of participants was small, the conclusions of this study may not be generalizable to all corporate contexts. In-depth interviews with more participants in more companies in diverse industries would make this study more rigorous by guaranteeing external validity. Also, the average length of experience as training designers is around 3 years. It would be desired to have subjects with more experiences.

The interview protocol was reviewed by one peer and two experts in order to have face validity. The sources of data were multiple (interview, follow-up interview, and document analysis). However, it would be better if data analysis were done by two more people beyond the author for ensuring reliability and validity. For future study, triangulation should be sought in terms of the source of data and data analysis.

¹ ASTD (American Society for Training and Development) defined training as follows: “Training focuses on identifying, assuring, and helping develop, through planned learning, the key competencies that enable individuals to perform their current job. Training’s primary emphasis is on individuals in their work roles (McLagan, 1989, p.3).”

² They defined customized learning as “presenting just the right material to the learner on demand.”

³ A conceptual framework is a set of interrelated concepts, principles and ideas that help organize and direct thinking about a concept under study. It is used to assist understanding of the concept, which is usually represented with graphics. The conceptual framework which can include all elements related to customized training and can depict relationships among those elements, is useful in designing customized training and development. The conceptual framework helps training designers to understand elements to be considered in designing and to see those elements from a systemic and systematic view.

⁴ Kevin’s company has quite comprehensive rubric for analyzing this aspect: 1) Size: Is the target audience is large or small? 2) Location: Is it decentralized or centralized? 3) Accessibility to Training: Is it poor or good? 4) Skill Level: Is it diverse or uniform? 5) Motivation: Is it high or low?

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| | | | | |
|--------------------------|---|--|---|--|
| What to Customize | What to Learn : Content | How to Learn : Instructional Strategies | When to Learn : Timing | Where to Learn : Place |
| | <ul style="list-style-type: none"> •Scope •Level of difficulty •Details •Sequence •Scenarios | <ul style="list-style-type: none"> •Learning Activities (simulation, Scenario-based, Goad-based, Action learning) •Locus of control (instructor-led, Facilitated, Self-paced) •Modality •Performance Support Supplement (Job-aid, EPSS, Mentors) •Mode of Delivery (Web, CD-ROM, Video/ Print) | <ul style="list-style-type: none"> •Flexible training Schedule for considering maximum Effectiveness •Just-In-Time training | <ul style="list-style-type: none"> •On-the-job •Off-the-job (Corporate Univ. External training center) |

| | |
|-------------------------|--|
| What to Consider | Individual Learner Profile (Role/ Competency/ Skill & Knowledge/ Motivation/ Learning Styles/ Career Path/ Location/ Accessibility/ Ed.Background) |
| | Collective Learner Characteristics |
| | Context in which learners apply what they learn |
| | Content Characteristics |
| | Organizational Learning Culture |
| | Business Objectives, Department Needs |

Figure 1. A conceptual framework of customized training

Discovering the Meaning of Community In An Online Master's Degree Program

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Abstract

The purpose of this case study was to analyze the characteristics of an online learning community from the perspectives of 18 adult learners all of whom completed an online master's degree program in instructional design and technology. This program was taught at a distance using the Blackboard.com e-learning system. Several program characteristics supported meaningful learning including institutional cooperation, students' prior experiences with technology, positive peer and instructor interactions, constructivist approaches to teaching and learning, cognitive changes generated through text-based, asynchronous critical discourse, accessibility and reliability of web-based technologies, and perspective transformations fostered by authentic assessments.

Introduction

This paper disseminates the preliminary results of an innovative case study conducted by an interdisciplinary team of six faculty members who teach in an online graduate program within a college of education. They investigated the question, "How was an effective online learning community (OLC) developed among the first cohort of students in the Master's of Science in Instructional Design and Technology program?" A WASC accredited program inaugurated in 2001 by a large state university in Southern California, the MSIDT program focuses on the direct applications of technology for teaching, learning, and curriculum development for professionals in K-12, business, industry, military, and corporate settings. The program was designed to provide students with a solid background in the field of instructional design with an emphasis on the design and creation of computer-based training and Internet technologies. The program involves faculty from elementary, secondary, special education, reading, and educational leadership departments all of whom have expertise and/or training in instructional technology, curriculum design, adult learning, assessment and evaluation. Students complete the 30-unit program, consisting of ten online courses completed over a 20 months, by taking two courses per 16-week term segment to fulfill their degree requirements. A face-to-face, two-day orientation session termed "Boot-up Camp" and a one-day "Mid-point Symposium" provided opportunities for community building. This presentation is geared to higher education faculty and administrators, distance educators, e-learning facilitators, web developers, instructional designers, students of instructional design and technology, and corporate trainers who may find the information applicable for improving their professional practices.

Purpose and Rationale

Online learning communities exhibit various features, characteristics, and purposes. It is difficult to categorize the attributes of online learning communities using standardized educational frameworks. The purpose of this study was to examine how an online learning community emerged from the first cohort of MSIDT students. While several contemporary studies have explored how community evolved within the context of a university course taken online for a semester, very little research currently exists regarding how an online learning community evolved within the curricular scope and sequence of an online degree-granting program. Furthermore, while several studies have investigated how an online learning community evolved from one researcher's perspective, few studies have integrated the multiple perspectives of six faculty members who teach in the program.

Methodology

Participants.

The participants were eighteen adult learners, 8 female and 10 male, all of whom were college graduates working in educational fields including K-12, postsecondary, corporate training. Most students lived in the state but a few resided outside; no students from foreign countries participated. Longitudinal research on the program is ongoing and the preliminary findings presented in this paper will be expanded to incorporate data collected and analyzed from two additional cohorts of approximately 18-25 students each.

Faculty.

Each faculty member, including the program coordinator, identified a research focus area—a “unit of analysis.” All focus areas reflected theoretical propositions about the characteristics of online learning communities in education found in the current professional literature. The following focus areas regarding online community development were researched: students’ attitudes and perceptions about learning online; institutional support, accessibility and reliability of web-based technologies; the impact of gender, race, ethnicity, disability and social class on critical discourse and the social construction of knowledge; constructivist approaches to teaching and learning, assessment/evaluation of learning and perspective transformation.

Setting.

The context of the research was a large, urban, comprehensive BA and Master’s Degree institution in a western state. The university had approximately 33,000 students and 1,800 faculty. Structurally, the MSIDT online community mirrored the university community. This online extension of the university was multidimensional and multilayered given the broad range of institutional support provided. The program was inclusive of adult learners, faculty, administrators, support staff, curriculum and instruction, and technology resources governed by university policies and practices. The MSIDT program was conceived of as a “pilot project” initiated by the president and vice-president of the university and represented the university’s first distance education program offering.

Design and Analysis.

The case study method proved to be an appropriate research design because it incorporated a comprehensive research strategy that linked all data collected to the initial question of the study. According to Yin (2003), a case study is an empirical inquiry that:

investigates a contemporary phenomenon within its real-life context, especially when the boundaries between the phenomenon and context are not clearly evident, and that relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and as another result benefits from the prior development of theoretical propositions to guide data collection and analysis (p.13-14.).

The following data sources were converged to analyze the data collected:

1. **Secondary Source Data.** Co-researchers consulted secondary source materials generated from the design, delivery, and evaluation phases integral to program development. Co-researchers reviewed documents previously prepared for national, regional, university, and college committees including advisory councils, workgroups, faculty presentations, the program website, Academic Senate approval, and WASC accreditation. At the programmatic level, co-researchers reviewed course proposals and syllabi and the online content of the ten courses comprising the program: Hardware and Authoring Environments (IDT505); Research Practices in Instructional Design and Technology (EDEL511); Instructional Design Issues for Technology-based Instruction (IDT520); Instructional Approaches to Learning and Cognition (IDT525); Planning, Designing, and Evaluating Technology-based Instruction (IDT530); Instructional Strategies Pre-K through Adulthood (IDT535); Web-based Teaching and Learning (IDT540); Emerging Technology and Issues in Instruction (IDT545); Practicum in Instructional Design and Technology (IDT550); and Master’s Project (IDT597). Co-researchers had access to most courses which contained approximately 15 asynchronous threaded discussion forums facilitated by the course instructor.
2. **Discussion Board Archives.** Data was collected and analyzed from the discussion board transcripts from four, fifteen week courses (IDT525, IDT535, IDT540, IDT545). This database served as the primary data source for the study. The data set included approximately 60 discussion forums with average postings of 125 postings per forum totaling 7,500 student postings. Each discussion forum

- contained all of the messages that shared a common overall topic, while multiple discussion threads within those topics reflected specific conversations consisting of multiple messages that addressed specific subtopics. The distinct advantage of using archived transcripts was to reduce participants' reactions to the presence of investigators.
3. Students' Written Records. During the mid-point symposium students responded in writing to the prompt, "Being an Online Student." Responses were collected and made available to the research group as a data source.
 4. Focus Group Data. A focus group for students was conducted by an outside evaluator in two, one-hour sessions split into two parts: a brief, ten-minute questionnaire followed by a forty-five minute discussion about students' perceptions about the strengths and weaknesses of the program. Both sessions were tape recorded with the consent of the participants. A faculty focus group was also conducted in a single, seventy-five minute session and was tape recorded with participants' consent. Results of both evaluations were provided to the students and to the faculty/co-researchers.
 5. Student Survey. A web-based interview protocol was developed and posted within a week of students' completion of the MSIDT degree. The survey was designed to elicit thoughtful, reflective, and in-depth explorations of students' perceptions about the impact of the program, especially their perceptions about learning within the context of an online learning community. The survey questions were grounded in the theoretical propositions regarding online learning communities. It consisted of fourteen, open-ended questions and one question consisting of 21 items configured in a Likert-like scale ranging from "strongly agree, agree, neither agree or disagree, strongly disagree, and no response." Fifteen out of the eighteen students submitted the confidential survey for a response rate of 83%.

Data Analysis.

Each researcher sorted through and chunked the data from the sources indicated above from the vantage point of their unit of analysis. Each researcher identified phenomenological themes relating to the unit of analysis they researched, substantiated with verbatim quotes that provided thick, rich descriptions of students' perceptions. Provisional findings from each thematic analysis were reported to the larger group. The pooled information was then reflected on by the whole group to identify patterns regarding the phenomenon of learning within an online community as it was experienced by MSIDT students. Trustworthiness was arrived at through data triangulation, empirical and consensual validation through member checks, group dialogue and discourse, and through critiques of multiple drafts of research reports disseminated to members by the lead author. (A multimedia presentation at the AECT 2004 conference and submission of this paper to the AECT Proceedings provides additional opportunities for public testing of the preliminary results).

Preliminary Findings

Several researchers share a common interest in communities enabled by the Internet and seek to redefine community in a virtual world. Online learning communities (OLC), e-Learning communities, virtual communities, and communities of practice are terms most often encountered in the literature. Online learning communities in higher education are communities existing in virtual environments consisting of formally and systematically organized teaching and learning activities in various academic domains in which the instructor and learners are geographically separated and use computer-mediated technology to communicate. According to Rovai (2001), "strong feelings of community increase the flow of information among all learners, the availability of support, commitment to group goals, cooperation among members, and satisfaction with group efforts" (Bruffee, 1993; Dede, 1996). The following themes discussed below emerged as constitutive of how learning was experienced within the MSIDT online learning community. When asked to review definitions of OLC's and respond to the survey question, "I feel I have been a member of an online learning community in the MSIDT program," 93% of the students responded that they strongly agreed or agreed with this statement with one student affirming in writing that "a true learning community formed." Comments culled from students' open-ended responses characterized the MSIDT online learning community as: "...a group of individuals sharing resources and learning together for a common purpose;" "...coming together in the context of a primary program structure and Blackboard where communication happens through a variety of means;" "...an amorphous being that grows and expands depending on a variety of factors including the personalities of the people involved;" "...participation from students who engage in a process of learning that requires traveling over and revisiting the same path many times;" "...a group of learners who gain knowledge in an online environment that allows for more personal, meaningful interaction;" However, while students almost

unanimously agreed that a community had formed, there was a caveat. One student observed: “I found it less meaningful than a place-based community.”

Prior Experience with Technology

Before being admitted into the program, each student submitted a resume, autobiography, and completed an interview. Experience with computers was required for admission including MS Office, navigating the Internet, using e-mail to send, receive, attach, and download messages. However, some students in the first cohort had additional or advanced skills in programs like Macromedia Director and Flash. These students were identified early on by their peers and served as informal mentors in courses where authoring skills were a requirement. Students’ characterized the community as being comprised of: “educational specialists and technology specialists...all contributing to a holistic understanding of the ID field;” “team leaders, technical experts, learning experts, production volunteers;” “members relied upon for certain technical skill;” “the online technical person, the devil’s advocate, the lost soul, and many people that were often supportive, helpful, or creative.” Data seems to reveal that students in the cohort recognized and valued each member’s contribution to the community, whether or not they were advanced technology users. Students’ comfort with their own technology skills (prior computer experience) may have made it easier not to feel intimidated by another’s advanced skills. This supports the notion that students’ prior experience with computers can boost positive perceptions of online learning, as noted by previous researchers (Huang, 2000). These prior computer experiences may contribute to students’ perceptions of a developing community of learners.

Peer Interaction

Researchers in previous studies found that students’ satisfaction with online learning environments is strongly related to the amount of active interaction with other learners, noting that small group activities can enhance learning motivation (Jung et al, 2002; Shin, 2003). Creating a safe learning environment through positive social relationships can support these interactions and contribute to community development. Data collected during this study support this. Students identified several strengths including social posting threads, group projects, group discussions, and face-to-face meetings at the orientation and at mid-point. Students’ comments included:

- “Each member of the cohort was an integral part of the learning community. We all came to the program with our own strengths and weaknesses and looked to the community to fill in the missing areas. Each member challenged me to become my best by asking questions and commenting on my discussion responses.”
- “The boot-up, midpoint and commencement experiences were necessary since the relationships needed to be established in order to gain a sense of trust with peers and instructors. I don’t feel I would have felt as much of a sense of drive completing the program had I not established relationships with my peers and instructors early on by meeting face-to-face. It would have been much easier to quit halfway through if it had all been online.”
- “Social relationships, especially online, are important for learning to occur, in that the exchange of experiences, ideas, and prior knowledge is more natural when all members feel socially connected to the community.”

Most students (74%) used social networking to decrease their sense of isolation. Overwhelmingly, students reported a sense of inclusiveness and support from their peers via their interactions through discussion boards, working in groups, peer evaluation, and e-mail. Comments included:

- “Interaction on the discussion board is what made inclusion happen.”
- “Most students made me feel included. We asked each other for ideas and we were always flattered to share our knowledge.”
- “Private e-mails that were either jokes or social, unrelated to a specific assignment contributed to the feeling of inclusion.”
- “I made sure to work with different members throughout the program so I did not feel excluded.”

While positive interactions and relationships contributed to students’ satisfaction toward online learning, only 26% stated that the most meaningful learning came about through their interactions with others. This supports research by Jung et al (2002) that found collaborative interaction may increase students’ sense of community, but it does not necessarily increase learning achievement. Conversely, negative interactions lead students to feel excluded and may decrease their desire to continue in the program. For example, one student noted feeling excluded by one classmate who snubbed a request for help. The student noted: “Needless to say, I did not e-

mail [that person] ever again.” Another student expressed that complaining, name calling, and finger pointing closed down learning and inhibited community participation.

Teacher/Student Interaction

Students’ positive interactions with their instructors influenced their perceptions of online learning and contributed to the development of a learning community. Researchers have contended that the instructor’s presence and social interaction influence students’ motivation, course engagement, and learning achievement (Jung et al, 2002; Shin, 2003). Data collected from the MSIDT cohort reflect this. Several students noted that the lack of instruction on an authoring tool during their first term made them feel excluded, overwhelmed, and intimidated. On the other hand, students noted that when professors “were extremely positive and encouraging” their motivation increased. Instructional factors that contributed to community development included responding to students’ contributions in weekly summaries of discussion topics, constant presence on the discussion boards, supportive phone calls, and a “good response time for e-mails and the thoughtfulness and caring they exhibited.”

Constructivist Approaches to Teaching and Learning

Effective online learning communities are founded on social constructivist pedagogy. As such, the interchange among students is vital to a constructivist learning environment where the conditions conducive to the development of community are created. In this program, systematically organized teaching and learning experiences engaged learners in knowledge construction through multiple interactions in online discussion groups. Student-to-student interactions were certainly as important as student-to-instructor interactions within this community, and perhaps more so. A learning curriculum was co-created by the learners and teachers in this program and became a pool of resources from which everyone could draw. This can be contrasted with a teaching curriculum, which often limits distance students by structuring the resources and controlling participants’ access to them. The difference between a learning curriculum and a teaching curriculum can be likened to the difference between a successful online community and a correspondence course. In a true online learning community, knowledge is co-created by members of the learning community, with each person contributing his or her additional resources to the “curriculum” of the course. This can be contrasted by a correspondence course, where students simply access the existing course curriculum, respond to it, and submit assignments individually. Certainly current research (Johnson, 2001; Rogers, 2000) suggests that students from online learning communities may come to learn more from the information added by the class members than what was originally presented by the instructor. Survey data reveals that 86% of the students confirmed they were engaged in constructivist learning experiences. A student in one course reflected: “The sum was much greater than the total of the parts in this class.” Another commented: “The resources we saw this week were awesome! I learned so much from the links provided this week. Thanks everyone for your contributions. I can definitely say that I benefited from all of your professional experiences in this topic—something I knew little about before we began this module.”

Meaningful learning in this program seemed to come about as the result of students’ interactions with each other, rather than through students’ individual learning efforts. Comments included:

- “I thought I’d feel alone, but instead, I feel a part of something different. I guess I feel connected to the people in this learning community. The people are what keep me going.”
- “When I first started this program I didn’t consider or know anything about an online community. It became apparent eventually, of course. And actually without it, I am not sure I could complete this program, as there have been times when I was feeling burned out and overwhelmed and wondered if I could sustain the effort with other things going on my life.”
- “I also feel that as a learner I have been intimately involved in the learning process, and I have a lot of learner control as well as input.”

The representative quotes highlighted above suggest that indeed, as Lave and Wenger (1991) suggest, learning is a relationship among people. In fact, according to the students in this program, the “social process, includes, indeed it subsumes, the learning of knowledgeable skills” (p. 29). The “social transactions” among all of the participants in this OLC allowed all members to see themselves as legitimate members of a community of practice—or an online learning community. This is a crucial consideration, especially in light of Conrad’s (2002) recent work, which suggests that the creation of an online learning community serves as the foundation for a successful learning environment. Other research (Brown, 2001) certainly emphasizes the important point that students can overcome feelings of being alone when they support one another in an OLC. Moreover, the

feeling of connection to the learning community is especially important because students who feel connected to learning communities often place a higher priority on the class and spend more time devoted to course content (Brown, 2001).

Accessibility and Reliability of Technology

One student observed, "I believe that even with the logistical issues we've had to deal with, I have learned a lot in this program. One thing that I have definitely learned is that the creation of a community of learning is very powerful. By reading others' posts I have had the opportunity to ask myself some very deep questions." 53% of the students surveyed responded that they agreed or strongly agreed that when there were technical difficulties with the reliability of the technology their sense of community was diminished; 43% said if they could not access the course their sense of community was impaired. However, 73% of the students agreed that Blackboard was easy to navigate and this reinforced their sense of community. In online learning communities technology accessibility and reliability is a critical factor for learning and community development. If access to the technology is interrupted or if the technology is unreliable or slow, students experience frustration which inhibits community participation.

In this study, there were a few technology issues having to do more with interrupted access to Blackboard and occasional slow transmission, but the technology itself was not a major factor impeding students' learning. Effective and frequent communication on the part of the instructor and to other students was more important than the technology. A mix of instructional strategies matched to the content and a variety of online tools, especially discussion forums, were equally important to students' success. Students with low-tech skills enjoyed learning the software programs such as FrontPage and Dreamweaver; high-tech students apparently enjoyed an open-ended approach to learning. Learning in a web-based environment was especially beneficial to MSIDT students because they were immersed in the very technologies they were studying. "I think our Masters program is more valid since we are becoming experts in instructional media by using it to get our degree," a student remarked. Instructors anticipated negative comments about the technology, but found that students were generally supportive, or at least neutral, about learning in a computer-mediated environment. The quality of the instruction and frequency of communication seemed to minimize technology issues. Overall, students affirmed that learning via technology contributed to their sense of community as these quotes reveal:

- "Technology can help or hurt education. It is just a tool as we have seen many times during our MSIDT program. If students are sitting at cubicles working on computers for hours on end this certainly increases isolation. Students who are creating a multimedia-learning object together as a group project would experience a decrease in isolation. Similarly technology could increase or decrease the level of abstraction in today's learning environment."
- "Communication in the online classroom is important in order to maintain a sense of community and reduce the feelings of isolation that students might feel. The online courses that I have taken took advantage of different modes of communication such as e-mail, discussion boards, group forums, and real time chatrooms. Providing different forums in which students and instructors could interact ensured timely feedback, privacy, and the opportunity to discuss issues related to the course."
- "I started this program believing that the various media (audio, video, hyperlinks, etc..) were the powerful tools to cause learning. Now I see that these media are simply the vehicles for delivering information that is packaged using principles of instructional design that match the learners."

Critical Discourse

The survey revealed that 80% of students agreed that engaging in the online discussions challenged them to think critically. Students perceived that open dialogue was an equalizing force and alleviated power, gender, race, class, disability and cultural diversity issues. "Online discussions are a gift from heaven for me...I feel free from cultural mores and more confident expressing my ideas. I feel safe to convey my thoughts in writing because I have time to re-write and edit my posts before I submit them," a student remarked. Participants shared their struggles with learning new information because they had established a comfortable rapport with their peers.

Institutional Cooperation

Five individuals were interviewed to ascertain their perceptions about community development as it pertained to application processing, bookstore ordering, being a program liaison, coordinating scheduling, creating a curriculum database in SIS+, using library information technology, consulting on web application

design and development, and serving as program librarian. 54% of the support providers surveyed strongly agreed or agreed that the MSIDT online learning community seemed to be an extension of the campus community online; 20% did not agree or disagree; and 20% disagreed. All institutional support providers strongly agreed that they contributed to the development of the online learning community. Likewise, all strongly agreed or agreed that they were comfortable sharing information, knowledge, suggestions and ideas with the program coordinator, MSIDT students, and faculty. They expressed commitment to the program by assisting students to attain their academic goals. 60% of the support staff strongly agreed that they were participating in a constructivist learning environment where they could be called upon to help students solve ill-structured problems; 40% believed they worked collaboratively with the students, faculty, and program coordinator to achieve the program's outcomes. Fully 80% of the support providers strongly agreed that they saw themselves as an important and respected part of the online learning community while 20% neither agreed or disagreed with this statement.

Perspective Transformation

Current applications of technology in institutions of higher education are not taking advantage of the potential of distance learning to inspire the construction of new models and outcomes for adult learning. Moreover, the capacity of web-based instruction to provide models of transformative learning has yet to be explored. The online classroom is "fertile territory for transformative learning" (Palloff & Pratt, p. 131). Mezirow (1991) defines perspective transformation as:

...the process of becoming critically aware of how and why our assumptions have come to constrain the way we perceive, understand, and feel about our world; changing these structures of habitual expectation to make possible a more inclusive, discriminating, and integrative perspective; and, finally, making choices or otherwise acting upon these new understandings (p.167).

Perspective transformation occurs along four lines of action: a change in the individual's existing frames of reference; the individual's ability to assimilate entirely new perspectives, a change in the individual's ability to be more critically reflective through problem solving activities, and the individual's ability to construct new meaning perspectives or habits of mind. In this study, 87% of the students experienced perspective transformations, as measured through reflective self-assessments, critical discourse in the discussion boards, tests, midterms, individual and group papers and projects. There is evidence that students were able to elaborate on their previously existing frames of reference as a consequence of community participation given these comments:

- "I took subjects I had learned in my credential program to a much deeper level of learning and understanding which enabled me to revisit some of the areas I hadn't given much thought to."
- "I'm slowly getting beyond the basics and really getting into more of a long-term understanding of the concepts."
- "This concept of learner-centered communities definitely opened my eyes because it supplied the words to the ideas that have been banging around in my head for a few years now."
- "The goals I had at the beginning of the program have remained the same, but I am more confident now. Colleagues are already looking to me for advice and I in no way would ever have expected that."

Some students assimilated entirely new frames of reference:

- "The constructivist perspective...was a new learning experience for me and a positive one at that. I had to admit that I kept thinking, 'What is it that the teacher expects of me.' Once I let go of that view and took the view of 'What do I expect of me,' then I felt less anxiety."
- "I recall one Saturday afternoon I sat in Starbucks and read through a number of chapters. I was so fascinated that every now and then I would catch myself talking out loud, saying something to the tune of 'curious, I did not know that!' I sort of shook my head and realized, I am learning. How could that be?"
- "Before this program, I had never built a lesson plan and I didn't know where to start. I built a lesson plan and learned a lot. Ironically, the same week I built my lesson plan, I was asked to do one at work and the experience in the program gave me the confidence to build a lesson plan properly. Without this experience, I honestly do not feel I would have been successful at work."

Some students changed their perspectives by becoming critically reflective of their assumptions through problem solving activities:

- “I was convinced that writing the collaborative research paper was going to be a bust both in terms of the end product and its educational value, but I was wrong. I really benefited from the interaction with my peers on a research task and found the challenges of asynchronous collaboration very instructive.”
- “At the beginning of this program, I felt like an Olympic high diver preparing to climb the ladder up to the diving board, mentally preparing myself over the first few months, gathering the knowledge to take the leap three stories down to a complete immersion in a new career. At the midpoint of the program, I felt the rush of adrenaline and significantly more confidence to leap off the ledge as I am now poised with new knowledge which will help me make a clean break into the water.”

Some students transformed their habits of mind, the filters they used to interpret the meaning of their experience:

- “I am becoming more and more aware that I am not aware of my awareness until I need to be aware of it.”
- “I’m excited about the transformation that is beginning to happen at my school because I can see an opportunity to influence the school as it transitions towards the adoption of a new philosophy. I thought I would receive resistance when I discussed it with the group, but since then that discussion the group has operated at a higher level of enthusiasm.”
- “The major learning that has taken place for me in this program has been the gradual chipping away of my ingrained instructivist nature. After many years of teaching using a single epistemology, the constructivist crack is beginning to open. It takes me a great amount of time to shift perspectives, so it will be interesting to see if my students need time to make a shift also, but I believe they will.”
- “The major thing I foresee beyond commencement is a grand unification of all of the theories, principles, and knowledge that I have gained in this program.”

Discussion

At this point in time, this case study provides provisional answers to the following question: “How was an effective online learning community (OLC) developed among the first cohort of students in the Master’s of Science in Instructional Design and Technology program?” Preliminary results indicate that various program characteristics were conducive to the development of an online learning community: institutional collaboration, members’ prior technological proficiency, positive peer and instructor interactions, adopting constructivist approaches to teaching and learning, cognitive growth through effectively facilitated critical discourse, accessibility and reliability of web-based technologies, and authentic assessments prompting perspective transformations. These findings are significant for online program providers in higher education because they underscore the importance of building online learning communities as foundations for transformative learning.

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The Conceptual Framework of Factors Affecting Shared Mental Model

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Abstract

Many researchers have paid attention to the potentiality and possibility of the shared mental model because it enables teammates to perform their job better by sharing team knowledge, skills, attitudes, dynamics and environments. Even though theoretical and experimental evidences provide a close relationship between the shared mental model and successful team performance, there has not been much consideration of the factors of the shared mental model that can show a causal relationship between it and team performance. Based on the reviews of existing studies, the purpose of this study is to specify what factors affect the shared mental model. For further research, it is necessary to conduct empirical studies that validate the causal relationship among the identified factors of shared mental models that affect team performance.

Introduction

Salas, Dickinson, Converse, and Tannenbaum (1992) define the term 'team' as "a distinguished set of two or more people: 1) who interact dynamically, interdependently, and adaptively toward a common and valued goal, object, or mission; 2) who have been assigned specific roles or functions to perform; and 3) who have a limited life span of membership." For example, a team in corporate settings consists of two or more persons who have similar knowledge, skills, and backgrounds. Team members have to achieve goals with similar missions and visions of the team to achieve better performance. Even though each team member has a specific role and responsibility, they should work together interdependently.

To become a high performance team, it has been argued that each team member should share various factors such as team knowledge, skills, work attitude, as well as team dynamics and the environment surrounding them. In other words, team members should have a shared mental model that represent information regarding the team members' knowledge, skills, attitudes, and behavioral tendencies to perform better across a lot of different domains (Griepentrog & Fleming, 2003). Terms such as team mental models, shared mental models, shared frames, teamwork schemas, transactional memory, and socio cognition have been interchangeably used by researchers to explain variance in team development, performance, strategic problem definition, strategic decision making, and organizational performance (Klimoski & Muhammed, 1994). In short, the shared mental model can be defined as a representation of shared knowledge regarding the team, the team's objectives, and information of team processes, communication, coordination, adaptation, roles, behavior patterns, and interactions (Klimoski & Mohammed, 1994).

A great deal of research has been done on shared mental models. For instance, Cannon-Bowers and his research colleagues (1993), Kraiger and Wenzel (1997), and Klimoski and Mohammed (1994) have all provided extensive reviews and research on shared mental models. In addition, they have attempted to analyze the relationship between shared mental models and team performance. Numerous studies have shown that a shared mental model improves team coordination and performance (Cannon-Bowers, Salas, and Converse, 1993; Klimoski & Mohamed, 1994). In addition, the shared mental model has potential value as an explanatory mechanism, which helps team members to understand team performance by explaining how effectively team members interact with one another.

Expert research has also shown that team members of high performance teams could often coordinate their behaviors without the need to communicate (Cannon-Bowers et al., 1993). In addition, when team members share knowledge, it enables them to interpret cues in similar manners, make compatible decisions, and take appropriate actions (Klimoski & Mohammed, 1994). A shared mental model also helps team members explain other members' actions, understand what is going on with the task, develop accurate expectations about future member actions and task states, and communicate meanings efficiently. Many studies have been done to

gain a better understanding of shared mental models and the causal relationship between shared mental models and team performance (e.g Cannon-Bowers, Salas, & Converse, 1993; Cannon-Bowers, & Salas, 1998; Cannon-Bowers, Janis & Salas, Eduardo, 2001).

However, there has been little research about what factors the shared mental model comprises. It is important to examine the factors of shared mental models because it is useful to investigate specific relationships between the shared mental model and team performance as well as understand the general characteristics of shared mental models. This study synthesizes the existing studies regarding the factors of shared mental models with alternative views.

Factors affecting shared mental models

Cannon-Bowers and Salas (1997) suggest that team members can use shared mental models to develop team members' "knowledge, skills, and attitudes required for effective teamwork" and the "understanding of facts, concepts, relations, and underlying foundation of information needed to perform tasks." That is, a shared mental model consists of: 1) requisite knowledge that is required for the team's effective task performance, 2) the skills and behaviors that are necessary to perform the task effectively and 3) the appropriate attitudes that promote effective team performance (Cannon-Bowers, Tannenbaum, Salas & Volpe, 1995). These are either specific or generic depending on task and the team.

In addition, a team's dynamics and their understanding of a complex situation at a certain time are also considered as factors of shared mental models (Cooke, Stout, & Salas, 1997; Stout, Cannon-Bower, & Salas, 1996). The dynamics of a team are mainly team interactions that happen among team members to create new ideas and facilitate communication. The environment surrounding the team affects the shared mental model as well as team performance. The outside environment changes the role, tasks, and final goal of the team members so that they have to adapt themselves to new environments by transforming the shared mental model that they used to have.

Based on literature reviews on the shared mental model, five components were identified and selected as main factors. The factors of shared mental models and specific descriptions are as follows.

Factor 1: Team knowledge

Team knowledge consists of two different types of knowledge: 'teammate knowledge' and 'task knowledge'. First, teammate knowledge is the extent of knowledge to which team members know other team members' preference, strengths, weaknesses and tendencies in order to maximize performance (Cannon-Bowers et al., 1993). This type of knowledge should help team members to compensate for one another, predict each other's actions, provide information before being asked, and allocate appropriate tasks or roles according to member expertise. That is, as members become more aware of one another, they can adjust their own behavior in accordance with what they expect from teammates. Knowledge of teammates is probably more useful across a variety of tasks rather than a single task.

Second, task knowledge is closely related in specific knowledge that is needed for conducting the task. In the case of procedural tasks, team members should share task models that are declarative and procedural knowledge for conducting the tasks. Whenever tasks are conducted in unpredictable ways, the value of teammate and task knowledge becomes more important. Cannon-Bowers et al (1993) argued that these two types of knowledge lead team members to better performance in specific tasks by sharing teammates' knowledge and skills as well as task knowledge.

Factor 2: Team skills

Skills refer to the abilities to do things associated with successful job performance, whereas knowledge indicates facts and information essential to performing a job or task. Numerous studies have addressed some types of skills that are needed to function effectively as a part of a team. For instance, Dickinson and McIntyre (1997) identified seven core skills of teamwork: 1) communication, 2) team orientation, 3) team leadership, 4) monitoring team performance, 5) feedback, 6) backup behavior and 7) coordination. These skills are important components for performing tasks successfully. Cannon-Bowers also presents a framework for team competencies in terms of team specific skills and team generic skills (Cannon-Bower et al., 1995).

Team specific skills depend on the particular team and include specific members' ways of dealing with conflicts and team cohesion. Team generic skills are transportable to other teams. These competencies include communication skills, interpersonal skills, and leadership skills. Each skill is not independent, but involves

interactive relationships.

Factor 3: Team Attitudes

Attitude is defined as “an internal state that influences an individual’s choices or decision to act in a certain way under particular circumstances” (Cannon-Bowers et al., 1995). This attitude in shared mental model research covers shared belief, shared value, teamwork, team concept, collective orientation, collective efficacy, and shared vision. First, shared belief refers to the category of what we believe in. Team members’ shared beliefs help teammates to have compatible perceptions about the task and environment and ultimately reach effective decisions. Sub factors include shared beliefs (Cannon and Edmondson, 2001) and cognitive consensus (Mohammad et al., 2000).

Second, shared values are what we are willing to work for (Carr, 1992). High performance teams have both a clear understanding of the goal to be achieved and a belief that the goal embodies a worthwhile or important result. Then, when everyone is clear on what they value, they can set goals consistent with these values and the team will believe that the goals are worthwhile and important.

Factor 4: Team dynamics

Smith-Jentsch and his colleagues (2001) examined team dynamics, which refer to the understanding of the components of teamwork that are critical for effective performance as well as the relationships between these components. In this study, team dynamics are viewed as the combination of dynamic processes of team coordination and team cohesion. First, team coordination consists of implicit and explicit coordination (Entin, & Serfaty, 1999; Stout, Cannon-Bowers, Salas, & Milanovich, 1999). In explicit coordination, team members communicate to articulate their plans, actions and responsibilities, whereas implicit coordination describes the ability of team members to act together without the need for overt communication. For successful implicit coordination, team members should have a shared understanding of the situation and an accurate understanding of each other’s tasks and responsibilities.

The advantages and disadvantages of implicit and explicit coordination depend on the nature of the task and the task environment (Fiore Salas, & Cannon-Bowers, 2001). The ability to coordinate implicitly can provide an advantage to team members during periods of intense task load by reducing the communication overhead needed for coordinated action. Implicit coordination is associated with effective performance if team members have an accurate understanding of each other’s needs, responsibilities, and expected actions; and communication may be necessary to build that understanding.

Second, team dynamics include team cohesion, defined as “a dynamic process which is reflected in the tendency for a team to stick together and remain united in the pursuit of its instrumental objectives and/or for the satisfaction of members’ affective needs” (Carron & Hausenblas, 1998). Team cohesion includes both the task and social aspects of cohesion. Widmeyer, Brawley, & Carron (1985) pointed out that a conceptual model of team cohesion should be distinguished between the individual/team and task/social cohesion. The four categories of team cohesion are: 1) team integration relating to the bonding of the team as a social unit, 2) team integration relating to the task, 3) individual attractions to the team relating to personal involvement and social interaction with the team and, 4) individual attractions to the team relating to the team task.

Factor 5: Team Environment

For the most part, the team environment - which is external conditions affecting the formation of the shared mental model - includes technology, organization, synchrony and geographic dispersion. First, technology is a mechanism that affects how teams interact (McGrath & Hollingshead, 1994). One example of technology is information technology. Information technology is a means for people to communicate with each other and transfer information through networked computing systems. There are numerous studies showing that information technologies affect dependencies, information flow, and workflow among collaborators in team performance (Grinter et al., 1999; Sproull & Kiesler, 1991).

Second, organizational factors such as culture, structure, and standard procedures also affect team performance. Various studies have addressed that organizations are social systems that affect (and are affected by) how technologies are used (DeSanctis & Poole, 1994; Orlikowski, 1992), all of which can affect the types of dependencies present in a task.

Third, synchrony and geographic dispersion also affect successful team performance. Team performance is affected by time flow in which team performance occurs synchronously or asynchronously. In addition, the place where team performance happens is different by being either co-located (i.e., same place) or

geographically dispersed (i.e., different places). Thus, four-folded modes of team performance occur when synchrony and team location are considered (Bullen & Bennett, 1993). Consequently, synchrony and geographic dispersion need to be considered when studying shared mental models because they can generate different work arrangements with different resulting sets and types of dependencies.

Conclusion: Toward general factors of shared mental models

Shared mental models include knowledge relevant to team work such as knowledge of team member roles, responsibilities, knowledge of teammates' knowledge, skills, abilities, beliefs, preferences, and style as well as knowledge relevant to task work, such as cue-strategy associations, understanding of task procedures, and knowledge of typical task strategies (Cannon-Bowers, et al., 1995). From the review of shared mental models, we identified five main factors affecting successful team performance, which are team knowledge, skills, attitudes, team dynamics, and team environments.

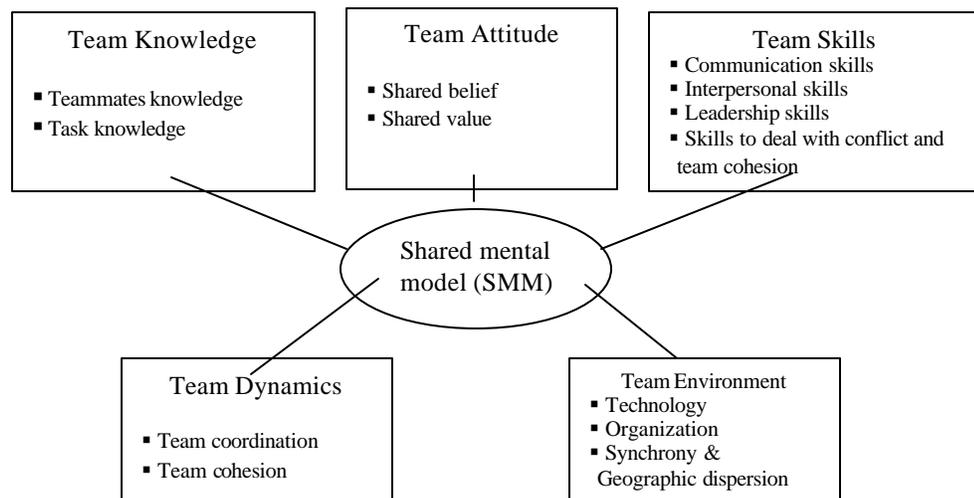


Figure 1. Theoretical Framework of Shared mental model

Discussion and Implication

The existing studies support the general hypothesis that shared mental models can be useful as a measure of team performance. Although shared mental models are strongly predictive of team performance, they have not been clearly defined in terms of the sub factors. The purpose of this study was to identify the factors which affect shared mental models. This study is hypothetical, it is therefore necessary to conduct an empirical study that validates the causal relationship among identified factors and team shared mental models. Also, we need to figure out how these factors impact team performance and how we can best support team performance based on our findings.

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From Theory To Practice – Utilizing Human Performance Technology To Assess Computer Security In An Educational Setting

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Abstract

The American Society for Training and Development (ASTD) defines human performance technology (HPT) as “a systematic approach to analyzing, improving, and managing performance in the workplace through the use of appropriate and varied interventions.” The first step in this approach is the performance analysis (Gilbert, 1978). In this step, the performance technologist/consultant works collaboratively with the client to examine the current situation. Performance gaps or deficiencies are identified and are prioritized according to the needs of the client (ISPI, 2004). This case study describes a project in a graduate level HPT class at a Midwestern university. A team of graduate students was formed to address computer security issues for the client organization. The project team implemented a performance analysis process (Define, Analyze, and Select) as described by Schaffer and Douglas (2004). This process incorporated tools and frameworks such as the Performance Relationship Map (Robinson and Robinson, 1995) and the Performance Pyramid (Wedman and Graham, 1998, 2004). The significance of the project is that it provided a real world context in which the project team and the client could learn about HPT processes. The experiences were enriched by the request from the client to continue the HPT process after the analysis project.

Introduction

“Think performance, not training!” (Robinson & Robinson, 1995, p. 6). Human Performance Technology (HPT) is a field of professional practice which is project-based and focused on workplace effectiveness (ISPI, 2004; Stolovitch & Keeps, 1999). The application of procedures is derived from scientific research and professional experience and is applied to the solution of practical problems. The American Society for Training and Development (ASTD) defines performance technology as “a systematic approach to analyzing, improving, and managing performance in the workplace through the use of appropriate and varied interventions.”

Many names have been given to this field, including human performance technology (Stolovitch & Keeps, 1999), human performance improvement (HPI) (Rothwell, Hohne and King, 2000), human performance enhancement (Rothwell, 1996) performance consulting (Robinson & Robinson, 1995), performance engineering (Dean 1994; Gilbert, 1978), performance technology (Harless, 1992), and so forth. In addition to the various names, many different performance improvement process models exist.

The first step in the HPT approach is the performance analysis, in which the performance technologist works collaboratively with the client to examine the current situation at one or more of the following levels: societal, organizational, process, work group, or individual. Performance gaps or deficiencies are identified and are prioritized according to the needs of the client (ISPI, 2004).

Schaffer and Douglas (2004) developed a framework for object-oriented performance analysis for the Automated Object-Oriented Performance Analysis Project (AOOPA). This framework recommends that organizations not bypass the problem-solving process by neglecting the definition and analysis of a problem/opportunity or by skipping directly to the selection of a single solution. According to this framework, the most basic elements in performance analysis are three iterative phases: define, analyze, and select.

The major tasks for each phase are as follows:

- Define: Define the opportunity or problem
 - Start with clear statement of the opportunity or problem

- o Identify gaps between what is and what should be at the organizational level
- o Communicate with stakeholders using visual models
- o Provide a rationale for decisions
- Analyze: Analyze gaps between what should be and what is at performer level
 - o Develop a performance model as foundation for development of data collection instruments to identify current performance and work environment barriers
 - o Review data with clients and collaborate to identify gaps
 - o Provide a rationale for decisions
- Select: Select solutions and recommend actions
 - o Map possible causes for gaps to possible solutions
 - o Collaborate with clients to prioritize
 - o Blend solutions most appropriate to organizational context
 - o Report recommendations
 - o Provide a rationale for decisions

This paper presents the experiences of a team of graduate students in Educational Technology at a university in the Midwest while conducting a performance analysis in a HPT course project. The team utilized the consolidated performance analysis with three major phases – define, analyze, and select; and integrated other organizational frameworks and models, including Robinson & Robinson’s (1995) Performance Relationship Map and Wedman and Graham’s (2004) Performance Pyramid, into the process to complete the performance analysis of computer users who lived in residence halls. The process and results of the performance analysis, as well as challenges, limitations and lessons that the performance analysis team learned are discussed in this paper. The team’s completion of the project provided them with the experience necessary to answer the following questions, which they discovered are crucial to the performance analysis process:

- What can be done to help the client understand the performance analysis process? What actions can be taken to ensure that the client is involved in performance analysis?
- When analyzing the causes of the performance gaps, what can be done to encourage clients to investigate causes other than the lack of skills and knowledge (or solutions other than training)?
- What is the next step after the performance analysis?

The Case

Overview

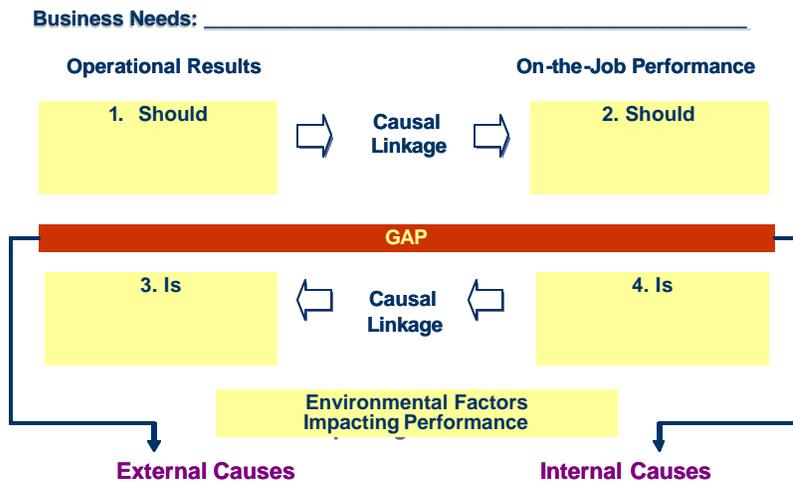
The study was a class project in a graduate level HPT class. A project team of four graduate students with two doctoral and two master’s students was formed. All members of the team were novices in the HPT field. The major concepts, including the definitions to the field, systems theory, HPT frameworks and models, and performance analysis were introduced before the beginning of the project. The client organization was one of the groups in the security and policy department, known as Security Outreach and Training, under the computer services at a midwestern university. The client was responsible for proactively and reactively combating the information security problems of the university population.

The performance analysis process began in October 2003 with an introductory meeting with the manager of the client organization. The project team completed the performance analysis in December 2003.

Define Phase

An initial client meeting with the client team was called for project alignment. The project team immediately began working through the Performance Relationship Map (Figure 1) with the client using an interview guide that addressed key performance analysis factors. The business problem was identified as “Insecure residence hall computer network computers are generating an unnecessary workload for the security and policy department.” The business need was defined as “The university community will have a secure computing infrastructure. The target performers were identified as the computer network users who lived in the residence halls. The Operational Results and the On-The-Job Performance Should’s on the Performance Relationship Map were documented after the desired organizational goals and desired individual performance goals were discussed.

Figure 1. The Performance Relationship Map adapted from Robinson & Robinson (1995)



In addition, a system model (a visual representation of the organizational process with inputs and outputs) was sketched together with the client in order to identify all the key stakeholders and their relationships surrounding the business problem. Resources and available support from the client were also discussed and arranged, such as the available data for the current operational results. Finally, the data collection process was brainstormed with the client.

After the meeting, a Statement of Work, which summarized the business problem and need, key stakeholders, resources for the performance analysis, target performers, and initial performance gaps based on available data and discussions in the initial meeting, was prepared and emailed to the client for confirmation.

Analyze Phase

Data Collection The analyze phase started with the analysis of available data provided by the client. The client had previously collected data about the number of machines compromised in particular outbreaks and vulnerabilities, the percentage of email messages received by the target performers that were classified as spam, and the number of machines in the mail server infected by a recent virus. The project team used this data to begin completing the Operational Results –Is box on the Performance Relationship Map.

Next, due to the population size of 10,500 performers, requirements for quantitative data, and the need for confidentiality of respondents, the project team selected a questionnaire as the instrument for additional data collection. In addition, a performance model (Robinson & Robinson, 1995), which detailed the competencies and computer security best practices for the performers, was drafted. As mentioned by Schaffer (2000), Dean and Ripley (1997) indicated that the ability to integrate and synthesize useful frameworks, processes and data that link the major systems and subsystems within and outside the boundaries of an organization is a critical skill set of performance improvement specialist. The development of the questionnaire is an example of this, as it required the integration of different process models and organizational frameworks. It was designed and revised based on the discussions during the initial client meeting, the initial performance relationship map, existing documents developed by the client, the performance model, as well as the comments and suggestions from the client and the project advisor.

In an effort to simplify the data analysis process, the project team developed the questionnaire so that it provided insight into both the existence and also the causes of existing performance gaps. To achieve this, the questions were crafted so that they assessed the performers' use of the best practices and also emphasized several of the building blocks, such as knowledge and skills, tools and equipment, etc. in the Performance Pyramid (Figure 2). The questions that addressed the Performance Pyramid blocks provided the basis for determining the environmental barriers and the internal causes on the Performance Relationship Map.

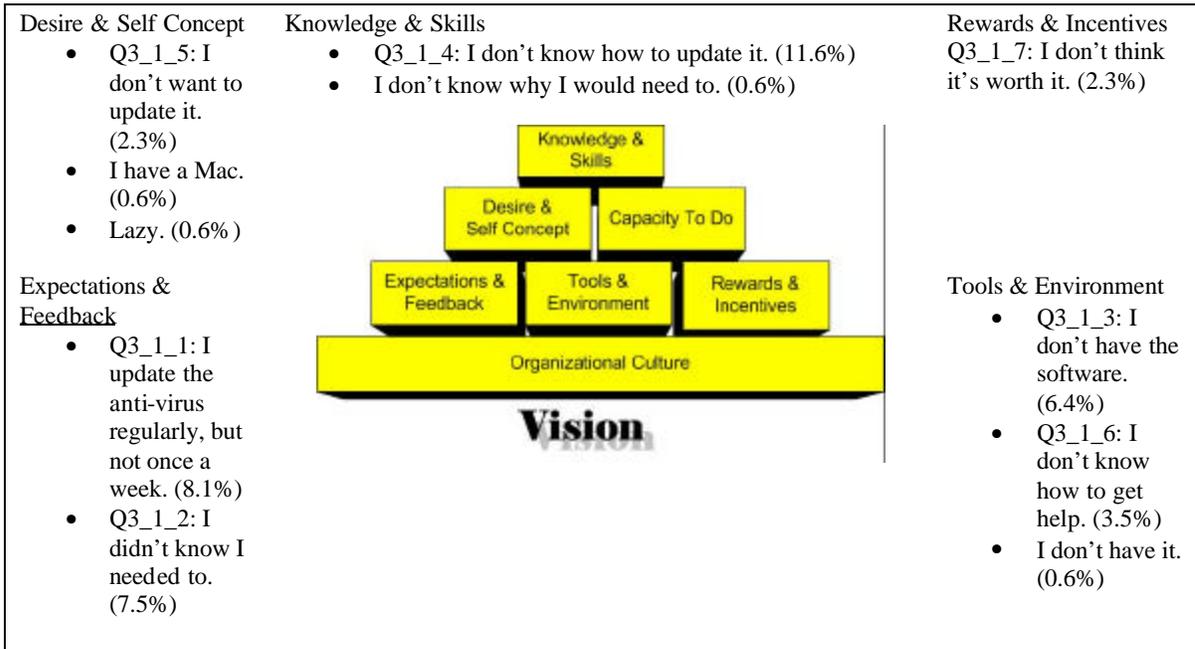
Figure 2. The Performance Pyramid (Wedman & Graham, 2004)



After development, the project team sent the questionnaire to the client for review. The client's feedback was incorporated. The questionnaire was then finalized and developed into a web-based questionnaire. Because the target performers were computer network users who lived in the residence hall, and because the majority of the network users living in the residence halls were undergraduate students, the subjects were chosen to be the undergraduate students from a 100-level computer technology class, a 200-level education class, and a 100-level engineering class. The survey was conducted for one week and 173 complete responses were collected.

Data Reporting The data collected were processed to identify current individual performance. A summary of data, pie charts and bar charts were prepared for the data review meeting as visual representations that were used to compare quantities, amounts, and proportions. A Pareto Chart, which is a specialized type of bar chart that organizes the data from highest to lowest (or lowest to highest), was also used. This chart helps to determine the causes with the most impact; and "is a highly useful way to establish priorities on problems or causes by surfacing and displaying those which are most problematic" (Rothwell, Hohne and King, 2000, p. 79). Instead of diagramming the responses for causes in Pareto Charts, the gaps were diagrammed in order to help identify the unacceptable gaps. The causes were then arranged according to the building blocks of the Performance Pyramid for the ease of distinguishing the type of cause, such as knowledge & skills, rewards & incentives, etc. (Figure 3).

Figure 3. Responses to Question 3: “Please tell us why you don’t update antivirus software at least once per week” grouped by Performance Pyramid block



Data Review Meeting During the data review meeting, the preliminary data report with a summary of data, descriptive statistics, i.e. frequencies, drafts for the performance model, Pareto charts, the performance relationship map, and results related to causes organized according to the Performance Pyramid was presented to the clients. The data from the questionnaire, as well as the data that was previously collected by the client, were used to complete the On-the-Job performance IS data on the Performance Relationship Map (Figure 4).

Through discussion, the client and the project team reached a group consensus on unacceptable gaps and environmental barriers. The project team and the client brainstormed some potential causes for the gaps in addition to those supported by the data. Frequently, the project team had to redirect the client so that causes other than a lack of knowledge or skills were considered. The project team did this by referencing the Performance Pyramid and asking the client about potential causes from specific blocks other than knowledge and skills.

In addition, the project team also had to redirect the client to focus on the causes instead of the solutions during the meeting, as the client representatives desired to jump straight to the solutions once they saw the data that displayed the performance gaps.

After the meeting, the project team prepared a cause prioritization worksheet, which listed the potential causes for the performance gaps, and provided to spaces for the two representatives of the client organization to rank those which they felt were important to address. Originally, this worksheet was to be discussed during the data review meeting. However, time did not allow for this discussion. Instead the worksheet was emailed to the client. Besides requesting that the client provide a rationale for the prioritization of the causes, the team also asked the client to list the potential solutions if applicable. Unfortunately, the representatives of the client organization did not provide much of a rationale or possible solutions. The time constraint that forced the project team to conduct this part of the performance analysis by email negatively affected the response of the client.

Figure 4. Completed Performance Relationship Map

| Organizational | Individual (ResNet Users in Residence Halls) |
|---|---|
| <p>Desired Results (Should)</p> <ul style="list-style-type: none"> ◆ 5% or less of all machines in ResNet compromised in any outbreak of vulnerability. ◆ The mailhub virus statistic goes down to zero. ◆ 20% of all emails are spam. | <p>Desired Results (Should)</p> <ul style="list-style-type: none"> ◆ 100% of users have strong passwords. ◆ 100% of users change security settings to the highest level that works for the website that they want to browse. ◆ 100% of users disable or set cookies to be discarded when a website is closed. ◆ 100% of users choose not to download unknown files or programs when browsing the Internet. ◆ 100% usage of firewall. ◆ 100% of users update anti-virus software at least one per week. ◆ 100% of users apply software and/or system updates and/or patches regularly. ◆ 100% usage of anti-virus software. ◆ 100% of users do not give out email addresses or personal information to suspicious websites. |
| GAP | |
| Organizational | Individual (ResNet Users in Residence Halls) |
| <p>Current Results (Is)</p> <ul style="list-style-type: none"> ◆ Approximately 10-20% of all machines (or 1000-1500 machines of 10, 500 registered hosts) on ResNet compromised in the outbreak of RPC DCOM worms. ◆ Approximately 1000 hosts were infected at peak infection. ◆ Approximately 40% of all emails are spam (i.e. 400,000 of 1 million of messages received per day in the Purdue mailhub). | <p>Current Results (Is) (Based on data collected from the survey)</p> <ul style="list-style-type: none"> ◆ 8.1% of users change password regularly (Q6_6). ◆ 36.4% of users change security settings to the highest level that works for the website that they want to browse (Q7). ◆ Strong password: <ul style="list-style-type: none"> ➢ 41% of users disable guest login (Q6_10). ➢ 42.2% of users use different passwords for different accounts (Q6_7). ➢ 45.7% of users don't set computer to remember passwords (Q6_8). ➢ 52% of users use keys next to each other on the keyboard (Q6_4). ➢ 57.8% of users don't set computer to automatic login (Q6_9). ➢ 65.9% users do not use personal information like SSN, birthday, names and etc. (Q6_3). ➢ 68.2% of users use 8 or more characters (Q6_1). ➢ 76.9% of users don't share password with anyone (Q6_5). ➢ 83.2% of users use letters, numbers and other characters (Q6_2). ◆ 42.2% of users disable or set cookies to be discarded when a website is closed (Q8). ◆ 50.9% of usage of firewall (Q4). ◆ 70.5% of users update anti-virus software at least one per week (Q3). ◆ 85% of users apply software and/or system updates and/or patches regularly (Q5). ◆ 86.1% of users choose not to download unknown files or programs when browsing the Internet (Q9). ◆ 93.1% of usage of anti-virus software (Q2). ◆ 94.8% of users do not give out email addresses or personal information to suspicious websites (Q10). |

Select Phase

Select Solution After receiving the Cause Prioritization Worksheet from the client, the project group discussed solution types that would be the most appropriate and developed solutions accordingly. Solutions were brainstormed with a job aid for matching causes with possible solutions based on cause type. For example, when dealing with lack of knowledge and skills, training, job aids, and feedback systems were listed as the appropriate solution categories. A list of proposed solutions to the client can be found in Figure 5.

Figure 5. List of proposed solutions

| List of Proposed Solutions | |
|--|---|
| Cause type: Expectations and Feedback, Desire and Self-Concept | <p>Solution type: Feedback Systems</p> <ul style="list-style-type: none">▪ Implement a software module to ensure the use of a strong password▪ Send a personalized email alert during major virus outbreak to remind performers to update their anti-virus software▪ Send a pamphlet emphasizing free security products available*▪ Send a personalized email reminder to change passwords once or twice during the semester▪ Email a monthly news release that describes how computers were compromised and the resulting problems due to weak or unchanged passwords or lack of or improper firewall use |
| Cause type: Knowledge and Skills | <p>Solution Type: Training</p> <ul style="list-style-type: none">▪ Deliver a tutorial when the performers sign for their ResNet accounts to teach about anti-virus software use and firewall use*▪ Present ITaP security resources and security best practices in dorm orientations* <p>Solution Type: Job Aids</p> <ul style="list-style-type: none">▪ Include a checklist with the characteristics of a strong password on the “Change Password” screen▪ Include a security best practices checklist in the Purdue Mortar Board (student daily planner)▪ Include a “how-to” job aid in the personalized email reminder to change passwords (mentioned above) |
| Cause type: Rewards and Incentives | <p>Solution Type: Reward and Recognition Systems</p> <ul style="list-style-type: none">▪ Give away free gifts (e.g. mouse pads, can-holders “koozies”) with security best practices checklists printed on them*▪ Allow students who proceed through the tutorial (mentioned above) to enter a drawing for free computer hardware or software* |
| *The performance analysis team suggested to the client that these solutions be included in the blended solution of holding “Security Awareness Weeks” at the beginning and/or end of each semester | |

The potential solutions were then rated by three of the four team members based on the following four solution selection criteria: opportunity (an organization-level support and commitment), capability (the collective knowledge and skills of an individual, department or organization), collaboration (the level of user involvement in adoption, adaptation, and implementation processes), and motivation (the perception or attitude potential adopters and stakeholders have of the attributes of the solution). Categories were rated using a 5-point scale (1 for Disagree and 5 for Agree). In addition, the estimated cost for each potential solution was also estimated using a 5-point scale (1 for the most cost-effective). The averages for the ratings from the three

project members were calculated. The rationales for ratings were compiled to indicate the strength and weakness of each solution.

The culmination of completing a performance analysis is the recommendation of solutions. A variety of solution recommendations and alternatives were provided due to an assortment of causes for each organizational gap. As noted in Figure 5, the team developed blended solutions. Blended solutions are often more effective because they can be re-purposed to develop collateral materials that will assist the performer when transferring or apply solutions in the workplace, and short-term as well as long-term solutions can be developed (Schaffer & Douglas, 2002).

Final presentation

During the final presentation, the project team reviewed the whole process of the project as a re-alignment strategy. The gap and cause analysis report was presented with the recommendations that related systematically with the potential solutions. Next, the potential solutions were presented with a description of how the solutions were selected, rated, and blended in order to meet the business needs. Furthermore, a list of actions, including communications, training, and work environment, were provided to the client as the answers of “What next?” or “What does it all mean?” Those actions were presented as the crucial steps and processes that should be considered by the client. Open discussion followed for the client to select the potential solutions.

An additional constraint surfaced during this meeting as it became evident that the client organization did not want to exercise too much control over the target performers. The client representatives made it clear that they were not willing to take actions such as revoking the user’s computer access, even if the performer was not acting according to information security best practices.

The outputs of this performance analysis included the identified performance needs, environmental barriers, causes and needs for improvement. These outputs provided the client representatives with a glimpse into attitudes and actions of their target performers. In addition the causes that were identified could later be used to facilitate the evaluation of solution effectiveness, since reaction, learning and skill transfer evaluation, as well as cost-benefit evaluations could be related to these causes.

Overall, the client representatives were pleased with the solutions presented, as evidenced by their asking of the project team for assistance in designing, developing, and implementing some of the proposed solutions.

Discussion

Challenges and Constraints

The project had several challenges and constraints. The target performer population was too broad and had diverse characteristics. The population size was about 10,500 with a variation of backgrounds in terms of descriptors such as major areas of study and class level. Additionally, due to the time constraint, the project team had to shorten the data collection to one week with a focused group of subjects that may not have been a representative sample of the population. Therefore, the project team considered the questionnaire as a pilot study that could be continued and improved upon in the future. Nevertheless, the data collected allowed the client and the team to interpret the data with effective tools, and to identify individuals’ current performance as a baseline. At the same time, the client was able to learn more about the data-driven systematic process.

As Robinson and Robinson (1995) mentioned, Block (1981) has identified three consulting styles that are used with frequency: “the pair-of-hands, expert, and collaborative styles” (p. 18-22). Only the collaborative style will yield results for a performance consultant. The team experienced “the pair-of-hands” throughout the process as they continually attempted to keep the client informed about, and involved in, the performance analysis process. In addition, on some occasions, some of the processes were modified to meet the client’s needs. For example, the project team could not prioritize the major causes of gaps during the data review meeting. The cause prioritization was conducted by emailing the client a form to fill out. Though the client completed the form, the rationale provided was below the project team’s expectations. Similarly, due to the time constraint, the project team had to alter the original plan for the select phase which should have included two meetings with the client in order to brainstorm, present and rate the potential solutions with the input of the client. Instead, the project team, independent of the client, rated the solutions, and then presented them to the client during the final meeting. The feedback of the client was later retrieved via email from the course instructor.

Lessons Learned

Collaboration is the Key to Success The most important lesson that the team learned while conducting the performance analysis is that getting the client involved in all phases of the analysis process greatly improves the process. This can be done by keeping the client informed of the project status via e-mail, status memos, minutes, and agendas. Again, as mentioned by Robinson and Robinson (1995), Block (1981) indicated that it will bring $1 + 1 = 3$ (synergy) when the client and the consultant work collaboratively. In addition, keeping the client representatives involved and sharing HPT visual models and frameworks with them helped to increase their understanding of the performance analysis process. This performance analysis experience was positive for all involved because of the involvement of various stakeholders throughout the entire process. Some of the feedback from the client is as follows:

“I would give both groups all 5's across the board for Organization, Professionalism, Quality, Results, and Outcomes. The only thing I wish we could have had more time and thought put into was the survey process. But given the constraints, I think this was well done also.”

“The computer security team presented us with some useful suggestions and I am planning on implementing (or at least trying to implement) some of their suggestions. I even spoke with our Communications AVP about the give-aways and she thought that was possible.”

In October 2004, the project team contacted the client for comments about the effectiveness of the proposed solutions. Some comments are as follows:

“We are in the process of getting the online class up and running. We are working with a vendor to obtain prizes as suggested by your group to entice students to participate in our course.”

“I think there is some improvement. We have had an increase in the number of downloads of our free Anti-virus software from our web site.”

Visual Models are Effective The performance analysis approach was introduced to the client during the process. The use of visual models, such as the Performance Relationship Map, Performance Pyramid, and system model proved to be effective in helping the client understand the processes. For example, the use of the Performance Pyramid aided the project team in helping the client to look to solutions beyond training to solutions that addressed gaps other than those caused by a lack of knowledge and skills. The client representatives enjoyed the use of visual models, as evidenced by the following feedback they provided when asked if the project provided any opportunity for them to learn about the HPT approach:

“Yes. I think the most interesting concepts were breaking down the lack of performance into the different categories, such as knowledge & skills verses desire, expectations and the other categories defining why someone is performing or not.”

“I think the visual models were effective in showing the different reasons for performance gaps. I found that breaking the questions into categories that specifically addressed each of the areas of the pyramid was very helpful in understanding reasons for the performance gaps.”

Conclusions

During completion of the project, the team gained specific knowledge about the performance analysis process. They learned that it is difficult, but possible to create solutions for an organization that has little control, or that chooses to exercise little control over the target performer. In addition, the team learned that it is often necessary to remind the client of the data to make sure that the process remains data-driven. Furthermore, the team became more aware of information security issues (the context of the project). Finally, the project team learned that visual models could be effective tools for educating clients about, and involving them in HPT processes.

In conclusion, the significance of the project is that it provided a real world context in which the project team and the client could learn about HPT processes. The novices on the project team learned how to apply HPT processes and work effectively with a client, and the client representatives learned how to assess and address performance gaps with varied solutions. In addition, the experiences were enriched and the consultant-

client relationship continued by the request from the client to continue the HPT process after the analysis project through the design, development, implementation, and evaluation of the solutions.

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Using Peer Feedback to Enhance Student Meaningful Learning

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Abstract

This study was designed primarily to investigate the impact of anonymous peer feedback on student meaningful learning in higher education. Forty-seven students from three undergraduate classes from a central US university participated in this study. Students were asked to build a web-based project. In the experimental group, technology-mediated peer review and feedback were provided for students to use in improving their projects prior to instructor assessment. The control group received no peer feedback. Students' projects were independently evaluated and analyzed. Results indicated that there was no significant difference on project quality between the control and experimental groups. However, post-assessment survey indicated that students had generally positive perceptions of this process.

Introduction

Promoting student autonomy and encouraging student meaningful learning has become an important focus in higher education in recent years. When students take a more active role, learning becomes more meaningful and their achievement is improved. Researchers (Orsmond & Merry, 1996; Orsmond, Merry, & Reiling, 2002) argued the need for academic staff to switch their roles from teaching to facilitating learning in order to achieve higher student engagement and responsibility and suggested that in assessment practices, some "power" should be "handed over" to students.

Students' behavior and attitude toward learning are shaped by the assessment system (Freeman, 1995). To achieve the outcome of meaningful learning, appropriate assessment methods should be applied. Unfortunately, the traditional instructor-led assessment method provides only limited opportunities for assessment and feedback. Peer assessment is believed to be one of the solutions, as it not only provides additional feedback but also stimulates student interaction and involves students in thinking critically about assessment criteria. Within this context, the assessment process can be viewed as "the learning exercise in which the assessment skills are practiced." (Sluijsmans, Brand-Gruwel, & van Merriënboer, 2002). Peer assessment, according to Topping and his colleagues (Topping, Smith, Swanson, & Elliot, 2000), is a process in which peers evaluate the achievement or performance of others of similar status. Cheng & Warren (Cheng & Warren, 1999) further defined this assessment form as reflection on "what learning had taken place and how." Peer assessment, as an alternative to traditional solo instructor assessment, has been applied in higher education courses such as writing, computer science, arts and engineering, etc (Liu, Lin, & Yuan, 2002). There are a number of studies illustrating how this process can be applied in both summative and formative evaluations. The majority of the literature on peer assessment in higher education has focused on the "assessment of individual contribution to group work" or the correlation between peer rating and instructor rating (Hanrahan & Isaacs, 2001, Sluijsmans et al., 2002). There are also some studies exploring the perceptions and feeling of students towards this process.

Peer assessment's benefits on higher thinking and cooperative learning have been established. Pope (2001) suggested peer assessment stimulates student motivation and encourages deeper learning. Freeman (1995) argued that studying the marking criteria and evaluating peers' work can improve students' critical assessment skills. Topping (1998), after reviewing 109 articles focusing on peer assessment, confirmed that peer assessment yields cognitive benefits for both assessor and assessee in multiple ways. Those "benefits might accrue before, during and after" the process. He further concluded that feedback yielded from this process has a positive impact on students' grades and subjective perceptions.

Most current peer assessment methods are conducted through paper-based systems. Two concerns associated with this system that hinder the widespread acceptance of this process are anonymity and the administrative workload.

Researchers noted their concerns towards the anonymity issue in peer assessment (Davies, 2002). One assumption of this process's credibility is that students usually provide fair and unbiased feedback to their peers. However, as reported by a number of studies, students find it difficult to rate their peers. They don't want

to be too harsh on their peers; they are uncomfortable critiquing others' work (Hanrahan & Isaacs, 2001; Topping et al., 2000). Conducted in an open environment, potential biases like friendship, gender or race could cause students to rate good performance down or poor performance up. Instructors need to design and maintain a distribution system to keep both reviewers' and reviewees' information confidential and anonymous, and at the same time, traceable for instructors to maintain the fluency of the process.

Taking more control of their learning process motivates students. Assessing peers' projects deepens their understanding of the topic being reviewed. Constructive feedback from peers helps to reevaluate and improve their own performance. These steps all contribute to more professional performance. At the same time, one of the advantages of peer assessment is the reduced assessment time for instructors. The instructor will spend less time diagnosing the underlying problems of student response, providing feedback, and reassessing students' revisions. This, of course, is good news for instructors who face the pressure brought by continuous growth in student enrollment and limited instructional time. However, another problem might be raised at the same time: the management of feedback documentation (Davies, 2002). Hanrahan and Isaac (2001) reported more than 40 person hours for documentation work in classes with 244 students. The load increases with larger classes. This is one of the major reasons some researchers found this process time consuming.

Technology-mediated peer assessment has been proposed as a solution to provide anonymity and minimize the workload. In this system, data can be automated and summarized, and students and instructors have instant access to data once they are generated. The whole process can be conducted in an anonymous way via the Internet. Reviewers and reviewees are not aware of each other. However, the integration of technology in peer assessment in higher education is still at an early stage of development. Limited data are reported even though various forms of computer-assisted peer assessment methods have been described (Topping, 1998). Our study addresses this issue by investigating an application of a peer assessment process that is delivered via an anonymous Web-based feedback management system. Our interest is in the impact of technology-based peer feedback on student meaningful learning and students' perceptions of this method in higher education.

In this study, peer assessment and feedback were utilized only for promoting learning, not as a substitute for instructor grading. Its three critical aspects include: 1) defining assessment criteria, in which students think about what is required; 2) evaluating the performances of peers; 3) providing constructive feedback for further project improvement. Compared with other methods in this area, this study is innovative because it utilizes a database-driven peer feedback website to ensure anonymity, simplify data management and stimulate student interaction.

Based on the outcome of previous studies, our hypothesis is:

1. Web-based peer feedback engages students in critical thinking and promotes meaningful learning, thus improving project quality.
2. Students gain positive perceptions about this process. They feel the process promotes deeper learning and helps them improve their project quality.

Facilitating Website

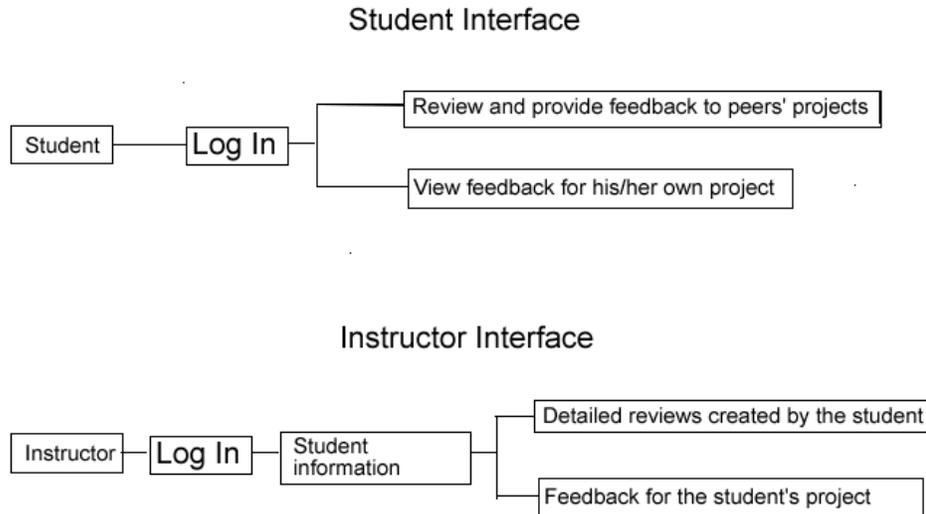
The emergence of information technology and rapid increase of online capacity have provided a new arena for education. Like other instructional platforms, innovative methods integrating technology have been proposed and tested in the assessment field. In the early 1990's, a novice collaborative learning network was studied at the University of Liverpool, England (Rada, Acquah, Baker, & Ramsey, 1993; Rushton, Ramsey, & Rada, 1993). One feature of this multi-user database-driven system was designed for facilitating peer assessment. This cost-effective tool constructed an environment where students could easily read, grade and provide suggestions to each other's work. Although this system presented incomparable superiority in stimulating students' interaction and reducing administrative load, as noted by the authors (Rushton et al., 1993), this process was not anonymous. Assessee's identities could be easily revealed.

Tsai and his colleagues (Tsai, Liu, Lin, & Yuan, 2001) employed a peer review network to foster students' critical thinking skills. Students completed their projects and uploaded them to the network. This network enabled students to review each other's performance and provide constructive feedback. Then students revised their own work according to the comments from peers. This procedure was repeated two or three times. Preliminary observation suggested that this system had positive influence on students' assignments. Tsai further asserted that peer assessment supported by a network was the most effective

Based on the previous research, our study was designed to ensure anonymity and facilitate the peer review process. A database-driven website was built that enabled students to register and log in with the username and password they specified. This system contained separate interfaces for instructors and students

(Figure 1). In the student interface, each student was randomly assigned two WebQuest projects created by two peers. Once students logged in, they could perform two roles—reviewer and reviewee. As reviewers, they reviewed the two assigned projects and provided their feedback confidentially according to the marking criteria for each project. The data were summarized for the author of each project; as reviewees, they had access to the feedback for their own projects. The instructor interface was designed to enable instructors to keep track of the peer review process. For each student, the instructor had access to the two reviews created by the student as well as the feedback this student's project received from two peers.

Figure 1



This system has the following major merits:

1. Anonymity was assured. This system ensured anonymity in two ways. First, students' identities were coded as numbers. No personal information, such as initials of their names, could be associated with their work. Secondly, students' projects were WebQuest web sites. Since they were typed and running on the Internet, no handwriting would reveal their identities or characteristics, such as gender. The potential risk of gender bias demonstrated by Falchikov and Magin's study (1997) was eliminated.
2. Management workload was reduced. All the data were aggregated and transmitted from users' computers to database. Management workload was minimal.
3. Students' interaction was stimulated. Submitted data were instantly summarized. Students and instructors had immediate access, which encouraged students' engagement and promoted their interaction.

Methods

Subjects

This study was conducted with forty-eight students from three undergraduate classes at a central US university. Although two teachers instructed these three classes, the same procedure was followed. Students were all from the same course entitled "Instructional Technology" at the College of Education and Human Sciences. Students were randomly assigned into an experimental group (27) and a control group (21). One student in the experimental group dropped the study for personal reasons. Since this course is a required technology application course for pre-service teachers at a college level, students have different academic backgrounds and range from freshman to senior.

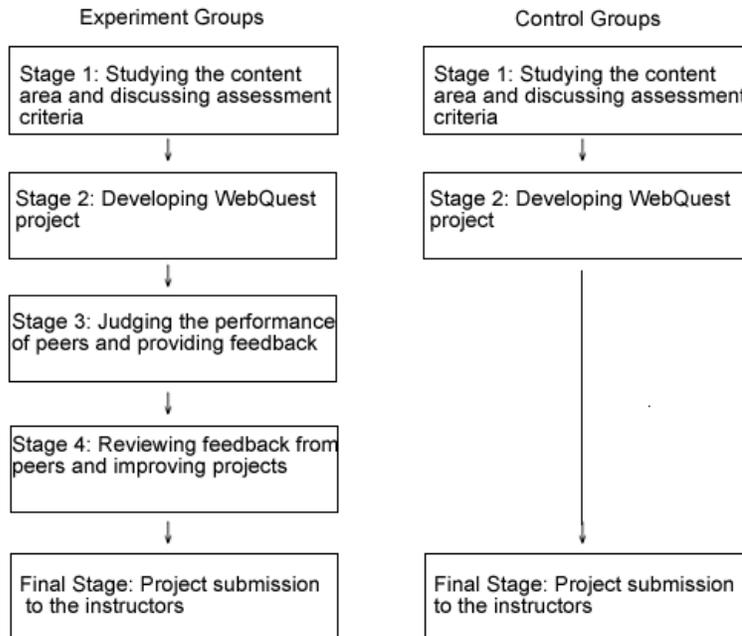
Procedure

In this study, students were asked to build a WebQuest project and upload it to the Internet. A WebQuest is "an inquiry-oriented activity in which most or all of the information used by learners is drawn from the Web" (Dodge & March, 1995). This model, developed by Bernie Dodge and Tom March in the early

1995, is designed to involve users in a learning process of analysis, synthesis and evaluation, which promotes their critical thinking and scaffolding skills.

In the control group, students were asked to individually develop WebQuest projects by themselves after studying the content area and the assessment criteria. In the experimental group, the following five stages were involved (Figure 2):

Figure 2



Stage 1: Studying the content area and discussing assessment criteria

After thoroughly studying the content area, students were presented a rubric and were asked to study it. Students were informed that this was the evaluation criteria that would be used by the instructor in assessing their projects and for their use in reviewing peers' projects. It depicted the basic elements required for a quality WebQuest; thus it was important and beneficial to the assignment. The assessment rubric was studied in two levels in a student-centered atmosphere. First students formed groups and discussed the rubric; then they were encouraged to share their understanding in class.

Stage 2: Developing WebQuest project

Students were requested to make a WebQuest project, build it a web site, and upload it to the Internet.

Stage 3: Judging the performances of peers and providing feedback

The website built to facilitate the peer review process was introduced to students. Once students logged onto the peer feedback website, they had access to two peers' WebQuest projects, which were randomly assigned to them. Students were asked to rate the projects and provide detailed comments according the rubric criteria.

Stage 4: Reviewing feedback from peers and improving their own projects

Feedback from peers was automatically summarized and made available to the creator of each project. After viewing the peer rating scores and comments, students had the opportunities to go back to improve their own projects.

Final Stage: Project submission to instructors

Students submitted their projects to instructors for grading.

Survey

After students in the experiment groups submitted their final projects, they were asked to complete a survey. Twenty-two students in the experimental groups responded to this survey. The survey replicated from previous study (Lin, Liu, & Yuan, 2002) consisted of 11 5-point Likert Scale items dealing with their general perceptions about the process, as well as two open-ended questions related to their likes and dislikes: "Please specify what you like most in this peer assessment procedure." "How would you change this peer assessment procedure? And why?"

Scoring Procedure

Two independent raters were trained and each of them graded all the projects using a rubric (Appendix 1) with slight modifications from an established rubric by Dodge (2001). Projects were assessed in six areas and received a score from 0 to 50 points. Both of the raters were former instructors of this course. They were knowledgeable in the content area and experienced in assessment. Furthermore, they were not associated with the course or students at the time of scoring, which minimized any potential existing biases. Students were instructed to remove any personal information in their projects. Projects from both experimental and control groups were coded and mixed together. Raters could not identify individual students or identify which group projects were from.

Inter-rater reliability was assessed for the two raters. The Pearson Correlation between the scores from two raters was .680.

Results

Two types of data were gathered in this study. The first type compared the difference of student learning represented by project quality between the experimental and control groups. The second type considered students general perceptions of this technology-mediated peer assessment procedure.

Difference of Projects Quality

Each project received two scores from two independent raters. The mean score was calculated and awarded to each project. ANOVA was utilized to test if there was any significant difference between the project scores of the control group and the experimental group.

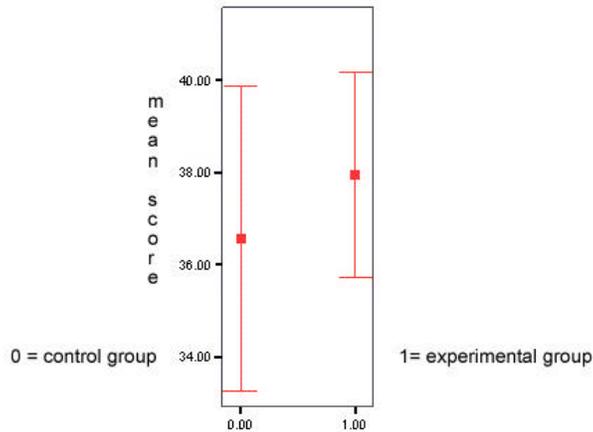
Table 1

| Group | Mean | SD | N |
|--------------|-------|------|----|
| Experimental | 37.95 | 5.54 | 26 |
| Control | 36.57 | 7.28 | 21 |

The difference between the two means (37.95 vs. 36.57) is not significant, $F(45) = .545$, $p = .464$.

Interactive graph (Figure 3) shows the confidence intervals of the group means present a large overlap. There is a trend that the mean score in the experimental group was slightly higher than that of the control group and scores in the experimental group were located in a more condensed cluster.

Figure 3



Students' Perceptions on Peer Assessment

Twenty-two students in the experimental group responded to the post-assessment survey. This survey consisted of two parts. The first part was an 11-item 5-point Likert Scale ranging from 1 (strongly disagree) to 5 (strongly agree). The second part consisted of two open-ended questions regarding students' likes and dislikes: "Please specify what you like most in this peer assessment procedure." "How would you change this peer assessment procedure? And why?"

Table 2

| Peer Assessment Survey | | | | |
|--|------|-----|---------|---------|
| | Mean | SD | Minimum | Maximum |
| 1. I am content with my own work. | 4.45 | .67 | 3 | 5 |
| 2. I learn more from peer assessment than from traditional teacher assessment. | 3.64 | .73 | 3 | 5 |
| 3. The procedures on how to do peer assessment are clearly outlined. | 4.55 | .51 | 4 | 5 |
| 4. Peer assessment is a worthwhile activity. | 4.18 | .59 | 3 | 5 |
| 5. Peers have adequate knowledge to evaluate my work. | 3.73 | .63 | 3 | 5 |
| 6. I benefited from peers' comments. | 4.32 | .65 | 3 | 5 |
| 7. The peers' comments on my work were fair. | 4.23 | .75 | 3 | 5 |
| 8. Peers can assess fairly. | 3.95 | .65 | 3 | 5 |
| 9. I have benefited from marking peers' work. | 3.91 | .92 | 2 | 5 |
| 10. I took a serious attitude towards marking peers' work. | 4.64 | .49 | 4 | 5 |
| 11. I felt that I was critical of others when marking peers' work. | 4.00 | .93 | 2 | 5 |

This table provides a picture of students' positive perceptions on peer assessment. Students reached a general satisfaction level for all of the items.

For the first open-ended question ("Please specify what you like most in this peer assessment procedure."), three major themes were depicted. First, the opportunity to review and grade peers' performance urged students on to greater efforts in the content area and the marking criteria. Secondly, feedback students received from peers helped them improve their projects. The third was the comfort brought by anonymous marking and instant feedback.

For the second open-ended question ("How would you change this peer assessment procedure? And why?"), three themes emerged. Several students stressed their satisfaction with this technology-mediated process. They stated that they wouldn't suggest any changes. Some students would have liked more than two peers rating their projects. They found it difficult to decide what to do if two peers gave them conflicting comments. Some students asked for more critical and constructive feedback.

Discussion

This study, investigating the influence of peer feedback in student meaningful learning and exploring student satisfaction level of this process, presented us an interesting picture. Data indicated that there was no significant difference of the project quality between the control and experimental groups. However, post-assessment survey revealed students' general recognition and acceptance of this process. These seemingly contradictory outcomes may be explained in part by the following.

First, independent ratings were used to compare the difference of students' project quality between two groups. To assure the reliability and consistency of scoring, inter-rater reliability was assessed. Two independent raters graded all projects according to the rubric. However, their grading didn't reach an agreement at a satisfactory level (the Pearson correlation equaled .680). Therefore, we cannot conclude that the scoring was reliable. There are many possibilities. It could be that our marking criteria was not categorized and described well enough for raters to evaluate students' projects and reach an agreement. Or it could be we need to provide more training to raters before they started grading. Or our measurement may not have discriminated levels of quality.

Secondly, Topping (1998) suggested that the benefits from peer assessment could accumulate anytime before, during or after the procedure. Peer assessment could have a positive impact on students' grades; it could also aid in the building of transferable skills and the foundation of lifelong learning. Like most peer assessment studies in literature, this study only focused on summative evaluation. Though statistically it revealed no significant difference of project quality between the control and experimental groups, the general agreement students reached in the post-assessment survey suggested students valued peer assessment as a worthwhile activity and they benefited marking peers' work. If formative evaluation was applied, there might be some indicators that student meaningful learning is enhanced by this process.

Finally, in the interactive graph (Figure 3), though the confidence levels have a large overlap and the difference between the two groups of scores is not significant, there is a trend that the mean score in the experiment groups was slightly higher than that of the control groups. If a bigger pool of students had participated in this study, the result might be the different. The variability of the scores in the experimental group was smaller than the control group. Further study may reveal that the procedure had a differential impact on the lower scoring students.

Based on these interpretations, we suggest that further study with a larger number of subjects and more instructors, and improved quality assessment measures is warranted.

The merits of this computer-mediated peer assessment process — anonymity and promptness — were recognized and addressed in students' survey responses. One student stated, "it helped out not knowing who the person was critiquing my project", another noted "it probably puts less pressure on the grader." Students liked "the instant feedback" from peers. At the same time, the instructors recognized a significant reduction of management workload. All the data were automatically summarized by the system. Students and instructors had instant access to data once they were generated. This certainly reduced the administration load.

Though the difference of project quality between groups was not significant, students expressed a rather high level of satisfaction toward this computer-mediated peer assessment process. Overall, we felt the peer feedback process in this study was a worthwhile activity. During this process, students were fully engaged and they changed their roles from reviewers to reviewees, and then improved their work. During this process, students' interaction was stimulated and their critical thinking skills were fostered. Compared to paper-based

systems, a computer-mediated system is certainly promising and provides advantages.

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Appendix 1 WebQuest Rubric

| | Beginning | Developing | Accomplished | Score |
|---|--|---|---|--------------|
| Overall Aesthetics (This refers to the WebQuest page itself, not the external resources linked to it.) | | | | |
| Overall Visual Appeal | <p>0 points</p> <p>There are few or no graphic elements. No variation in layout or typography.</p> <p>OR</p> <p>Color is garish and/or typographic variations are overused and legibility suffers. Background interferes with the readability.</p> | <p>2 points</p> <p>Graphic elements sometimes, but not always, contribute to the understanding of concepts, ideas and relationships. There is some variation in type size, color, and layout.</p> | <p>4 points</p> <p>Appropriate and thematic graphic elements are used to make visual connections that contribute to the understanding of concepts, ideas and relationships. Differences in type size and/or color are used well and consistently.</p> | |
| Navigation & Flow | <p>0 points</p> <p>Getting through the lesson is confusing and unconventional. Pages can't be found easily and/or the way back isn't clear.</p> | <p>2 points</p> <p>There are a few places where the learner can get lost and not know where to go next.</p> | <p>4 points</p> <p>Navigation is seamless. It is always clear to the learner what all the pieces are and how to get to them.</p> | |
| Mechanical Aspects | <p>0 points</p> <p>There are more than 5 broken links, misplaced or missing images, badly sized tables, misspellings and/or grammatical errors.</p> | <p>1 point</p> <p>There are some broken links, misplaced or missing images, badly sized tables, misspellings and/or grammatical errors.</p> | <p>2 points</p> <p>No mechanical problems noted.</p> | |
| Introduction | | | | |
| Motivational Effectiveness of Introduction | <p>0 points</p> <p>The introduction is purely factual, with no appeal to relevance or social importance</p> | <p>1 point</p> <p>The introduction relates somewhat to the learner's interests and/or describes a compelling</p> | <p>2 points</p> <p>The introduction draws the reader into the lesson by relating to the learner's interests or goals and/or engagingly describing a compelling question or</p> | |

| | | | | |
|---|--|---|--|--|
| | OR The scenario posed is transparently bogus and doesn't respect the media literacy of today's learners. | question or problem. | problem. | |
| Cognitive Effectiveness of the Introduction | 0 points The introduction doesn't prepare the reader for what is to come, or build on what the learner already knows. | 1 point The introduction makes some reference to learner's prior knowledge or previews to some extent what the lesson is about. | 2 points The introduction builds on learner's prior knowledge or effectively prepares the learner by foreshadowing what the lesson is about. | |
| Task (The task is the end result of student efforts... not the steps involved in getting there.) | | | | |
| Connection of Task to Standards | 0 points The task is not related to standards. | 2 point The task is referenced to standards but is not clearly connected to what students must know and be able to do to achieve proficiency of those standards. | 4 points The task is referenced to standards and is clearly connected to what students must know and be able to do to achieve proficiency of those standards. | |
| Cognitive Level of the Task | 0 points Task requires simply comprehending or retelling of information found on web pages and answering factual questions. | 3 points Task is doable but is limited in its significance to students' lives. The task requires analysis of information and/or putting together information from several sources. | 6 points Task is doable and engaging, and elicits thinking that goes beyond rote comprehension. The task requires synthesis of multiple sources of information, and/or taking a position, and/or going beyond the data given and making a generalization or creative product. | |
| Process (The process is the step-by-step description of how students will accomplish the task.) | | | | |
| Clarity of Process | 0 points Process is not clearly stated. Students would not know exactly what they were | 2 points Some directions are given, but there is missing information. Students might be | 4 points Every step is clearly stated. Most students would know exactly where they are at each step of the process and know what to do next. | |

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| | supposed to do just from reading this. | confused. | | |
| Scaffolding of Process | <p>0 points</p> <p>The process lacks strategies and organizational tools needed for students to gain the knowledge needed to complete the task.</p> <p>Activities are of little significance to one another and/or to the accomplishment of the task.</p> | <p>3 points</p> <p>Strategies and organizational tools embedded in the process are insufficient to ensure that all students will gain the knowledge needed to complete the task.</p> <p>Some of the activities do not relate specifically to the accomplishment of the task.</p> | <p>6 points</p> <p>The process provides students coming in at different entry levels with strategies and organizational tools to access and gain the knowledge needed to complete the task.</p> <p>Activities are clearly related and designed to take the students from basic knowledge to higher level thinking.</p> | |
| Richness of Process | <p>0 points</p> <p>Few steps, no separate roles assigned.</p> | <p>1 points</p> <p>Some separate tasks or roles assigned. More complex activities required.</p> | <p>2 points</p> <p>Different roles are assigned to help students understand different perspectives and/or share responsibility in accomplishing the task.</p> | |
| Resources (Note: you should evaluate all resources linked to the page, even if they are in sections other than the Process block. Also note that books, video and other off-line resources can and should be used where appropriate.) | | | | |
| Relevance & Quantity of Resources | <p>0 points</p> <p>Resources provided are not sufficient for students to accomplish the task.</p> <p>OR</p> <p>There are too many resources for learners to look at in a reasonable time.</p> | <p>2 point</p> <p>There is some connection between the resources and the information needed for students to accomplish the task. Some resources don't add anything new.</p> | <p>4 points</p> <p>There is a clear and meaningful connection between all the resources and the information needed for students to accomplish the task. Every resource carries its weight.</p> | |
| Quality of Resources | <p>0 points</p> <p>Links are mundane. They lead to information</p> | <p>2 points</p> <p>Some links carry information not ordinarily found in</p> | <p>4 points</p> <p>Links make excellent use of the Web's timeliness and colorfulness.</p> | |

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| | that could be found in a classroom encyclopedia. | a classroom. | Varied resources provide enough meaningful information for students to think deeply. | |
| Evaluation | | | | |
| Clarity of Evaluation Criteria | 0 points Criteria for success are not described. | 3 points Criteria for success are at least partially described. | 6 points Criteria for success are clearly stated in the form of a rubric. Criteria include qualitative as well as quantitative descriptors. The evaluation instrument clearly measures what students must know and be able to do to accomplish the task. | |
| Total Score | | | | /50 |

Social Presence Questionnaire of Online Collaborative Learning: Development and Validity

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Abstract

This study articulates the construct of social presence and develops a social presence questionnaire for examining online collaborative learning with tests for reliability and validity. Questionnaire items were developed by revising the social presence questionnaire developed by Picciano in 2002 as well as reviewing research in the literature of computer support for cooperative systems (CSCW). Twenty items were developed and administered to 15 graduate students taking an online course. Exploratory factor and reliability analyses resulted in the identification of 12 items reflecting online social presence.

Introduction

Computer mediated communication (CMC) is a substantial aspect of learning at a distance, and Short et al. (1976) claim that social presence is the critical factor in a communication medium. Social presence is defined as “the ability of participants in a community of inquiry to project themselves socially and emotionally, as real people through the medium of communication being used” (Garrison & Anderson, 2003). Online learning environments which feature mainly asynchronous text-based CMC have been criticized for their lack of support for social presence, and this lack of support for social presence may impact the sense of belonging and acceptance in a group (Rovai, 2002).

In the earliest research of social presence, Short et al. (1976) related the concepts of intimacy and immediacy with social presence. This early work suggested that intimacy and immediacy enhance social presence (Gunawardena, 1995). Social presence also was defined as a quality of the medium itself. They used the semantic differential technique with bipolar scales to assess social presence in face to face television and audio systems around four dimensions: unsociable-sociable, insensitive-sensitive, impersonal-personal, and cold-warm. Since an asynchronous text-based CMC has different attributes from one-way television, Gunawardena (1995) examined social presence as an attribute of a computer conference by revising Short et al.’s scales to 17 5-point bipolar scales that characterized the intimacy of the medium.

Further, Gunawardena & Zittle (1997) developed a social presence scale containing 14 questionnaire items that embodied the concept of immediacy to focus on perceived sense of online community and degree of social comfort with CMC. Tu (2002) argued that current social presence instruments are unable to capture a thorough perception of social presence and asserted that social presence is a complicated construct containing 4 dimensions: social context, online communication, interactivity and privacy. His social presence and privacy questionnaire instrument measures social presence in email, bulletin board and real-time discussions and contains 17 social presence items and 13 privacy items with a five point likert scale and 12 demographic responses. In addition, Rourke et al. (2001) directly examined responses of computer conference participants through content analysis of conferencing transcripts and developed three categories and indicators to assess social presence including affective responses, interactive responses, and group cohesive responses.

Our review of the social presence literature and instrumentation suggests there is still a lack of agreement about how to conceptualize and measure social presence, but that there is also a growing appreciation for its potential to explain participation and outcomes in distance learning. No reliability and validity assessments of the social presence instruments developed by Short et al. in 1976 & Gunawardena in 1995 were reported. For the instrument developed by Gunawardena & Zittle in 1997, concurrent validity of the social presence scales was indicated by the strong and positive correlation with bipolar social indicators based on Short et al.’s instrument; however, the scale itself was not validated. The social presence instrument developed by Tu in 2002 has been validated; however, his instrument mainly focused on participants’ attitudes toward CMC in a general context. It is unclear whether the reported relationship between attitude toward CMC and the experience of social presence would hold when confronted with specific tasks or opportunities in specific social groupings.

Previous research has examined the association of social presence with participation and outcomes in distance learning. Social presence has been associated with enhanced online social interaction (Tu & McIsaac, 2002). Social presence is also seen to influence not only online activities generally designated as group projects,

but also those usually designated as individual projects (Richardson & Swan, 2003). In addition, students with high overall perceptions of social presence scored high in terms of perceived learning and perceived satisfaction with the instructor (Richardson & Swan, 2003). Students with high overall perceptions of social presence are also most likely to enhance their socio-emotional experience by adopting different ways to express their affect in an asynchronous text-based learning environment (Gunwardena & Zittle, 1997). Finally research has also shown that instructors or moderators of online communities can cultivate social presence by developing interaction skills that create a sense of social presence (Gunawardena, 1995).

The purpose of the work presented in this paper is to further articulate the construct of social presence and to develop a social presence instrument which can be used to examine social presence in online collaborative learning.

Questionnaire Development

To measure the social presence of students working collaboratively in an online course, two strategies were used to develop items for the social presence questionnaire. First, the first 10 items were developed by surveying social presence literatures and adapting items from the social presence questionnaire developed by Picciano (2002) based on a questionnaire developed by Tu (2001). Second, the last 10 items were developed newly from our reading in the literature of computer support for cooperative systems (CSCW). In this literature there is a greater emphasis on social navigation and awareness of others than we have found in CMC more generally and especially distance learning. This literature emphasizes the role that awareness of the actions of others and the understanding that others are aware of your actions shapes action. See Munro, et al., (1999) and Hook, et al., (2003) for good compilations of this research. In all, 20 statements were created to measure social presence. Statements were placed on a 7-point continuum with endpoints of strongly agree (1) to strongly disagree (7).

Method

In a pilot study the 20 items were administered to 15 graduate students in an online graduate level course delivered through Shadow netWorkspace™ (SNS) during the fall of 2003. SNS is open source software using the GNU General Public License (GPL). The software can be freely downloaded and distributed under the terms of the GPL. Shadow netWorkspace is freely available to anyone at <http://sns.internetschools.org>. The online course was organized into 8 weekly group activities and two individual projects. After the third weekly activity, all the students were asked to complete the web-based social presence questionnaire.

Exploratory Factor Analysis and Reliability Analysis

Responses to the 20 items were subjected to exploratory factor analysis using principle component with varimax rotation. Initial factor analysis procedure showed the 20 item questionnaire to have three factors having eigenvalues of 8.114, 3.277, and 2.329 that accounted for 40.570%, 16.384%, and 11.643% of the variance, respectively. The factor analysis was repeated and 6 items were deleted since they were found to contribute approximately equally into at least two factors. Finally, the three factors which explained 73.889% of total variance were named as “perception of the assistance of group activity to learning”, “social comfort of expressing and sensing affect”, and “social navigation”. Cronbach’s coefficient alpha was computed for the 14

Table 1. *Factor loadings for social presence questionnaire*

| Item | Factor loading |
|---|----------------|
| Factor 1: Perception of the assistance of group activity to learning | |
| 1 I felt like I was a member of a group during this past week activities | 0.753 |
| 2 I felt comfortable participating in this past week online group activities. | 0.811 |
| 8 I felt I came to know the other students in this past week online group activities | 0.746 |
| 16 This past week online group activities helped me accomplish the assignment with higher quality than if I were working alone. | 0.804 |
| 17 This past week online group activities helped me learn more efficiently than if I were working alone. | 0.831 |

| | | |
|---|--|-------|
| Factor 2: Social comfort of expressing and sensing affect | | |
| 4 | I felt comfortable expressing my feelings during this past week activities. | 0.833 |
| 6 | I felt comfortable expressing my humor. | 0.918 |
| 7 | I was able to appreciate the humor of members of the group. | 0.867 |
| 9 | I was able to form distinct individual impressions of some group members during the online group activities. | 0.833 |

Factor 3: Social navigation

| | | |
|----|--|-------|
| 14 | Actions by other members of my group usually influenced me to do further work. | 0.891 |
| 15 | Knowing that other members of my group were aware of my work influenced the frequency and/or quality of my work. | 0.690 |
| 19 | Knowing what other members of the group did helped me know what to do. | 0.792 |

item social presence questionnaire as a test of internal consistency. Cronbach's coefficient alpha values for three factors were 0.6747, 0.6649, and 0.7031 respectively. By dropping one item individually from "perception of the assistance of group activity to learning" factor and "social comfort of expressing and sensing affect" factor, their reliabilities were raised to 0.8905 and 0.9218 respectively. Alpha of the entire questionnaire of 12 items was 0.8402 (M=55.6667, SD= 11.8181). The scale's reliability met acceptable standards of 0.70 and above and can be interpreted as internally consistent or as measuring the same phenomenon (Bowers & Courtright, 1984). Table 1 shows factor loadings of three factors for 12 items.

Conclusion

Our work is leading to a social presence questionnaire which can be used in online collaborative learning. The exploratory factor analysis isolated three factors: "perception of the assistance of group activity to learning", "social comfort of expressing and sensing affect", and "social navigation". In this pilot study, the sample size for factor analysis was far from an appropriate sample size of close to 300 cases (Tabachnick & Fidell, 2001); hence, future studies are planned with larger sample sizes.

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Exploring the Instruction of Fluid Dynamics Concepts in an Immersive Virtual Environment: A Case Study of Pedagogical Strategies

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Abstract

The deployment of immersive, non-restrictive environments for instruction and learning presents a new set of challenges for instructional designers and educators. Adopting the conceptual frameworks of Sherin's (2002) learning while teaching and Vygotsky's (1978) cultural development via the mediation of tools, this paper explores one professor's pedagogical approaches used for instructing fluid dynamics concepts within the Metaverse, a highly innovative, physically immersive visualization display that does not require the use of head-mounted or other restrictive devices.

Introduction

The emergence of virtual realities (VR) in the educational technology landscape in recent years has aroused the enthusiasm of instructional designers and educators, especially among instructors in the discipline of science. Virtual reality technologies enable a new dimension of representing difficult scientific concepts and processes that 2-D desktop graphical representations have not been able to offer (Jimoyiannis & Komis, 2001; Fiolhais & Trindale, 1998). However, integrating these burgeoning technologies into school curriculum and higher education presents a new set of challenges within the realms of learning and instruction (Barajas & Owen, 2000). In the past decade, a plethora of discussions and inquiries in educational technology journals and conference proceedings have placed significant emphasis on various aspects of simulated desktop virtual environments, 2-D multimedia representations and web-based instruction and learning (Davies, 2002; Antonietti & Cantoia, 2000; Maher & Corbit, 2002; Gabrielli, S., Rogers, Y., & Scaife, M. 2000; Gazit, E., & Chen, D., 2003). Moreover, empirical studies on the applications and implementations of immersive, non-desktop virtual reality interfaces in education, especially scalable virtual reality infrastructures are scant (Crosier, Cobb, & Wilson, 2002).

To this end, the Metaverse, a NSF-funded interdisciplinary research project at the University of Kentucky, has marked a milestone in the development of educational technologies. In addition to developing self-configuring, scalable visual displays, the Metaverse makes it possible for learning and instruction in a commodity hardware supported immersive, non-restrictive environment. The objectives are to support meaningful human-computer interaction and to understand the impact these visual environments have on education. For the past three years, the Metaverse team has been translating, designing and implementing prototype instructional materials into immersive displays. One of the preeminent tasks that the educators of the team face is to seek ways of facilitating instruction in this dynamic, non-linear teaching and learning environment. Many initial questions arise. Chief among them, for example, is how can teachers learn to use an immersive environment in which developing their own understanding of the nature of the new computer-generated 3-D environment is of primal concern? As McLellan (2003) pointed out, careful and continual examination of virtual reality technologies, especially within the context of learning and instruction are important for two reasons: 1) virtual reality technologies are still in their nascent stage of development as a category in educational technologies, and 2) rapid technological improvement posts concerns for the issue of outdated technological capabilities.

Thus, the purpose of this exploratory study was to analyze the emerging pedagogical strategies within a non-restrictive, immersive environment. More specifically, this study examined the teaching approaches employed by a professor in the instruction of fluid dynamics concepts using in the Metaverse display. Using Sherin's (2002) concept of "teaching while learning" and Vygotsky's (1978) notion of "cultural development" through the mediation of tools, this paper seeks to understand the instructor's integration of subject matter knowledge and his newly acquired knowledge in deploying the immersive technology. The goals are to: a) shed some light on the development of effective instruction, b) to optimize the full potential that this inherently

“open-ended” learning environment affords, and c) to provide an initial step toward future studies of scalable, immersive, virtual learning environments for educational applications.

Conceptual Framework for the Study

According to Sherin (2002), teachers go through a process of transforming, adapting, and negotiating when faced with changes in instructional curriculum or materials. “These classes of interactions between the teachers’ content knowledge and the implementation of the novel curriculum. . . represent the different ways that teachers apply their content knowledge as they attempt to use new materials” (Sherin, 2002, p. 129). Moreover, Sherin (2002) posits that it is only through the process of negotiating with new instructional materials or situations that teachers truly engage in the active role of learning. In other words, teachers who work with new instructional content often experience a series of changes that prompt them to arrive at an innovative stage of developing new ways of interpreting and presenting their newly acquired content knowledge. However, it is inadequate to address the wide spectrum of pedagogical strategies required to deliver meaningful instruction within an immersive, non-restrictive environment such as the Metaverse display. Specifically, additional concepts are needed to frame the interaction between the instructor and the immediate environment.

Drawing upon Vygotsky’s (1978) concept of “cultural development”, the authors of this study argue that an immersive virtual environment can be viewed as a “culture” in which both the instructors and students alike develop their own tools and verbal and nonverbal signs in the process of becoming familiar and efficient with their navigation within the environment. According to Vygotsky (1978), tools and signs represent different ways of orienting human behavior and are the essence of mediated activities.

The tools’ function is to serve as the conductor of human influence on the object of activity, it is *externally* oriented; it must lead to changes in objects. It is a means by which human external activity is aimed at mastering, and triumphing over, nature. The sign, on the other hand, changes nothing in the object of a psychological operation. It is a means of *internal* activity aimed at mastering oneself; the sign is internally oriented (Vygotsky, 1978, p. 55).

Within the context of this study, tools, referred to by Vygotsky (1978) as the external object, imply the user’s physical body movement to navigate in the immersive visual display. Analyzing the body movement that revolves around a series of actions, described by Vygotsky (1978) as “true gesture”, the authors attempt to examine the embedded dimensions of teaching that may be unique to immersive environments.

The Environment

This exploratory observational case study is anchored in the Metaverse, a non-restrictive, immersive environment. One of the fundamental concepts behind this infrastructure is its visually immersive and interactive affordances. The 500 square-foot room with its fourteen ceiling-mounted projectors and calibrating systems enable a single user to move around freely without constrain of devices like the head-mounted display, data gloves, or stereo glasses, which are characteristics of typical CAVE-like immersive environments. As the user moves to various locations in the projected two-wall and floor display environment of the Metaverse, a head-tracking device on a fedora hat or being held by the user corrects for changes in the display in real-time. In another words, the viewpoint or perspective changes simultaneously as the user moves within the environment. Further, a user in the display can obtain top, bottom, interior and exterior views of the display or the projected image by strategically positioning him or her in the environment. The problem in using this type of physically immersed environment surfaces when the cues of depth in virtual environments are often different from that of the natural world (Wann & Mon-Williams, 1996). In addition, time lag in displaying the corresponding view as to the user’s body movement also creates challenging usability/context-for-learning issues.

Subject Matter Content

The subject matter content of the inquiry pertained to the behaviors of a laboratory simulated fire whirl. “Fire whirls occur infrequently, usually as the result of . . . large scale wildland or urban fires—the former usually caused by lightning strikes, and the latter often due to earthquakes or some similar disaster” (McDonough & Loh, 2003. p. 1). Studies on the characteristics of fire whirls have been sparse despite the

potential damages that these phenomena can cause and the possible control measures of small pool fire in industrial applications. Selection of this subject matter content also relates to the availability and accessibility of the visual display for the Metaverse environment.

As the technical development of the Metaverse and its contents is an ongoing process, the simulation of the fire whirl in the Metaverse display during this study was a simple cylinder-shape projected image with areas of grey, blue, orange and yellow. The concept of this display is to show the circular moving flow field and the color-coded regions of flame temperature. Walking inside or to other regions can lead to changes in the appearance of the flame and the temperature. One of the objectives in creating this simulation in the Metaverse was to provide visualization of the turbulent flow behaviors of the flame and its various burning regions.

The Participant

Selection of the professor for the study was based upon his involvement with the NSF grant of the Metaverse project, his expertise in the field of fluid dynamics, and his enthusiasm in experimenting with the immersive visualization interfaces. The primary task of the professor was to present and demonstrate the characteristics and turbulent flow behaviors of the simulated fire whirl described earlier. Yin (1994) has noted the acceptability of a case study of one to describe or explore a unique or extreme case. The unique situation criterion is clearly met in this instance.

Data Collection Procedures

To maximize the trustworthiness and reliability of the study, the authors adopted various data collection resources. For instance, the eight-minute presentation of the fire whirl in the Metaverse display was digitally video and audio recorded. The video recording was then transferred to CD-Rom, and the content was transcribed verbatim and member checking by the professor. Moreover, other methods of collecting data included a focused interview with the professor after examining the video-recorded presentation, email communication, and field notes. To compare the behaviors of the professor in the immersive display with his in-class teaching methods, the lead author conducted eight fifty-minute classroom observations for two semesters prior to analyzing the recorded video and transcript.

Analysis

The authors based the analytic techniques of this case study on both the conceptual frameworks of Sherin's (2002) learning while teaching and Vygotsky's (1978) cultural development through the mediation of tools. As such, the researchers examined the interaction categories of transform, adapt, and negotiate, and the mediation of tool (body movement) in two phrases: 1) identified, coded, and analyzed the incidences that negotiation took place in terms of the subject matter content, and 2) identified, coded, and analyzed the incidences of tool (the body) manipulation. These analytic strategies followed the case study tradition of pattern-matching (Yin, 1994), the coding and categorization of evidence (Stakes, 1995), the displaying of events in table and form, and the tabulation of the frequency of incidences (Miles and Huberman, 1984).

Aside from analyzing the video and its transcript, the authors also conducted an ongoing process of triangulating field notes and transcribed interview to search for emerging patterns and themes. Stake (1995) has posited that triangulation increases the validity of the study and thus ensures the accuracy in interpreting the collected data. Moreover, Yin (1994) and Stake (1995) maintain that collecting and analyzing varied evidence sources such as interviews, observation, and documents verifies the authenticity of the phenomena under investigation.

Results and Discussion

Analyzing the transcript and taped video reveal several findings regarding the professor's attempts to cope with delivering his content knowledge in the fire whirl immersive display (new context). Table 1 provides samples of incidences that illustrate the instructor's use of existing content knowledge to implement a new context through the process of transformation. Furthermore, the table shows evidence of the professor's skill in developing new content knowledge and implementing the information into the presentation (process of adaptation), and his approach in developing new content knowledge and modifying the content information as he proceeded with his instruction (process of negotiation). Although each of these three classes of interactions reflects learning through teaching, Sherin (2002) maintains that attention should be placed on negotiation as it signifies the teachers' active role of learning during instruction. By definition, negotiation occurs when

“teachers develop new content knowledge and at the same time make changes in a lesson as it unfolds in the classroom. . . In other words, the teacher not only develops new content knowledge but also uses this knowledge to interpret the lesson in progress and decide how to proceed” (p. 130).

Throughout the presentation, the professor negotiated his fire whirl content and the immersive environment by making comments that centered on his justification of what could have happened if the immersive display was programmed with a complete data set. For instance, in the beginning of the presentation, he remarked, “If we had a complete simulation, we will be able not only to see the temperature in this thing, but we will be able to see the flow field down underneath.” In another incidence, the professor developed and integrated his new content knowledge within the context of the environment by pointing out the advantage and disadvantage of having the immersive visual display. “Now, one of the things that’s missing from the system that we will eventually have in place is the ability to know just exactly where we are in a given time. As we stand right now, I don’t know exactly where I am. But, by walking around in here at the very least we can see how the different regions connect up to the other.” These sample incidences illustrate the professor’s creativity in generating new content about the flame as he explained its turbulent behaviors in the immersive display. Further, a comparison of the professor’s frequent integration of new information during the presentation to the highly structured, non-interactive classroom lectures also suggests the instructor’s active negotiation within the immersive environment.

Placing Vygotsky’s (1978) concept of “cultural development” through the mediation of tools in the context of this study, the instructor demonstrated his role in creating a culture for the environment and his development in gaining competency in deploying the immersive display. By moving or situating his body (the tool) in various positions and locations, the professor was able to obtain different perspectives or views of the fire whirl visual representation (Figure 1, 2, & 3). Moreover, competencies in obtaining the desired views in the display required skills through repeated actions. For instance, the following statement made by the professor illustrated his lack of confidence in obtaining the desired view of the display and his challenge in mastering his tool (body movement). “If we get in the right place here, we maybe get to a place where I get fire all around me. It’s moving a little erratically. Let’s try this way. . . there we go.” As the instructor gained knowledge with repeated use of the fire whirl immersive display, his accuracy in obtaining the desired view of the display with the least amount of time increased. “The first thing we are going to do is to see if we can look down on top of this to see some evidence of burning. And we can see that here. Over here. . . and it’s stabilized. And now we bring the tracker back down and actually get underneath it and look at it from the bottom”. This instance, which occurred toward the end of the presentation, exemplified the professor’s skills in mastering the nature (the immersive environment) and mastering of behaviors. He became more decisive in manipulating his body movement and in taking the required actions

| Interaction Class | Sample Evidence with number of similar instances | Content Knowledge | Novel Lesson |
|--------------------------|---|--------------------------|---------------------|
| Transform | Discussed the behaviors of flow field by interacting with and showing the visual display (4 incidences) | Unchanged | Changed |
| Adapt | Invented explanation for the different color regions and heat temperature when asked about the indicators of the changes in time in the immersive display (2 incidences) | Changed | Unchanged |
| Negotiate | Statement such as “If we had a complete simulation, we’ll be able to see the temperature...the flow field down underneath” surfaced throughout the instruction. The professor created new content knowledge (showing the lower part of the flame) caused by the inadequacy of the visual presentation (new content) to fully describe the phenomenon (5 incidences) | Changed | Changed |

Table 1. *Illustrations of the three classes of interaction, transformation, adaptation, and negotiation as exhibited by the professor in the 8: 25 minutes of Metaverse fire whirl presentation.*

to obtain the desired views of the simulated fire. In other words, the learning through teaching occurs and can

be described as mediated activities that suggest the fulfillment of the intended goals, which are the requisite pedagogical strategies to support meaningful instruction.

Conclusion

This initial study provides the frameworks to explore the development of pedagogical approaches within the context of the immersive, non-restrictive environment. Although the visual display and the immersive environment are still in an early stage of development, it offers a fertile ground for research in human computer interaction, learning and instruction, and human behaviors that may provide insight in areas of cognitive domain.



Figure 1. Lowering the body (tool-shown in bottom left) to show the underneath view of the flow field



Figure 2. Showing the fire whirl data from the top view by standing (tool) and holding up the tracking device (artifact)



Figure 3. Lowering the body (bottom right) and holding the tracking device with the left hand to manipulate the view of the display

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Survey Study of Using Technology in Online Courses

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Introduction

Compared to courses delivered in face to face setting, courses that were delivered entirely online rely more on technology (Bonk, 2001; Firdyiwiek, 1999; Moore, 2003). Technology, especially the Internet, provides a common virtual space for students and instructors who are physically separated; it is widely acknowledged as an essential component of teaching and learning environments in online setting.

As more and more technology tools become available for online education, there have a development of interest among educators and other professionals in the potential application of the tools in online courses (Hanna, 2003; Moore, 2003). For instance, some researchers argued that a course manage system (CMS), a collection of such software tools as asynchronous discussion board and real time chat tools, had potential to transform teaching and learning (Ansorge & Colley, 2003; Carmen & Haefner, 2002). At the same time, researchers realized that technology tools, like other tools human beings developed, can be used in profound as well as very trivial and careless ways in educational practice (Althausser, R. & Matuga, J., 1998; Ottenhoff & Lawrence, 1999). In addition, instructors have been acknowledged to play a key role in using the technology successfully (Garrison, Anderson, & Archer, 2003; Willis, 1994; Wilson, 1998).

What is the current state of online instructors in using the technology tools? As many researchers pointed out, there is a pressing need to study how the technology is being used in online courses (Bonk, 2001, 2003; Garrison et al, 2003; University of Illinois, 1999). Answers to this question not only help researchers understand the current state of the online courses, but also help tool developers, instructional designers, instructors, and administrators in making decisions for their practices, products, or services. However, literature indicated that our understanding of the question was very limited (Bonk, 2003; Garrison, et al, 2003). Only a few survey studies were found for answering the question; and even fewer studies were found to investigate the question from different aspects in depth. The particular study was conducted with an attempt to make contributions to the area.

Purpose of the Study

The study attempted to investigate the use of technology by online instructors from the following aspects: what tools were used by the instructors in teaching online courses? What features of the tools did they use, in which way, and for what purpose(s)? How did they perceive the importance, necessity, and effectiveness of the features? What new features did they expect the tools to have? Were their skills of using the tools related to their perceptions of and the way how they used the tools?

Due to the plethora of available technologies as well as time and budget constraints, this study focused on the following key elements in the online courses: asynchronous discussion, real time (synchronous) chat, audio/video, and supporting team work function. Features such as survey functions, use of e-mails (external and internal), control of sharing level in managing courses (i.e., giving feedback or delivering materials to the whole class, a team or an individual) were also included in the study.

Methods

Participants

Thirty instructors, who taught online courses in the School of Education of a large Midwestern university during the period from Spring to Fall of 2003, were invited to participate in the study.

Instrument:

An electronic questionnaire was used that consisted of ten sections, including asynchronous discussion, real-time online chat, audio/video, team work, survey function, control of sharing level, etc. A five-point scale was utilized to ask the participants to rate the importance of the features, the effectiveness of the tools they used in support their teaching, and their levels of skill in using some features. In addition to the close-ended questions, there were eleven open-ended questions included in the survey. The open-ended questions asked participants to explain why they thought certain tools or functions were necessary or not necessary, to describe how they used real-time chat, asynchronous discussion, video/audio, and team work in their courses, and to list

the new features that they would like the tools to have.

Data Analysis

Responses to the close-ended questions with a five-point scale were analyzed by SPSS. Percentage, mean, and standard deviation of individual items were calculated. Correlations between or among some relevant items were also examined. Data collected from the open-ended questions were analyzed manually. The frequency of each emerging theme was counted, and the representative quotations of the respondents were selected.

Procedure

: The contact information of the 30 instructors was collected from the websites of the course they taught. The questionnaire was sent to the instructors by an e-mail attachment in the October of 2003. In the e-mail, the purposes of the study were explained. To improve the survey return rate, the e-mail was personalized as much as possible. For instance, each of the participants was addressed by their name (e.g., Dr.xx, Professor xx), and the course(s) he or she taught was also mentioned in the e-mail. The participants returned the survey also by e-mail. Many of the participants returned the completed surveys the same day or the second day that the survey was sent out. A thank-you e-mail was sent to each of the respondents after the survey was returned. Some respondents were asked to elaborate some points further by a follow-up e-mail.

Limitations

The study had two major limitations. First, the sample size was small. This might be justified by the fact that the questionnaire included more open-ended questions than normal survey studies, and the data were a mix of quantitative and qualitative data. Nevertheless, readers need to be cautious when making generalizations on the findings of the study beyond the sample. Second, even though the drafts of the questionnaire were reviewed by three experts and tested by two associate instructors before it was sent out, the questionnaire could be further improved. For instance, some survey items later turned out still not to be very specific to some respondents.

Results and Interpretations

Twenty out of thirty participants (66.7%) completed the questionnaires. Among them, thirteen were females. Seven were males.

Ninety percent of the respondents were found to use the course management systems (CMS) that the university provided, namely, SitesScape Forum (SSF) and Oncourse. Only five percent did not use the CMS, but the Bulletin Board System (BBS).

Asynchronous Discussion

Importance. Respondents were asked to rate the importance of using asynchronous discussion in online courses with a five-point scale (1=lowest importance, 5=highest importance). Whereas 5% of the respondents rated the importance as the lowest, 70% of them rated it as the highest. On average, the respondents perceived using asynchronous discussion as being important or very important in online courses ($M=4.4$, $SD=1.4$).

How it was used. Respondents who used asynchronous discussion in online courses described the way they used it. Their responses were listed according to the frequency of the themes from high to low: (1) students shared their reading reaction, experience and got support from peers and mentors/instructors; (2) assigned roles (facilitators/leaders and wrappers/summarizers, instigators, devil's advocate) to students, word count for the discussion; (3) the instructor raised some discussion questions; students responded to the questions and responded to each other; (4) peer-review posted projects and assignments; (5) students posted their reading reaction first, then were responsible for responding to a certain number of their classmates' postings; and (6) students discussed in teams of 4 or 5 at the end of the discussion period; each team posted a summary of their discussion to share with the whole class. The duty of facilitator rotated among the team members. Students completed peer evaluations on their peer performance. The instructor monitored the discussion and added occasional comments, especially if s/he thought they were getting off track.

Effectiveness. Participants were asked to rate the effectiveness of the tool(s) that they used in supporting online asynchronous discussion with a five-point scale (1=least effective, 5=highest effective). Results showed that none of the respondents rated the effectiveness as the lowest, while 44.4% of them rated it as the highest. On average, the respondents believed that the tools they used were effective ($M=4.11$, $SD=.96$).

New functions. Participants were surveyed on what new functions that they would like the tool(s) to have and which suggestions they might have for improving the tools they used. Their responses could be divided into two categories: (1) pedagogy related: ability to hide posts until a student posts themselves (to ensure the first-level postings are original, not borrowing from others); ability to hide/change name for anonymity in discussions periodically; ability to easily create discussion group space; track of read and unread messages well; automatically formulate folders instead of thread; and ability to support graphic and video; (2) usability related: ability to recall, delete, edit one's own messages; better threading of the discussion; a more user-friendly interface design; easier printability and navigation, and ability to simultaneously view the posting to which one was replying.

Real-time (synchronous) Chat

Real-time chat tools that the respondents used included: Tapped-in, AOL instant messenger, MSN messenger, SchMooze, and the chat function of the course management systems (i.e., SSF or Oncourse).

Necessity. When asked about whether it was necessary to use real-time chat in online courses, 30% said "no"; 25% said "yes"; 25% of the respondents said it could be beneficial, but had some problems; 15% said it would depend on the characteristics of students, instructional goals, and technology consideration(s); One respondent indicated that she did not know because she had not used this before. Reasons that the respondents gave for why it was necessary to use could be put into two categories: (1) students felt more comfortable since real-time chat was more informal; it brought in some authenticity, and helped build a sense of community; and (2) it was efficient to use real-time chat to communicate and give immediate feedback. Problems and concerns that the respondents who held a negative or neutral position in using the real-time chat were listed as follows based on the order of the frequency from high to low: (1) it was difficult to arrange for both instructor and students because students were from different time zones and had different schedules; (2) asynchronous discussion was more important because it forced students to reflect more and provide them more time flexibility; (3) it would take away one of the advantages of taking online courses; and (4) it would be an unreasonable burden for students.

How it was used. Respondents who reported that they used real-time chat in their online courses described the way they used it. Their responses were listed according to the order of frequency from high to low: (1) had students share their ideas for their own or group project and get feedback from the instructor and peers; (2) had students visit virtual environment to explore possibilities of use in their [student] teaching; (3) used Instant Messenger for office hours: Students can "pop in" to ask questions; and see when students are online and remind them of things; (4) used for interaction with a guest speaker; (5) introduced everyone to each other at the very beginning of semester, and to answer any concerns that have come up in terms of using the tool; (6) used for unit wrap-ups, discussed the main topics of that week, and clarified assignments; (7) used for readjust course schedule; and (8) used for personal communication.

Rating of skills. Participants were asked to rate their skills of using real-time chat with a five-point scale (1=lowest, 5=highest). Two out of the twenty respondents did not answer the question. Those two respondents had previously indicated that they had not used the real-time chat and would not consider using it in the future. Among the eighteen respondents, 33.3% of them rated their skills as lowest, while 27.8% of them rated their skills as highest.

Audio/Video

Necessity. Participants were asked whether it was necessary to use audio/video in online courses and why they thought that way. Only one out of the twenty respondents (5%) said "yes". The reasons he stated were as follows: "it helps enhance the authenticity of a learning environment and create a psychological proximity in the geographically distributed learning community. In addition, both audio and video can enhance students understanding for learning concepts and principles, which is otherwise explained through heavy text. As the majority of the students had high-speed connection, downloading was not an issue." Another respondent (5%) said he did not know because he had not used audio/video in online courses before. 20% of the respondents chose "no". The reasons given included: "Current resources (without using audio/video) are sufficient and effective 'in supporting students' efforts to meet course objectives"; "Audio did not add much to course management, Asynchronous conferencing has, as literature also tells us, advantages and that is good enough (reflective & critical thinking, etc.) for my purposes of attaining high-level learning"; "Many people like anonymity". Thirty percent of the respondents believed it would depend on the course content, students (needs), instructor, circumstance, etc. As one of the respondent said, "In my classes, I don't really think it is necessary. But for other online courses that gear toward multimedia design and other visual/auditory-oriented subjects,

audio/video supplement might be helpful.” Forty percent of the respondents believed that it was not absolutely necessary, but it could be useful, fun, and could increase class interactivity, etc. In the words of one respondent: “It’s not necessary, but it can be a useful tool.... some things are easier to show in a video clip, for instance, than to describe in words.”

How it was used. If they had used audio/video in their courses, participants were asked to describe the way they used it and the students’ responses to it. Five respondents answered this question. One respondent reported that she used a stream video which was composed of interviews of online teachers and students about their experiences; According to her, students really liked it, but she had to send students a CD ROM via “snail mail” because about 25% of them had technical problems. Another respondent said that he used audio and video clips as examples since the course was about multimedia production, and students were required to make audio and video clips on their own. However, he was not sure whether students liked the clips or not. Still another respondent reported that he created an audio clip of lecture because he could not find a web resource with relevant information. He had assumed that audio would be more interesting than reading a long document; however was surprised to receive complaints from some students because the clip did not have visual elements.

Consider using it in the future. Participants who had not used audio/video in their courses were asked whether they would consider using it in the future. Almost 42 percent (41.6%) of the respondents said “yes” based with the reason that it could enhance learning and enrich the online classroom to meet the learning styles of different students. One of them said that she would learn how to use it, if it was indeed proven useful. 16.7% said they would not consider using it in the future. The rest of the respondents reported that whether they would consider using it depended on students’ needs. As one of them said, “It would have to really be worthwhile for me to use it, rather than a high-tech option.”

Teamwork

Necessity. Sixty-five percent of the respondents believed that it was necessary to use team work in online courses. The reasons they listed included: (1) it forced/encouraged students to learn from each other, and take advantages of the learning community; (2) it helped students to get to know one another and increase the feeling of community; (3) it addressed affective needs; (4) it helped students to process new information more effectively; (5) it encouraged students to keep up with the course; and (6) it helped students to try out their ideas in a low-stakes setting. Fifteen percent of the respondents said it was absolutely not necessary based on the following reasons: (1) students often had different schedules and were working on different parts of the course; (2) teamwork was time-consuming. Since students were from different places with busy schedule, there were usually challenges to overcome before the team work even took place; and (3) team work was only one potential pedagogical option in any course (online or face-to-face). While it had benefits, it also created some problems. Students can still effectively interact without having to be on a team project. Twenty percent of the respondents held a neutral position, believed that it was not necessary but a plus, or indicated that it would depend on a lot of things such as of the topic and the instructional style of an instructor.

How it was used. Fourteen respondents described how they used the team work in online courses. The ways included: (1) using teamwork for discussion, peer review and giving each other feedback; (2) giving student certain roles in doing the teamwork; and (3) requiring students to provide a team product and did team presentation.

Effectiveness of supporting teamwork. On average, the respondents perceived the effectiveness of the tools they used in supporting teamwork as moderately high ($M=3.4$, $SD=1.0$).

New functions to be added. Suggestions that respondents given for making the tools to support team work more effectively included: add a white board; offer synchronous video conference; and to improve the functions of using team space.

Other Features

The study also surveyed other features such as survey functions, e-mails, and control of sharing level. Results indicated that respondents did not perceive the survey function as important ($M=2.3$, $SD=1.26$). They used the survey function mainly in the following ways: (1) collecting formative and/or summative evaluation from students about the course design, teaching, and learning satisfaction; (2) setting synchronous meeting time; (3) finding out students’ level of experience with technology in the first week of class; and (4) asking students at the beginning of the course what they hope to get from this course.

Results also indicated that the feature of controlling sharing level in online courses was perceived as important (Mean=3.9, $SD=1.20$). Regarding the internal e-mail function that the course management system provided, most respondents perceived its importance as moderately low ($M=2.83$, $SD=1.20$). In contrast, the

importance of using regular e-mails in teaching online courses was perceived as being high ($M=4.05$, $SD=.78$). Due to the space limit, data on other features that were also collected with the questionnaire were not reported in the paper, but are available upon request.

Discussion and Implications

As noted, almost all the respondents in the study were found to use course management systems in their online courses. This finding is consistent with what other studies found (e.g., Bonk, 2001; Teles, 2003). It also added empirical data to the literature that CMS has become mainstream practice in online courses (e.g., McLoughlin & Luca, 2000). The popular use of the CMS has implications for tool developers, university administrators, instructional designers, and technical support staff. For instance, they need to continue to develop and improve the CMS, and provide support for using it.

Asynchronous discussion, also known as asynchronous communication, threads discussion, and delayed computer conferencing in the literature, has been used for over a decade (Garrison, et al, 2003). Its advocates argued that it supported greater independence and flexibility from temporal and geographical barriers and provided more reflective participation (Feenberg, 1989). The respondents were found to have a high consensus toward the importance of using it in online courses. Eighty-five percent of them perceived it as the most important or very important. The finding was consistent with the relevant literature and studies (Bonk, 2001; Bonk & King, 1998a, 1998b; Garrison et al, 2003; Teles, 2003). Literature showed that asynchronous discussion could be used in following ways: general discussions, exchanging ideas, working on specific topic areas, and peer commenting (Siegel & Kirkley, 1998; Kang, 1998). The way the respondents used it was supported by the literature. Some respondents assigned students different roles in doing weekly discussion, and some asked students to facilitate the discussion in teams. This helped students master the content and develop their collaboration, reflection and critical thinking skills (Duffy, Dueber & Hawley, 1998; Zhu, 1998). This study indicated that most instructors become familiar with using asynchronous discussion and are relatively skillful with it. Duffy et al. (1998) criticized that “many designers of conferencing systems have had a simplistic view of discussion as simply talking” (p.74), and argued for a more effective and pedagogical-based conferencing system to support online asynchronous discussion. It is worth noting that at the present time some conferencing systems have developed a number of pedagogical features suggested by Duffy et al (1999). For instance, SSF enables instructors to track the history of each post and see who has read it, thereby providing the instructors with yet another index of student’s participation. The respondents in the study, on average, believed that the current asynchronous discussion tools were effective in supporting their teaching. However, based on the respondents’ suggestions it still seemed to be a need for the designers and developers to further improve the tools in both pedagogical and usability aspects.

According to the literature, real-time chat, also known as synchronous discussion or synchronous communication, was critical for online courses. Its advocates argued that unlike the delayed exchange (asynchronous communication), real-time chat provided “teachers and students with a forum for an immediate and dynamic interchange of ideas”, and “can be an exciting asset to collaborative learning environments” (Cooney, 1998. p.263). It can be used to foster group cohesion and decision making, brainstorming, and build high levels of socialization (Kang, 1998; Roberts, as cited in Garrison et al, 2003). The respondents in the study who believed using real-time chat was necessary shared the same view, especially on its efficiency of giving immediate feedback and helping build a sense of community. How they used it was also consistent with what the literature suggested. Such strategies as using it for office hours and interaction with a guest speaker demonstrated the advantages of the real-time chat and the instructors’ skills of using it in a very thoughtful and effective manner. However, two-third of the respondents held a neutral or negative position on using real-time chat. The problems and concerns that they listed (e.g., hard to arrange because of different time zones and schedule) were reasonable. Administrators, instructional designers, and support staff members seem to be able to do at least two things in order to help the instructors who held similar position to take advantages of using real-time chat. One is to help them realize what the advantages are; another is to provide them with strategies on how to tackle the problems and help solve concerns that they have in using it. In addition, the finding of the study indicates that low skill and lack of experience is another barrier for the instructors who did not utilize the technology well. For instance, the respondents who rated their skills as the lowest were also those who had not used it. This further proved the need to expose the instructors to how to use the real time chat in both the technical and instructional sense.

As reported earlier, one respondent who supported using of audio/video listed the following advantage of using it. e.g., helping enhance the authenticity of the learning environment, create a psychological proximity, and enhance students’ understanding of learning concepts and principles. However, the finding of the study

indicated that the advantages seemed not to have been widely acknowledged. Among the 20 respondents only one chose “yes” when asked about the necessity of using the technology. In addition, the technology did not seem to be utilized to its best capacity. Kirschner (1991) found that using audio clips as one way to give feedback to student assignments was perceived as being of higher quality than text-based feedback. Provision of feedback with audio also took less instructor time. Among the only five respondents who described the way how they used in their courses, however, none of them indicated that they used the technology to give feedback or communicate with students. The finding implied that, like in the case of the real-time chat, administrators, instructional designers, and other support staff members need to provide online instructors with more opportunities to realize its advantages and to help them improve instructional strategies in using it. It is worth pointing out that compared to their responses to real-time chat, respondents who had not used the technology seemed to be more willing to consider using audio and video technology in the future. When surveyed for what new features needed to better support asynchronous discussion, one respondent listed the ability to support video. This is consistent with what some researchers found. Garrison et al. (2003) argued that “as tools become more efficient and less costly and bandwidth becomes cheaper and more widely available”, “most new computers come equipped with microphones and recording software, and video recording systems can be purchased and install on newer computers for under \$200”, there will be “considerable value” in adding such multimedia technology to the CMS (p.119).

The advantages of using teamwork, also called as group work or collaboration, has been discussed widely in the literature (Johnson & Johnson, 1996). The majority of the respondents perceived using teamwork as necessary in online courses. The reasons they gave reflected that their positions were grounded on thoughtful pedagogical considerations. The various ways of using teamwork that the respondents described indicated that the respondents were experienced on this regard. It is notable that compared to the rating of the effectiveness of the tools in supporting asynchronous discussion, the effectiveness of the tools to teamwork was rated lower. It is also interesting to notice that one respondent suggested adding synchronous video conferencing to make the tools better support. One suggestion given to better support asynchronous discussion addressed the video element as well.

When compared the respondents’ perceptions, it was found that their perceptions on the four elements varied. If the perceived importance (or necessity) of using the elements are regarding as a continuum with the most important (necessary) in one end, and the least important and not necessary on the other end, then respondents’ perception on using asynchronous discussion and teamwork will be above the middle point (neutral position) and more toward the end of most important (or necessary) side. In contrast, using real-time chat and audio/video will be lower than the neutral position, and toward the end of least important (or necessary) side. In addition, the study also found that the respondents’ position on the importance or necessity of using certain tools was related to the extent that they perceive the benefits (or advantages) and challenges (or problems) of using the tools. Specially, the more benefits they emphasized, the more likely they perceived the tools as important or necessary to use. In other words, their position will tend to be positive. If they put more emphasis on the challenges, their position will be more likely to be negative. In addition, the study indicated that there was a positive correlation between the instructors’ skills of using certain tools and how likely they have used or will use them. There was also a positive correlation found between the perceived importance and how often the tools were used. As discussed earlier, this has implications for the online administrators, instructional designer, and other supporting staff members. Workshops on helping the instructors better understand the advantages and disadvantages of using the tools, and how to use them technologically and pedagogically are needed.

Summary and Conclusions

The study attempted to investigate the current state of how instructors use technology in online courses with a focus on use of the four key elements. Namely, asynchronous discussion, real-time chat, audio/video, and team work. Major findings include that asynchronous discussion and team work were perceived as being very important or necessary to be used in online courses; while audio/video and real time chat were perceived as less important or less necessary. The way the instructors used the technologies in their courses were reported and was connected the relevant literature. The study also identified some relations between the instructors’ perceptions and their practices, between their skills of using certain tools and how often, and how likely they used them. The findings of the study will help add empirical data to the relevant research, and help online administrators, instructional designers, instructional and technical support staff, and tool developers with offering better tools, appropriate workshops, and corresponding support.

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Socio-cultural Context for Online Learning: a Case Study Viewed from Activity Theory Perspective

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Abstract

The complexities of digital age pose challenge to existing instruction technology theory as it applies to a distance learning environment. Through the lens of Activity Theory, this study takes a broad picture of an online course and examines the socio-cultural factors affecting the success of a distance course as well as their complex relationships. Interventions at the group and organizational levels will be explored to balancing local tensions emerged in the implementation of a distance course

Introduction

Computer-Mediated Communication offers great flexibility and accessibility in an online learning environment. Enormous elearning demands place distance learning from a previously marginal field to the central field of education (Moore & Anderson, 2003). However, distance educators and administrators increasingly realize the internet-supported technology offers much more than online classroom (Hara & Kling, 2000). In the most recent Handbook of Distance Education (DE), it is stated "...distance education holds the promise of better teaching, better quality of learning, and far better returns to public and private institutions for money invested education and training. None of this can happen without careful and deliberate planning, without a vision and clear policy." (Moore & Anderson, 2003). However, to plan distance education is not easy without a thorough understanding of the complex issues involved in DE. Previous research on online learning has placed much effort on comparative studies which usually produce "no significant differences" results or mixed results that have no practical values for improving the effectiveness of distance learning (The institute for higher education policy, 1999). A survey of current DE research literature noted several limitations: limited theoretical framework, failure to describe the complexities of the dynamics of online learning and lack of qualitative analysis of social-cultural factors of distance learning (Berge & Mrozowski, 2001; Holmberg, 1987; Saba, 2000).

There is a shift in educational research from focusing on how individuals function in different group or activity settings, to targeting the group itself as the unit of analysis (Dillenbourg, Baker, Blaye, & O'Malley, 1996 as cited in Bonk & Wisher, 2000). Schwen (2001) argues the prevalent instructional technology theory is often "implicitly or explicitly linked to a micro instructional theory" which are unable to explain the complexities of the digital age. This research will use Activity Theory (AT), a meso level theory, as a theoretical lens to illuminate how social, cultural and organizational factors implicitly or explicitly embedded in the structure of a distance course influence the successful online learning experience. AT examines how a group of people collaboratively work toward a common object within the context of a community that is mediated by *rule, tools and divisions of labor* (Engestrom 2001). From AT perspective, learning activities cannot be fully understood without understanding the social or institutional contexts for learning. AT suggests studying human practice in a social and historical context and emphasizes the interaction of human, social, technological and organizational behavior of human practice.

In this study, we examined systematically the socio-cultural factors affecting the success of a distance course and their complex relationships through the lens of Activity Theory. Using Activity Theory, this study also looked at the systemic tensions of distance learning unit and explored opportunities for refining existing practices to support a distance-learning course.

Methods

The study was an instrumental case study in that the overall goal will be to provide better understanding or theorizing of a complex system (Stake, 1994). The unit of analysis identified in this study was a well-reviewed distance courses in an accredited online MBA program. Two cases were examined in this study. Two courses were both core MBA courses. One course was Accounting Management and Decision Making. Another course was Strategic Marketing Management.

Semi-structured interviews were used as primary methods for data collection. The interview subjects involve with various stakeholders of the course, including the instructor, all students, technical support staff, and academic advisor. More than 30 participants were interviewed in this study for two to three times each. 15 students from Accounting Management and Decision Making and 13 students Strategic Marketing Management participated in this study. Four instructors, the chairperson, the technical support staff and other administrative support were also interviewed. The interview questions examined the participant goals in the course, social rules, program policies, allocations of responsibilities, and organizational operational process. concerned with the delivery of this course.

Meanwhile the researcher examined all online documents or offline that the researcher had access to for the study, including course syllabus, archived online asynchronous or synchronous discussion s cripts, and email communications. In addition, the researcher observed the progress of the course through online course management system to grasp some emerging issues that occurred in the process of delivering the course. The documents and observations were used to provide more specific details of the historical or contextual information of the case and the people under study as well as to triangulate emergent data in the interviews and to "corroborate and augment evidence from other sources" (Yin, 2003).

Findings

Two cases that were examined in this study seemed to have different nature and course design. Accounting Management and Decision Making involved more numerical analysis, and Strategic Marketing Management course was more discussion-oriented with case-based learning as major instruction method. However, the socio-cultural issues emerging from the study were strikingly similar. The findings below were presented under several categories, including learner factors, instructor factors and course contextual factors.

Learner

The students were unanimous in confirming that the flexibility of online learning was the most selling point for them to participate in online learning. While in their mid thirties and forties, their life was facing a lot of responsibilities, and the flexibility seemed to be the most attractive feature of online learning compared with other educational options. Normally they had three choices for further education to advance their career, traditional full-time MBA, part-time evening MBA and video-based distance education. However, the busy work schedule did not allow them to take a leave from work to enter a full-time MBA program. To enroll in a part-time program was not flexible and efficient after a whole long day work. Video-delayed program lacked interactive discussions with instructors and fellow students. Online learning seemed to be most viable learning options for the participants in this study.

Activity theory suggests that the participants are often concurrently involved in several activity systems. Each activity system has its own rules, tools and division of labors. There will be conflicts and negotiations among different roles and rules of the participants (Engestrom 2001). MBA students were extremely busy working professionals. They were facing the expectations and responsibilities of multiples communities: work environment, online learning and family. Analysis of interviews indicated the tensions among different roles and responsibilities of online learner in their work, online learning and family activity systems appeared to be one of the core tensions in online MBA courses. At any point in their life, their behavior was a constant balancing and negotiation act. Two students' quotes below described the competing responsibilities of their life as an online learner.

By working under the "put out the biggest fire first" mentality. It's the only way to get through, constant re-prioritizing all the demands.

Probably it is just. I don't know if it is this course, if it is what else is going on. In my life right now, you know, school work, other classes, spring time coming up or what, the biggest thing for me in this course is just being time management. It is hard enough sometimes to get your own, finding time to do assignment. Having to find time that both work for you and four other people to get the assignment put together. That has been difficulty. There are so many assignments. Like I said, two or three postings a week that have been turned in. The greatest challenge is just time management.

The participants consistently noted their motivation to obtain MBA degrees for a complete package of their education and for a better job prospect. They unanimously seek online programs with good reputation to

ensure that their credentials were guaranteed. Several metaphors were used frequently by the participants to describe the importance of credentials, such as “check box approach”, “company ladder”, “punch the ticket”. Thus, ranking became an important criterion for them to choose online programs because for them, good ranking means good quality of education and good job prospect. One of the participants in this study elaborated on the importance of reputation of an online MBA program.

I wanted to do MBA to have a better job prospect. I tried for admission for full-time MBA in top 3 MBA programs in US but didn't get admission. Then I started looking for distant programs that are reasonably priced for me and have brand name. Online program has the advantage of moving from one geographic area to another without abandoning the MBA program. From research in Business Week's website, I found Kelley Direct satisfies my criteria best and fulfills my needs. Hence I joined Kelley Direct MBA program.

Instructor

Rather than viewing online teaching as a transformation from traditional classroom, the instructors of two cases still viewed online learning activity system as historically new development of traditional activity system. However, the introduction of new online tools caused disturbances in the instructors' beliefs about their roles in a traditional setting and thus made them to make adjustable actions. By trying to adjust to a new environment, instructor's philosophies and beliefs about online learning were reflected from several influences: cultures and communities of profession, historical influence of traditional teaching, perceived attributes of online tools and new rules and according adapting strategies.

The instructors expected to give online MBA students equivalent education than traditional students. The new activity system of online courses retained the same objective and teaching methodologies they used in traditional classroom. One advantage of online learning perceived by the instructors was that multiple identities of online students gave them a learning advantage than traditional student. For example, one professor from the Marketing Strategic Management course commented,

So our final assignment takes them right specific to their company and hopefully the outputs in their specific job and we try to set them up by saying the assignment on the final project is to make at least one implemental recommendation for an improvement and we encourage them to show it to other people in the company because they have to interview them in that context and that sort of bolsters their ability to take the stuff which is hopefully become less abstract in the course and apply it very close to home and hopefully to obtain professional recognition in-house and that has happened sometimes.

The loss of social-contextual cues in the online activity system caused disturbances on traditional teaching process. Without the dynamics in a classroom, the instructors felt it is difficult to understand and engage students in the same way as in traditional classroom. One of the instructors commented on how he tried to use the explicit and exaggerated language to create a warm environment but perceived it as an imperfect way to do this in an online course.

Within the direct classroom there's direct relationship and it exists at different levels of intimacy, professional intimacy. Online you can sort of feign that and I always in email try to use, I learned this in '84, '85 when I was the MBA Chairman dealing with the MBA students that didn't have a class. Always I feel it's good to use warm language. So, it's not, the meeting is 5, it's I'd love to have a meeting with you tomorrow. It's to keep the language that you would never in direct verbal communication because it would be artificial but it warms a cold environment, right? But I'd like to find a way to warm the environment with more than the use of exaggerated language.

Course Context

Online Discussion Rules

The findings from activity analysis suggested that there was a contradiction embedded in the rules of

online discussion, that is, the **mandatory vs optional** participation in discussion forum. It was observed that when online participation was mandated, the majority of the students tended to post for visibility. Their attentions were blocked on the participation grade rather than meaningful participation. When it was optional, there were few participants. Most students did not participate and attributed it to the reason of timing competitions. When asked whether an online discussion should be made mandatory to stimulate more interactions in an online course, one participant commented,

“I agree with it as well. But I don't think that's enough. If participation is made mandatory like in the marketing class vs. accounting class, true that most people will post on time, but more people post their comments about the topic instead of comments about others' posting. If it is optional, I think it mostly depends on how busy I am. For example, I am so busy with the marketing class and trying to catch up with the accounting class reading that it is very difficult to push myself to get involved in the optional online discussion in the accounting class.”

The findings once again suggested that the reality of online students, their extremely busy work and study life, constrained their active participation in online learning activities.

Secondly, findings also suggested that lacking of teacher's presence seemed to be one of the reasons that the discussion forum was not attractive to students. Some students indicated that instructor needed to be involved to argument and redirect the discussion to make it more interesting and refreshing so as to avoid the comments posted by the students reached the saturation of the complexities of the questions. The following quote illustrated the point that the presence of instructor in a mandatory discussion forum could facilitate meaningful discourse online.

I don't know whether I had mentioned my last course I used to take in UM. The instructor had kept 20% grade on the discussion ... what she had done was that she said she would read everybody's post and then she had said that you cannot be just posting yes or no such answer, you have to be thoughtful l... there has to be someone there to moderate the discussion right. This would do that in that case.

Course structure and organization

Almost all student participants agreed on that “stay with the schedule” was an important rule for learning online. On one hand, this again implied the competing responsibilities of online learner which caused the difficulty in catching up with the schedule. On the other hand, the students noted that any unpredictable schedule change might cause disturbance on their study schedule and affect their learning performance. Many times online MBA students looked for regularity in course design, they preferred weekly based modular format, clearly specified deadlines and regular deliverables. To have structured course plan seemed to be important for them to plan ahead and ensure their participating in an online course.

Because if you slow done, you are going to be passed up. The course will leave you behind especially when it is in a hurry pace. That is something to think about, have twelve weeks. You almost jamming everything, you are doing your best to stay up with this, to absorb and to own the knowledge you are taking in. that is a tough thing to think about it.

I wish there were more frequent assignments in this class since that would insure I'm grasping the material incrementally and on schedule. Assignments are a couple weeks apart and cover content from several chapters so it's difficult to know if you're understanding the content as well as needed since the assignments and quizzes are scheduled so far apart.

However, the findings also suggest that there was a tension between the **structure** and the **flexibility** of course design. Overly structured online course might cause disturbance in students' activities. Within overall structure, the threshold of flexibility was also essential because this was the point that they chose online program. For example, several days time frame was necessary for an online exam so that it can accommodate individual differences on their work schedule. The tension of structure vs. flexibility was well illustrated in the quote of a student from Strategic Marketing Management course.

I think originally there were a whole lot more flexible than they are now. Now, you know, as you get into the MBA classes and I think as they've gotten more experience with some of the classes, it seems that they've gotten a little more rigid on you having specific dates and times that you have to have things done. In at least some of my classes, I've seen those to be, you know, it's not nearly as flexible as it was at first. You have, especially with a lot of group work. You know, you'll have a deadline that's pretty rigorous and in order to get going, you have to start ahead of time planning and, you know, meeting with your group and doing, coming together and doing different deliverables up front to put together the groundwork to create your final presentation, so I've found that lately it's gotten more just like a normal class. But you still do know up front what you have to do.

Online Community

Analysis of interview transcripts revealed that the students who participated in two courses had a very weak sense of belonging to an online class. Instead, the sense of community feeling came from the group they worked with. For example, when asked whether he felt a sense of community in this course, a participant stated: "... I haven't exchanged notes or compare thoughts with others in the class. To me the class is [student name1], [student name2] and the professor." Another participant admitted that he had rarely interacted with any students other than the group members and teacher in this course. When asked whether he felt a sense of community, he stated, "Not really. I think maybe with the professor and our group, but not necessarily the other groups as much."

Many participants indicated the sense of community came more from their team than from the class. Sometimes the students interacted intensively with group members, however, their sense of community didn't go beyond the group community. Two students commented,

I think we're all going through the same thing in the course and in reading what the other classmates are thinking, whether it's different or the same, it kind of, yeah, it forms a kind of community, but I think the major community that we do form is with our own team members.

Frankly, not in this course. Even in other courses, the learning community didn't develop beyond the group members. Only in Quant course, professors used to hold lectures (literally) in chat rooms at specified times. That was the only real learning community experience so far.

Many students agreed that it was important for them to feel a sense of belonging to an online community because it provided them with a socially supportive environment. The following quote demonstrated the perceived benefits of an online community.

I think it is very important that students feel they are in it together, for both emotional and academic support. It is not easy to get through this program since it is very demanding. And only students who are in the same program would understand the difficulties.

When asked to give an example of a class where they felt a good sense of community, many participants mentioned a course where they felt a strong sense of community in one of the chat rooms. An participant commented,

Yes, I had a decision analysis class with [instructor name] last semester that had a great sense of community. We had scheduled weekly class chat sessions. [Instructor] instructed and took questions from the class on the material. We also used the time to review assignments and ask questions. There was a lot of interaction with John, with our TA, and amongst the students. It did a lot for my confidence in learning the material and understanding the process, not just the solution. And it was good to know that other students had the same questions/problems I was having.

The online courses featured a weak sense of belonging to a class community among online learners. However, it seemed that the community existed at the small group level. Even so, as indicated by the students, the group community usually discontinued when the class was over.

Teamwork

Majority of the participants indicated that in online learning environment, group work was valuable because the group brought different backgrounds and assets of the people together to share. As one student commented,

In this course [name] and [name] I am working with we worked together very well. Again it is neat to meet these GM people you wouldn't meet otherwise because GM is so large, so diversified, we work with people in very different areas that have very different responsibilities from what I have. We all bring different backgrounds and different assets in these groups. It is a great experience.

Within a team, the students usually divided the tasks of one assignment and work on it, and then different parts were compiled together as one group deliverable. The requirement for the coordination on the tasks was high, which was in conflict with the efficiency-oriented feature of teamwork process. Contradiction usually occurred when long meeting time was spent on coordinating different opinions, especially when the issues were not related to the critical content but rather to the task-related issues. One participant commented,

The teamwork is at times very valuable at times frustrating. I will take the barco case for example. The final product was just one page. A lot of team issues were that you were kind of debating among yourselves what to present on that one page. It wasn't technical. It was more than just trying to present your idea, how to defend your own ideas ... Sometimes time spends more on team related issues rather than course related issues. I was much preferred to have the ability to have my own response to work with a team to learn and then with our own response.

Though students valued the experiences and lessons learned from dealing with different personalities (identities) in a team work, such alignment of different personalities (identities) can be difficult sometimes that it causes resistances on collaboration in online courses. The disturbances within teamwork were sometimes caused by the conflict or inconsistent views on quality standards about the group product. Specifically this kind of issues occurred in a team where majority team members had lower standards than minority. The following quotes represented two such examples.

Sometimes I've gotten, I've told somebody that, okay, you're going to be working on this part of the assignment and they'll come back with basically just crap and, you know, I'm not going to turn this in, so I'm left trying to take what they've given me and revising it to something that's at least legitimately good to be going to the professor and that's probably an advantage where you, if you were in class and you were able to get a better understanding of what people's capabilities were from just the basic interaction that you would have in class, it would really help out.

There are problems with online learning. Participants post message board only for the purpose of assignments. Very few teams had real interactions or consistent interactions ... Whenever we dialed up in the teleconference, and found out that there was not much to discuss (because we were not prepared). Most of the people look like ... OK, when is this due and what is the format, then we started dividing our task, then after a while, people say, sorry, I have to pick up my children. Then the meeting is over. Very few people will sit down and ask each other, what you think of this question ... "

With highly efficient and task-oriented teamwork, conflicts develop between high-performance, task-oriented goals and the social-emotional needs of the participants. Participants indicated that their teamwork can mainly satisfy the task needs of the group instead of social need due their tight schedule.

We tried not to waste too much time chatting about non-class related subjects. Again, it all comes down to time spent on homework vs. time spent on the rest of your life. The faster we can divide the work and reach consensus on an issue the better.

However, the participant indeed felt lack of opportunities to socialize with team members made it difficult to develop good group dynamics. In traditional classroom, people learn from body language and facial expression. In online environment, the loss of behavior cues created barriers for students to really get to know each other's personalities. The participants indicated that this kind of "knowing" is important because it could help with coping with different personalities to create a better atmosphere.

In a physical meeting, people usually come a little earlier. For teleconference, people always arrive at the exact time or only one or two minute difference. So this leaves little time for socializing. In addition, people were not familiar with each other and cannot see each other's body language. Even people can speak up, they are mostly superficial... Basically we don't know each other. We don't know each other's personalities. Some people are more aggressive and some are more conservative. If we can meet face-to-face, we would take this factor into consideration. However, if we cannot meet face-to-face, just by phone or internet, it takes longer to make an impression on that person. However, this course only lasts ten weeks. When you started to get a sense of his personality, the train already left the station.

Conclusion

Through the lens of activity theory, this case study depicted a rich picture of online MBA courses in its activity context. The findings suggest that there are various facets of an online course that affect the performance of online participants as well as the success of the course overall. In reviewing the findings, it is not difficult to conclude that it is important to design a course that takes into the consideration of learner's social context, e.g. competing responsibilities, the commercialism of MBA education etc. Understanding these contextual factors is important for us to decode the complexities of an online course, the priority level of online students and their performance and behavior on learning tasks. Such considerations could result in the deliberate selection of course materials that do not over teach and structure meaningful learning experiences that really motivate online learners. Secondly, the findings suggest that the culture of an online course seems to be temporal and it might be difficult to facilitate an online learning community within a short time frame. To facilitate the community building in an online course, there needs a structure to facilitate the building of a congenial social atmosphere either at the class level or at the cohort level, e.g. inter-group activities, social activities among cohort level. Finally, there seems to be a fine line between structure and flexibility. Well-structured and planned learning environment is desirable in online learning environment. However, online course design also needs to take into consideration the "flexibility" factor of online learning.

As a case study, the generalization of the results from the context of this study is limited. However, the strong socio-cultural themes that emerged from the study provide a framework for assisting distance educators and policy makers to make educational policies and practices for providing satisfactory education experiences for various participants in similar online learning environment.

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The Impact of Computer-Mediated Intercultural Communication on Learner's Cultural Awareness and Sensitivity: A Case Study

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Abstract.

This study examined the changes in the level of intercultural competence of high school students that had participated in a transnational project where technology was utilized to exchange information, ideas, and create a final web-based product. Participants of the study included 162 tenth grade students from three different high schools located in the U.S. and Taiwan. Data was collected from pre and post self assessment surveys and in-depth interviews with selected participants were conducted. Results show that American students as well as students with prior travel abroad experience had higher levels of intercultural competence compared to Taiwanese students and students with no travel experience. It was discovered that prevalent language barriers had prohibited the communication and collaboration between the participating students.

Introduction

Upon entering into the 21st century, it is becoming more evident of how increasingly interdependent and interconnected we are. As the children of today are the decision makers of tomorrow, it is imperative that they not only possess the knowledge and attitudes for becoming responsible, well-informed citizens of the society but are also equipped with the skills and capabilities to be able to work or perform in a variety of diverse settings that would call for interaction with people from different cultures. In other words, our students need to acquire a global perspective (Ramler, 1991) as well as develop a level of intercultural competence in which they have "the ability to interpret intentional communications and customs in cultures different from one's own" (Bennett, 1999).

According to Hanvey (1979), there are five key dimensions to a global perspective; perspective consciousness, "state of the planet" awareness, knowledge of global dynamics, awareness of human choices, and cross-cultural awareness. To achieve the goal of cultivating a global perspective in our next generation, we should provide students with learning opportunities that will help enhance their awareness and understanding towards intercultural and international "human relations, critical thinking, social sensitivity, and civic responsibility" (Garcia, 1999; Le Roux, 2001). In addition, Hughes-Wiener (1988) proposed that internationalizing the curriculum by incorporating cultural understanding, intercultural sensitivity, and attention to cultural change across the disciplines will help students develop a greater understanding in breadth and depth of the subject being learned.

With the advent of information communication technology (ICT), especially the Internet, valuable tools and resources that can "bridge gaps in international communication and help erase cultural and social boundaries between countries" (Lu, 2003; Szente, 2003) are made available. These rapid advancements in ICT have created many opportunities for teachers and students to be able to acquire immediate access to the world. Moreover, curriculums can be enriched as learning is contextualized through the cultural and linguistic diversity of transnational communities that are built through the Internet. Hence, we have seen a growing number of classrooms joining online learning networks and communities where teachers and students from around the world are able to get together to work on collaborative projects or carry out cross-cultural email exchanges. However, not all outcomes or results from joining online learning networks or email exchange projects meet the expectations of the participants (Lu, 2004). Nevertheless, despite the recent trend and increasing interest in utilizing technology to promote cross-cultural learning and collaboration, few studies have explored the impact of these learning experiences on the participants in terms of their cultural awareness, attitudes and sensitivity. Therefore, this study is an attempt to examine the impact of computer-mediated intercultural communication on learners' cultural competence that includes cultural awareness, understanding, acceptance and appreciation of

diversity (Ward & Ward, 2003).

The Intercultural Communication Over the Net (ICON) Project

This Intercultural Communication Over the Net (ICON) project is a transnational collaborative project between one high school in the U.S. and two high schools in Taiwan that was facilitated in the beginning of the year 2004 by the College of Education at the University of Missouri - Columbia, USA and the Graduate Institute of Education in National Chiao Tung University, Taiwan.

Like other transnational or international network projects via telecommunications technology, such as emailing or video conferencing, the ICON project provided the opportunity for participating teachers and students to build local-to-global, cross-cultural learning through the interaction and collaboration with people from other nations or cultures. Therefore, the ICON project researchers conducted an exploratory study examining the impact of learning with people from a different culture on the learner's level of intercultural competence.

Method

Sample

The sample consists of students (n=162) from three different senior high schools in the US and Taiwan. The teacher from the high school in St. Louis, Missouri USA, was interested in partaking in a cross-cultural exchange project and therefore agreed to have her students in all four of the classes that she was currently teaching, totaling 64 students, participate in the ICON project. Also, a teacher from Taiwan had her students from three different classes in two different high schools in Taipei, Taiwan, totaling 98 students join the ICON project as well.

Materials

The ICON project researchers were responsible for creating the collaborative activities for the participating classes. Many factors were considered in the design and development of the interdisciplinary instructional materials and instructional tasks. First of all, in order to prevent the ICON project from becoming an "add on" to their already packed curriculum, the expectations of the teachers and the overall curriculum goals had to be taken into account so that participation in the project will be seen as something that can actually enhance the students' learning experience. Therefore, in the initial stage of the project, the researchers had discussed with the participating teachers what their expectations of the ICON project were and how they thought it would fit into their curriculum. Information gathered from the discussions helped the researchers determine the content and format of the instructional activities.

Secondly, it was essential that the instructional activities focused on themes that introduced the students in a systematic way to different cultural traditions and norms as compared to their own so to foster intercultural insight, understanding and sensitivity. However, the context should also easily relate to real life experiences so that the students are encouraged to examine and reflect on their own perspectives, attitudes and cultural background. Therefore, the overall theme for the instructional activities was "Going abroad to study" and the sub-themes consisted of "Classroom culture" and "Scenic spots".

Finally, due to the physical distance between the participants, all communication and collaboration were to be done through the Internet utilizing online discussion boards, a computer mediated communication (CMC) tool. As the value of the project lies in the quality of the interaction and the exchange of information and ideas between the students, the researchers created structured discussion board topics and relevant questions to prompt the communication. Therefore, the instructional tasks included participation in structured discussions with an assigned partner; one discussion board for each of the two sub-themes, each one lasting for one week, and then in the third and final week, the paired groups create a web page reporting what they have learned from their discussions.

Instruments

In order to ensure data triangulation, a combination of quantitative and qualitative data collection approaches were employed, including: (a) pre and post surveys, (b) pre and post interviews with the teachers, (c) post interviews with selected students, and (d) student performance assessment through analysis of student artifacts. The surveys were the primary source of data as the follow-up interviews with participating students

provided support or clarification of preliminary findings.

The pre-/post survey instruments included the researcher-developed 36-items self-assessment survey, three open-ended questions and a background data sheet consisting of information, such as gender, cultural background, travel experience, and knowledge of other languages, were also collected from the survey. The 36 items were adapted from existing measures of multicultural personality and awareness and cross-cultural sensitivity, including measures developed by Cushner, McClelland & Safford (2002), D'Andrea, Daniels, & Heck (1991), Helfant (1952), Thurstone (1931) and Van der Zee & Van Oudenhoven (2000). The items selected were used to measure the intercultural knowledge and competence of the students. It also aimed to understand students' perception and attitudes towards other cultures, people from other cultures, and international relations.

Design and procedure

Implementation of the project started in early March of the year 2004 and was completed in early May of the same year. In this study the effects of the three-week intervention (i.e. instructional collaborative activities) were judged by the difference between the pre-survey and the post-survey results.

The intervention consisted of two aspects; the cultural scenario and the learning partner. The cultural scenario was based on learning about either American or Chinese culture. In addition to learning about a specific cultural scenario, the students were divided into two groups: the experimental group included intercultural pairs that consisted of one student from each culture (i.e. one American student and one Taiwanese student); the control group included intracultural pairs that consisted of students from the same culture (i.e. either all American students or all Taiwanese students).

Students were asked to complete required activities during the three-week implementation with their learning partner. The content of the final product was developed during the pair group collaboration and presented via web pages.

It was hypothesized that students who worked with a collaborative learning partner from another culture will develop a greater sense of cultural awareness and sensitivity than those working with a learning partner from the same culture. This is based on the belief that increased cultural knowledge and attitudes are associated with greater prior contact with or exposure to people from different cultures. Such results would demonstrate the significance and efficacy for participating in cross-cultural collaborative learning projects via the Internet.

Results

Of the 162 ICON project participants, 104 completed both the pre-survey and post survey. As stated earlier, the main purpose of this study was to examine the impact on the level of intercultural competence of students that had participated in a collaborative activity with a learning partner either from the same culture or from a different culture. In Table 1 a crosstabulation of the change between the pre and post survey results of the American and Taiwanese students that were either studying about their own culture or a different culture with a culturally same or culturally different learning partner is shown. The difference between the pre and post survey results was categorized into three levels; negative impact (pre survey results > post survey results), no impact (pre-survey results = post survey results), and positive impact (pre survey results < post survey results).

From Table 1 it shows that more than half (60.5%) of the American students self-assessed that the collaborative project had an overall positive impact on their level of intercultural competence. However, on the other hand, only a little over a third (39%) of the Taiwanese students thought the project had an overall positive impact.

Table 1: *Crosstabulation of Pre-Post Difference * Learning Partner and Cultural Scenario * Cultural Background*

| Cultural Background | Learning Partner and Cultural Scenario | | | Total |
|---------------------|--|--|---|-------|
| | Someone from different culture, studying one's own culture | Someone from different culture, studying a different culture | Someone from same culture, studying a different culture | |
| | | | | |

| | | | | | | | |
|--------------|------------------------|--------------------|------------|-------|-------|-------|--------|
| America n | Pre-Post Difference | Negative impact | Count | 2 | 2 | 3 | 7 |
| | | | % of Total | 5.3% | 5.3% | 7.9% | 18.4% |
| | | No impact | Count | 3 | 1 | 4 | 8 |
| | | % of Total | 7.9% | 2.6% | 10.5% | 21.1% | |
| | | Positive impact | Count | 3 | 6 | 14 | 23 |
| | | % of Total | 7.9% | 15.8% | 36.8% | 60.5% | |
| | Total | | Count | 8 | 9 | 21 | 38 |
| | | | % of Total | 21.1% | 23.7% | 55.3% | 100.0% |
| Chinese | Pre-Post Difference | Negative impact | Count | 9 | 8 | 13 | 30 |
| | | | % of Total | 13.6% | 12.1% | 19.7% | 45.5% |
| | | No impact | Count | 1 | 3 | 6 | 10 |
| | | % of Total | 1.5% | 4.5% | 9.1% | 15.2% | |
| | | Positive impact | Count | 4 | 5 | 17 | 26 |
| | | % of Total | 6.1% | 7.6% | 25.8% | 39.4% | |
| | Total | | Count | 14 | 16 | 36 | 66 |
| | | | % of Total | 21.2% | 24.2% | 54.5% | 100.0% |

An independent samples T- test was then performed to check if there was a significant difference between the American and Taiwanese student in terms of the impact on their level of intercultural competence after participation in the project. Results indicate that the impact of participating in the ICON project had a significant positive difference on the level of intercultural competence of the American students ($M = 1.61$, $SD = 3.04$) than the Taiwanese students ($M = -.21$, $SD = 3.05$), $t(102) = 2.93$, $p < .05$.

Therefore, the researchers continued to examine whether student's prior personal experiences such as the amount of travel abroad experience had any influence or impact on their level of intercultural competence before and after participation in the project.

In Table 2 it shows the pre-survey results of American and Taiwanese students based on their amount of travel abroad experience. The researchers categorized the pre-survey results into three levels of intercultural competence; low (total survey score from 8-16), moderate (total survey score from 17-25), and high (total survey score from 26-32). Also, the amount of travel abroad experience was categorized into three levels as well; no travel experience (has never traveled before), some (have traveled 1-3 times), a lot (have traveled at least more than 3 times).

Results show that in the case of having no travel experience, neither American nor Taiwanese students had assessed themselves as having a high level of intercultural competence.

Table 2: Crosstabulation of Pre-survey * Amount of Travel Experience * Cultural Background

| Cultural Background | | | | Amount of Travel Experience | | | Total |
|---------------------|----------------------------------|------------------------------------|------------|-----------------------------|---------------------------------|---------------------------------|--------|
| | | | | None | Some (traveled 1-3 times) | A lot (more than 3 times) | |
| American | Pre-survey | Low intercultural competence | Count | 2 | 2 | 1 | 5 |
| | | | % of Total | 5.3% | 5.3% | 2.6% | 13.2% |
| | | Medium intercultural competence | Count | 8 | 8 | 12 | 28 |
| | % of Total | | 21.1% | 21.1% | 31.6% | 73.7% | |
| | High intercultural competence | Count | 0 | 2 | 3 | 5 | |
| | | % of Total | .0% | 5.3% | 7.9% | 13.2% | |
| | Total | | Count | 10 | 12 | 16 | 38 |
| | | | % of Total | 26.3% | 31.6% | 42.1% | 100.0% |
| Chinese | Pre-survey | Low intercultural competence | Count | 6 | 7 | 3 | 16 |
| | | | % of Total | 9.1% | 10.6% | 4.5% | 24.2% |

| | | | | | | |
|-------|---------------------------------|------------|-------|-------|-------|--------|
| Total | Medium intercultural competence | Count | 18 | 22 | 8 | 48 |
| | | % of Total | 27.3% | 33.3% | 12.1% | 72.7% |
| | High intercultural competence | Count | 0.0% | 1 | 1 | 2 |
| | | % of Total | | 1.5% | 1.5% | 3.0% |
| | | Count | 24 | 30 | 12 | 66 |
| | | % of Total | 36.4% | 45.5% | 18.2% | 100.0% |

Subsequently, similar to Table 2, in Table 3 it shows the post-survey results. Comparing the two Tables 2 and 3, we can see that after participation in the ICON project, none of the American students assessed themselves as having a low level of intercultural competence regardless of their amount of travel abroad experience. In addition, the number of American students with “high intercultural competence” increased from 5 to 8 students.

On the contrary, even though the total numbers in each categorical level of intercultural competence for the Taiwanese students did not change between the pre and post survey, the numbers in each of the cells however did change. In the “No travel experience” column, not only did the number of low level intercultural competence increased from 6 to 10 Taiwanese students but the number of moderate level intercultural competence also decreased from 18 to 14 Taiwanese students after participation in the project. Then again, for Taiwanese students with either some or a lot of travel abroad experience, the numbers in the low intercultural competence decreased while the numbers in the moderate intercultural competence had increased.

Table 3: Crosstabulation of Post-survey * Amount of Travel Experience * Cultural Background

| Cultural Background | | | | Amount of Travel Experience | | | Total | |
|---------------------|-------------|---------------------------------|------------|-----------------------------|------------------------------|------------------------------|-------|--------|
| | | | | None | Some (traveled 1-3 times) | A lot (more than 3 times) | | |
| American | Post-survey | Medium intercultural competence | Count | 7 | 10 | 13 | 30 | |
| | | | % of Total | 18.4% | 26.3% | 34.2% | 78.9% | |
| | Total | High intercultural competence | Count | 3 | 2 | 3 | 8 | |
| | | | % of Total | 7.9% | 5.3% | 7.9% | 21.1% | |
| | | | | Count | 10 | 12 | 16 | 38 |
| | | | | % of Total | 26.3% | 31.6% | 42.1% | 100.0% |
| Chinese | Post-survey | Low intercultural competence | Count | 10 | 5 | 1 | 1 | |
| | | | % of Total | 15.2% | 7.6% | 1.5% | 24.2% | |
| | | Medium intercultural competence | Count | 14 | 24 | 10 | 48 | |
| | | % of Total | 21.2% | 36.4% | 15.2% | 72.7% | | |
| | Total | High intercultural competence | Count | 0 | 1 | 1 | 2 | |
| | | | % of Total | .0% | 1.5% | 1.5% | 3.0% | |
| | | Count | 24 | 30 | 12 | 66 | | |
| | | | | % of Total | 36.4% | 45.5% | 18.2% | 100.0% |

Another independent samples T- test was performed to see if there was a significant difference between students with travel experience and students without travel experience in terms of the impact on their level of intercultural competence after participation in the project. Results show after participation in the ICON project, students with prior travel abroad experience (M = 25.24, SD = 4.31) significantly have a higher level of intercultural competence compared to students with no travel experience (M = 23.59, SD = 3.73), $t(102) = -2.02, p < .05$.

Following the data analysis of the pre and post survey results, the researchers proceeded with reviewing student artifacts and conducted in-depth interviews with 9 American and 6 Taiwanese students. Information acquired from the interviews provided valuable insight into the project’s learning experience and the students’ perspectives in terms of expectations, limitations, and accomplishments.

Discussion

The present study yielded two major findings. First, prevalent language barriers and limitations seriously inhibited the communication and collaboration between American and Taiwanese students. English

was the primary language used in the project, even though there were Chinese versions of the pre and post surveys as well as instructional materials, however all discussion board communication and development of the final product had to be in English. Therefore, being English as a Foreign Language (EFL) learner, the Taiwanese students felt deeply challenged and frustrated because they were limited by their lack of English proficiency. One Taiwanese student commented in her interview that she spent more time looking up new vocabulary in the dictionary than working on the collaborative activity. On the other hand, some American students did not realize that language barriers were the main reason for their partners' lack of response, which had made them feel discouraged at the time. Referring back to Table 1, this might explain why there were such high numbers of positive impact from students that were assigned with a learning partner from the same culture because language barriers may not have been as a serious problem when it came to working with someone from the same culture.

Second, the experiences of exposure to different people and culture, such as traveling abroad, not only enhances a persons' level of intercultural competence, but it also increases their capability and motivation to learn and develop more than others with less exposure to diverse people and cultures. In other words, the more a person experiences culturally different people and things, the higher their level of intercultural competence is. Unfortunately, not all people have the opportunity to experience or become exposed to diversity due to their surrounding environment or current situation. However, rather than studying about a culture from reading books or watching television, the project researchers believe that learning with and from a person of that culture is the most effective and motivating way to learn as technology plays the crucial role of bridging the gaps in time and distance between people from different countries and cultures.

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Predicting Intrinsic Motivation

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Abstract

Intrinsic motivation can be predicted from participants' perceptions of the social environment and the task environment (Ryan & Deci, 2000) in terms of control, relatedness and competence. To determine the degree of independence of these factors 251 students in higher vocational education (physiotherapy and hotel management) indicated the extent to which they perceived control, relatedness, and competence in different types of education, their motivation to learn, and their study behaviors. Principal component analysis showed that the perceptions of control, relatedness and competence are so strongly related that when students rate one of the constructs negatively, such as their perception of the task control, they will also rate the others (relatedness and perception of competence) more negatively. These results were confirmed by analyses of two additional data sets. Consequences for measurement issues and motivational science are discussed.

Predicting Intrinsic Motivation

In the past two decades there has been a strongly renewed interest in the study of motivation in relation to learning. Simon (1995), for example, noted that it “is imperative for progress in instructional methods that we deal simultaneously with cognition and motivation in our research... We already have too much medicine that is (cognitively) good for the patient – who will not take it - and medicine that patients find delicious – but that contributes little to their cognitive abilities” (p. 508). Pintrich (2003) described this as a *motivation science* coming into being.

This interest has much to do with a new view on education. Simons, van der Linden, and Duffy (2000) for example stress *new* instructional methods (in their words “new learning”) such as independent learning, discovery learning, experiential learning, self-directed learning, problem-oriented education, simulations, and work-based learning. To a large extent, these methods are based on constructivism in which, according to Reiser (2001), learners are responsible for their own learning process. Such self-regulated learners are motivated, independent, and metacognitively active participants in their own learning (e.g., Bastiaens & Martens, 2000; Dalgarno, 1998; Duffy, Herrington & Oliver, 2000; Lowyck & Jonassen, 1993; Pierce & Jones, 1998; Wolters, 1998). All of these instructional methods hold that stimulating motivation is crucial in learning, but while an increasing number of researchers are trying to link instructional strategies, motivational processes and learning outcomes (Ellinger, 2004; Garris, Ahlers & Driskell, 2002), the research evidence is still “embryonic” (Garris et al., p. 442).

Motivation is not an easy concept to define because it is related to many partly overlapping theoretical constructs (Norwich, 1999). On the one hand it is seen as a relatively stable personality trait (e.g., Sheldon, Ryan, & Reis, 1996), while on the other hand it is seen to vary from situation to situation (e.g., Boekaerts & Minnaert, 2003). This article sees motivation as the latter case and finds its roots in the work of Ryan and Deci (2000) who distinguish between extrinsic motivation, which refers to the performance of an activity in order to attain a certain outcome, and intrinsic motivation, which refers to doing an activity for the inherent satisfaction of the activity itself. The effort or motivation on which constructivist learning environments try to rely is typically intrinsic motivation, with its associated features as curiosity, deep level learning, explorative behavior and self regulation (Martens, Gulikers, & Bastiaens, in press). Research has shown that intrinsically motivated students exhibit study behaviors that can be described as explorative, reflective, self-regulated, and aimed at deep level processing (e.g., Boekaerts & Minnaert, 2003; Martens et al, in press; Ryan & Deci, 2000).

Ryan and Deci developed a model to explain and predict the persistence of intrinsic motivation. They state : “...our theory of motivation does not concern what causes intrinsic motivation (which we see as an

evolved propensity; Ryan et al, 1997); rather it examines what conditions sustain versus subdue and diminish, this innate propensity” (p. 70). This approach can be linked to evolutionary psychology and can be found, for example, in work by Bjorklund and Bering (2002) and Bjorklund and Pellegrini (2002). In their view, if humans become *amotivated* there is a reason for this in their perceived social and physical environment. This is quite different from the often taken developers’ viewpoint that it is the developer (of education, of games, of ...) who has to make the material motivating (e.g., the ARCS Model of Motivation from Keller and Suzuki, 1988). In spite of this theoretical difference, practical advice and guidelines derived from both viewpoints partly overlap.

Cognitive Evaluation Theory (Ryan and Deci, 2000) predicts that the perception of certain aspects of the social and task environment are crucial to intrinsic motivation. These perceptions may influence each other, but exactly how is unclear. More specifically, a sense of relatedness, control or competence is seen to be positively correlated with intrinsic motivation. Various authors describe these aspects as predictors, factors or mediators. If, for instance, the amount of control is varied, then the perception of control can be considered as a mediator between variation in control and intrinsic motivation. For purposes of clarification, this article will speak of the perception of relatedness, control and competence as predictors since they can be seen to predict intrinsic motivation.

Cognitive Evaluation Theory describes stages in motivation, varying from amotivation via introjection to intrinsic motivation for which scales have been developed. Although the debate is still going on, quite some research evidence for this model has been built. Some of this evidence will be presented here.

Perception of control has been shown to be positively correlated with intrinsic motivation (Enzle & Anderson, 1993; Hardre & Reeve, 2003; Nichols, 2004; Pelletier, Seguin -Levesque, & Legault, 2002). Raffini (1996) stated that students’ need for a sense of autonomy or self-determination significantly influences their intrinsic motivation to learn in the classroom and stresses the importance of building a sense of autonomy in students by providing them with choices. This effect has also been reported for educational software, for example, by Cordova and Lepper (1996) and Kinzie, Sullivan and Berdel (1988). Iyengar and Lepper (2000) also found that too much choice or control can be experienced. Deci, Koestner and Ryan (1999) performed a meta-analysis on the effects of extrinsic rewards - a form of external control (Henderlong & Lepper, 2002; Norwich, 1999) - on intrinsic motivation and found that many forms of external reward undermine intrinsic motivation.

Perceived competence is the whole complex of beliefs about one’s own competences and as such is highly related to self-esteem, the evaluation of one’s self-concept. According to Harter (1990), perceived competence is an important psychological mediator of achievement behavior and motivation among children and adolescents in the academic domain and has often been demonstrated to affect intrinsic motivation. In a correlational study, children’s self-reported perceptions of academic competence and personal control were found to be positively related to their intrinsic interest in schoolwork and preference for challenging school activities (Boggiano, Main, & Katz, 1988). Competence can be perceived through praise, through comparisons with other students or other indications of good performance or through meaningful effort (e.g., Henderlong & Lepper, 2002). Finally, objective mastery praise has been shown to be better than social comparisons in affecting motivation (Henderlong, Tomlinson, & Stanton, 2004).

Finally, a *sense of relatedness* (belongingness or connectedness with others) has quite often been demonstrated (e.g., Ryan & Deci, 2000; see also Furrer & Skinner, 2003 for an overview) to have a positive impact on intrinsic motivation, and thus on engagement and persistence. Relatedness is characterized by fulfillment and involvement with the social world. This social aspect affects relatedness by creating a climate or culture of trust, respect, caring, concern, and a sense of community with others. In a related area Kreijns and Kirschner (2004) have studied the role of this social interaction in collaborative learning. They show that the existence of a sound social space - the network of social relationships amongst the group members embedded in group structures of norms and values, rules and roles, beliefs and ideals - is essential for reinforcing social interaction. A social space is ‘sound’ if it is characterized by affective work relationships, strong group cohesiveness, trust, respect and belonging, satisfaction, and a strong sense of community (cf. Rourke, 2000; Rovai, 2001).

What then are the effects of intrinsic motivation on learning? Cordova and Lepper (1996) tried to increase children’s intrinsic motivation in educational software. As predicted, children exposed to motivationally embellished activities displayed higher levels of intrinsic motivation. As a result, they became more deeply involved in their activities, used more complex operations, and learned more from the activities in a fixed period of time. Another effect found is that the risk of drop-out decreases (Hardre & Reeve, 2003; Vallerand, et al., 1997). Intrinsically motivated students are more persistent and more likely to achieve set goals (Curry, Wagner & Grothaus, 1990), and have higher levels of self-regulation (Pintrich & de Groot, 1990) than

those who are not intrinsically motivated. Intrinsically motivated adult students tend to exhibit higher subjective well-being (Levesque, Zuehlke, Stanek, & Ryan, 2004). Low intrinsic motivation, on the other hand, has been shown to be correlated with educational self-handicapping, avoidance behavior, loss of social support networks, and passivity (Thompson, 2004). Overviews (e.g., Ryan & Deci) indicate that intrinsically motivated students are more curious and engage in more deep level learning, an effect that holds true for students of all age groups (cf. Bruinsma, 2003; Turner et al, 1998; Wolters & Pintrich, 1998;). It is, however, not necessarily the case that more extrinsically motivated students always do less (Ryan & Deci, 2000). Martens et al (in press) found that students with high intrinsic motivation do not do more in computer based learning programs, but do different things (i.e., they exhibit more exploration behavior). A compounding problem is that it sometimes is impossible to design educational tasks that are intrinsically motivating to all students (Kaufmann & Husman, 2004). In other words, we need to know more about how motivation affects cognition. This is, according to Pintrich (2003), one of the leading questions to be answered by the 'motivational science'. Thus, although it is clear that perception of control, relatedness and competence are related to intrinsic motivation, it is unclear how they are interrelated. Rarely do researchers present data about such mediators or predictors and even more rarely are these data presented with all the possible mediators together. That there are relations is evident, since all these predictors are related to scales measuring intrinsic motivation.

For any science the exact measurement of its basic constructs is crucial. Unfortunately, in motivational research there are four important problems that hinder this, namely.

- It is unclear how control, relatedness and competence are related. Do they strengthen each other? Do they compensate for each other?
- Most researchers do not measure these three predictors. Reeve, Nix and Hamm (2003), based upon an analysis of more than 300 studies, conclude that very few researchers actually investigate the impact of what may be called autonomy (or lack of control or choice) as a possible mediator in the relation between choice and intrinsic motivation.
- There are serious measurement and definition problems such as what the exact definition is of perceived control. Deci and Ryan (1987), for example, see autonomy or the absence of external control as a theoretical concept connoting an inner endorsement of one's own actions (origin, personal causation, internal locus), an experience during that action of high flexibility and low pressure (psychological freedom), and a sense that one's actions are truly chosen (perceived choice). Current theoretical statements treat these qualities as overlapping and mutually supportive, but others doubt this (e.g., Reeve et al., 2003).
- Investigators who routinely use different psychometric measures to operationally define the three predictors often rely either on a single item predictor (Boggiano et al., 1993; Eisenberger, Rhoades, & Cameron, 1999; Overskeid & Svartdal, 1996) or only a pair of items (Reeve & Deci, 1996; Thompson, Chaiken, & Hazelwood, 1993). According to Reeve et al. (2003) "researchers question the validity, internal consistency, and conceptual ambiguity these measures generate. This limits researchers' attempts to theoretically understand and operationally define self-determination as an ephemeral, situationally sensitive, and state-like experience (i.e., state self-determination). In contrast, efforts to assess perceived self-determination as an enduring characteristic in the personality (i.e., trait self-determination) have been deemed psychometrically sound." (p. 375). Highly reliable, valid, and educationally useful instruments to assess trait self-determination include the Academic Self-Regulation Questionnaire (Ryan & Connell, 1989), the Causality Orientations Scale (Deci & Ryan, 1985), and the Academic Motivation Scale (Vallerand et al., 1992). Unfortunately as soon as we try to more measure perceived self-determination as based on the context or situation, it is a less stable measure. However, this is exactly what happens in most cases. Based on adaptations from scales used, most researchers develop their own variations that are specific for a certain context. These adapted scales are quite often used in correlational research and covariance structure analysis alternatively known as Structural Equation Modeling (SEM).

This brings us to the main research question of this article, namely: If multiple reliable scales to measure the perception of control, relatedness and competence in different educational situations are constructed, how many factors then underlie these predictors? An explorative analysis investigated the number of factors that underlie the predictors focusing not on questionnaire construction, but on the connection between the predictors that the scales measure. In addition, the study behavior that coincides with high intrinsic motivation is also studied. Bruinsma (2003), Ryan and Deci (2001), Turner et al. (1998) and Wolters and Pintrich (1998) all found that intrinsically motivated students generally learn at a deeper level, are more self-regulated and are more communicative than those who are not. These effects appear to occur together, possibly meaning that the

predictors are linked. If, for instance, high motivation coincides with study behavior in which the learner is more communicative, then it is likely that the predictors are strongly related since it is quite conceivable that communication is related to a perception of relatedness.

Method

Participants

Participants were 251 full-time undergraduate students, studying Physiotherapy or Hotel Management at a Dutch polytechnic. They were in the second, third or final year of the four year program and had an average age of 20.8 years ($SD = 2.04$). Seventy five percent of the participants was female. Participation (the filling in questionnaires) was voluntary and anonymous with a response rate of 80%.

Procedure

Five distinct educational systems were distinguished in five specific courses given at the polytechnic, namely:

- *Skills-based*, where physiotherapy students were involved in skills training;
- *Problem based learning (PBL)*, where physiotherapy students received education based upon specific physiotherapy problem cases in tutor groups;
- *4C/ID*, where students received education according to a competency based educational approach set up following the Four-Component Instructional Design (Van Merriënboer, 1997);
- *Practice-based*, where physiotherapy students were involved in their internship period at the end of their education; and
- *Virtual Hotel School (VHS)*, where students from the Hotel Management School work together in a virtual company.

Instruments

Four scales were developed / adapted to measure perceived control, perceived competence, perceived relatedness and intrinsic motivation. Each scale contained between three and seven items (7-point Likert scales). In Table 1 the scales are summarized with respect to their size and reliabilities. Though generic in nature, the scales were minimally specified to suit the specific educational setting in which they were administered (i.e., substitution of the word problem in PBL for task in 4C/ID). Most items were common over all educational types. Table 1 also contains examples of the items (translated from Dutch).

Table1. *Scale Reliability*

| Scale and example of item | Cronbach's Alpha, (number of items) and number of respondents | | | | |
|---|---|-----------------|-----------------|-----------------|-----------------|
| | Skills | PBL | 4C/ID | Practice | VHS |
| Perceived control 'This activity was mandatory' | .65 (3) n=65 | .60 (4) n=64 | .65 (5) n=50 | .57 (3) n=27 | .56 (3) n=36 |
| Perceived competence 'I think I'm good at this activity' | .75 (3) n=65 | .66 (3) n=68 | .85 (5) n=53 | .87 (5) n=27 | .64 (4) n=34 |
| Perceived relatedness 'I trust my peer students' | .64 (6) n=62 | .55 (3) n=69 | .60 (5) n=51 | .82 (6) n=24 | .71 (4) n=34 |
| Intrinsic motivation 'I like this activity' | .84 (6) n=60 | .87 (6) n=65 | .75 (7) n=51 | .91 (4) n=26 | .96 (6) n=34 |

Single items (7-point Likert scales) were used for the measurement of study behavior, and thus no reliability scores were calculated. These items measured *effort* invested by the participant, learning aimed at trying to *understand* the content, trying to *use* learning content in practice, having *discussed* the content with other students, *concentration*, ease of *recall*, *curiosity* about content, and feeling of being easily *distracted*.

Results

The Scales

First, the bivariate correlations between each of the different predictors and with intrinsic motivation were determined (see Table 2). Since the constructs are significantly correlated and meet with all parametric

criteria necessary to calculate such correlations, a principal component analysis (PCA) on the scales was then performed, in an attempt to explain as much variance as possible.

Table 2. *Bivariate Correlations of Predictors and Intrinsic Motivation*

| | Perceived control | Perceived competence | Perceived relatedness | Intrinsic motivation |
|-----------------------|-------------------|----------------------|-----------------------|----------------------|
| Perceived control | 1 | .028 | .163* | .174* |
| Perceived competence | | 1 | .355** | .411** |
| Perceived relatedness | | | 1 | .508** |
| Intrinsic motivation | | | | 1 |

*= $p < .01$; **= $p < .0001$; two-tailed, $n = 250$

Principal component analysis on this correlation matrix revealed a 1-component solution with the following loadings: perceived control = .323; perceived competence = .696; perceived relatedness = .796, and intrinsic motivation = .827.

Table 3. *Total Variance Explained after Principal Component Analysis*

| Component | Initial Eigenvalue | | | Extraction SSL | | |
|-----------|--------------------|---------------|--------------|----------------|---------------|--------------|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 1.907 | 47.676 | 47.676 | 1.907 | 47.676 | 47.676 |
| 2 | .980 | 24.509 | 72.185 | | | |
| 3 | .632 | 15.798 | 87.983 | | | |
| 4 | .481 | 12.017 | 100.000 | | | |

The principal components analysis shows a 1-component solution with the criterion eigenvalue > 1 , although (with a two component solution) the second component on which perceived control loads does, explain a substantial part of the variance. Inspection of the reliability estimates in Table 1 indicates that a source of error variance might be the unreliability of the perceived control scales. In other words, due to a certain amount of unreliability of the measurement of one of the four variables, the correlations between these variables may be underestimated. This can be rectified by making use of a correction of attenuation (e.g., Schmidt & Hunter, 1996). By dividing the bivariate correlation by the root of the weighted reliability coefficients the estimated correlation coefficients - if both variables were measured with perfect reliability - are achieved. These correlations are shown in Table 4.

Table 4 *Correlations after Correction for Attenuation*

| | Perceived control | Perceived competence | Perceived relatedness | Motivation |
|-----------------------|-------------------|----------------------|-----------------------|------------|
| Perceived control | 1 | | | |
| Perceived competence | .04 | 1 | | |
| Perceived relatedness | .26 | .49 | 1 | |
| Motivation | .24 | .51 | .69 | 1 |

Principal component analysis based on this correlation matrix again yields a 1-component solution with the loadings: perceived control = .384; perceived competence = .732; perceived relatedness = .874, and intrinsic motivation = .878.

The correction for measurement unreliability shows an increase in the explained variance (Table 5).

Table 5 *Total Variance Explained with Principal Component Analysis after Correction for Attenuation*

| Component | Initial Eigenvalue | | | Extraction SSL | | |
|-----------|--------------------|---------------|--------------|----------------|---------------|--------------|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 2.218 | 55.442 | 55.442 | 2.218 | 55.442 | 55.442 |
| 2 | .968 | 24.212 | 79.655 | | | |
| 3 | .505 | 12.614 | 92.268 | | | |
| 4 | .309 | 7.732 | 100.000 | | | |

To determine whether these results are unique, or whether there may be other corroborating evidence, two secondary studies were carried out. First this approach was repeated on data of an already published study (Ntoumanis, 2003). Second, new research with a different population in the Netherlands using the same instruments was carried out. These results will be reported in a forthcoming article.

Analyzing the Ntoumanis (2003) data yields the same picture as the first analysis presented. Ntoumanis uses scales to predict intrinsic motivation with moderate to high reliability (ranging from .43 for autonomy to .87 for intrinsic motivation). The correlations, standard deviation and number of participants presented by Ntoumanis were entered in a matrix as input for PCA. Before correction for attenuation a 2-component solution was found; after correction a 1-component solution was found.

Original data from a second, new research sample was also analyzed. This sample consisted of 338 higher education students studying in the Netherlands in full-time higher vocational education at the Maastricht School for Hotel Management. A small majority of the students was female (60%) and had an average age of 19.1 years. The students filled in the same questionnaires as in the original study. All scales had moderate to high reliability. The exact coefficients can be found in Appendix 2. Again PCA resulted in a 1-factor solution, with the criterion of Eigenvalue > 1.

These analyses all point in the same direction, namely that if the unreliability of measurement common for scales used to predict motivational processes, scales for autonomy, relatedness, competence and intrinsic motivation are taken into account, they appear to measure the same construct.

Study Behavior

As stated earlier, a second aim of this research was to determine the impact of intrinsic motivation on self-rated study behavior. Table 6 shows that intrinsic motivation appears to coincide with specific study behaviors.

Table 6. *Correlations between Intrinsic Motivation and Self Reported Study Behavior*

| | Effort invested | Learn for understanding | Use content in practice | Discuss content with others | Good concentration | Easy to remember | Curious about content | Feel easily distracted |
|----------------------|-----------------|-------------------------|-------------------------|-----------------------------|--------------------|------------------|-----------------------|------------------------|
| intrinsic motivation | .526 | .445 | .434 | .233 | .478 | .440 | .638 | -.240 |
| N | 250 | 250 | 223 | 248 | 248 | 249 | 247 | 245 |

All correlations are significant at the .001 level (2-tailed)

Students with high intrinsic motivation exhibit a higher degree of effort, perceive the learning materials as being more useful, are inclined to learn more for understanding, try to apply what they learn in their practice, and appear to discuss the content more with other students. They report having better concentration, more curiosity and say that they find it easier to remember the learning content. Finally, they report feeling less distracted while studying. Again this combination of study behaviors accompanying intrinsic motivation shows, as predicted, how strongly related the perceptions are. If, for example, high intrinsic motivation is correlated with more inclination to discuss and communicate what has been learned with fellow students, this will probably be linked to a more positive perception of relatedness.

Discussion

It is widely accepted (see Ryan and Deci, 2000 for an overview) that perception of relatedness, control (or autonomy), and competence predicts intrinsic motivation, which in turn predicts study behavior. Less clear is how these three predictors are related. This research shows that they are so strongly correlated that in fact they appear to be constituents of the same process. Functionally, they form one single factor. This means that a negative perception of one of the three predictors always comes jointly with a negative perception of the other

two. In plain English: if you feel amotivated because someone is constantly commenting on what you do and telling you exactly what to do (thus decreasing your perception of autonomy), it is very likely that you will not only experience a low perception of relatedness to this person (i.e., alienation), but that you also will not feel very competent at the task at hand. Or: if you have to partake in a sport activity that you do not feel that you are very good at (i.e., a low perception of competence), you will probably both dislike the activity (experience a loss of intrinsic motivation), but will also experience a loss of relatedness or belongingness with your teammates. In other words, manipulations intended to influence any one of the three aspects - perceived relatedness, competence and autonomy - will also influence the other two.

This study also shows that when scales to measure the predictors of intrinsic motivation are well constructed (i.e., high reliability) one can rely on measuring only one predictor, since the other predictors all seem to be part of the same mechanism (i.e., construct). This 'mechanism' also explains the typical reactions that are commonly found (e.g., Wolters & Pintrich, 1998) to be related with low intrinsic motivation. These effects were replicated in this study: students with low intrinsic motivation tend to be less inclined to interact with their peers or to discuss the study content, phenomena that can be linked to lower feeling of relatedness. This lower relatedness can be interpreted as an avoidance tendency: if forced to join a certain a group and engage in certain unpleasant activities people will tend to want to leave this group.

Some critical remarks also have to be made. First, principal component analysis is a technique where the result depends on many elements. The same holds true for related techniques such as exploratory or confirmatory factor analysis. In general, discussions on the number of factors that underlie psychological measurements are difficult and lengthy. It took a long time to reach agreement about the 'big five' factors used to map personality (e.g., Schmit & Ryan, 1993) as well as on the factors underlying verbal intelligence. It is, thus, quite likely that other research, both exploratory and confirmatory, with other data might lead to different factor solutions, even though this article reported three samples that all pointed in the same direction. Also, the correction for attenuation used, only yields a hypothetical estimate of the correlation that would appear after a perfect measurement.

Nevertheless the results presented in this study provide evidence for the idea that there appears to be a connected functional mechanism underlying motivational processes. This is in line with other findings suggesting (e.g., Ryan & Deci, 2000; Thompson, 2004) that suggest that diminished intrinsic motivation comes along with a specific but broad set of related consequences, varying from passivity, to lower well-being, less communication, avoidance behavior, and so on. This mechanism can be tentatively termed an 'amotivation module'.

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Effects of Instructional Events in Computer-Based Instruction

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Introduction

Forty years ago, Robert Gagne published the first edition of his book *The Conditions of Learning* (1965) in which he proposed nine events of instruction that provide a sequence for organizing a lesson. These events remain the foundation of current instructional design practice (Reiser, 2002; Richey, 2000). They represent desirable conditions in an instructional program and increase the probability of successful learner achievement in the program (Gagne, 1965, 1985, 1988; Gagne, Briggs & Wager, 1992). Other authors cite similar elements of instruction that promote student learning from an instructional program (Dick & Carey, 1996; Sullivan & Higgins, 1983).

Gagne (1985) defined instruction as “a set of deliberately planned external events designed to support the process of learning.” He noted that a designer or instructor controls these external events, and that learners control their own internal learning processes. His external events of instruction were conditions for facilitating effective learning processes in students.

The individual events that Gagne incorporated into his model have been the subject of a substantial body of research. However, many of these events may produce a much different effect when they are studied individually than when they are combined into a more complete set that incorporates most or all of Gagne’s nine events. As Hannafin (1987) noted, some design strategies may have positive effects when used in isolation that are diminished or negated when these strategies are used in combination with more powerful techniques.

A research design that incorporates most of Gagne’s events of instruction into a quite complete version of an instructional program, then systematically deletes selected events from other versions, has the potential to identify the events that are most powerful in promoting student learning. That type of design was used in the present research. The events from Gagne’s model that were directly incorporated into the study were objectives, information, examples, practice with feedback and review. The research literature on each of these events is briefly reviewed below.

Objectives

An instructional objective is a statement that describes an intended outcome of instruction (Mager, 1962). According to Ausubel (1968) stating an objective at the beginning of instruction will help the individual learners to structure their own learning. Reiser and Dick (1996) state that, “At a fairly early stage, learners should be informed of what it is that they are going to be able to do when they finish the instructional process. By knowing what will be expected of them, learners may be better able to guide themselves through that process” (p.48).

Some researchers have found that instructional objectives improve learning. Kaplan and Simmons (1974) reported that performance on information relevant to an objective was high when instructional objectives were used as orienting stimuli or as a summary/review upon prose learning. Staley (1978) found that the provision of objectives facilitated learning, but that presenting objectives by subsets had no advantage over presenting the entire set at once. Research on effectiveness of objectives in computer-based cooperative learning indicated that students who received instructional objectives performed significantly better on posttest items than students who received either advance organizers or no orienting activities (Klein & Cavalier, 1999). Studies have reported that objectives enhance learning of relevant content, but provide less assistance for incidental learning. (Kaplan & Simmons, 1974; Morse & Tillman, 1972; Rothkopf & Kaplan, 1972). Research has also indicated that inclusion of objectives resulted in more positive student attitudes (Staley, 1978).

Some researchers have found that objectives do not produce a significant difference in learning (Filan & Gerlach, 1979; Hartley & Davis, 1976). Hannafin (1987) found that, when computer-based instruction was systematically designed, the presence of objectives did not make a difference but that it did influence performance in lessons that were not well designed. Research has also indicated that the benefits of objectives are reduced when a more powerful instructional element such as practice is included in computer-based lessons

(Hannafin, 1987; Hannafin, Philips, Rieber & Garhart, 1987; Philips, Hannafin & Tripp, 1988).
Information

A significant part of the instructional process involves presenting students with the necessary information for learning (Reiser & Dick, 1996). All models of direct instruction include presenting information to students. Gagne (1985) stresses the importance of emphasizing the information presented to the learners. In his nine events he mentions presenting the stimulus or content where information is presented to the learner. Distinctive features of what is to be learned should be emphasized or highlighted when the information is presented (Gagne, 1985). Content presented should be chunked and organized meaningfully. (Kruse & Kevin, 1999).

Practice and Feedback

Practice is defined as the event of instruction provided to learners after they have been given information required to master an objective (Gagne, 1985). Practice involves eliciting performance from learners. It provides an opportunity for learners to confirm their correct understanding, and the repetition also increases the likelihood of retention (Kruse & Kevin, 1999). Practice is effective when it is aligned with the assessment in the form of a posttest and with the skills, knowledge and attitudes reflected in the objectives (Reiser & Dick, 1996).

Researchers have found that practice has a significant effect on performance. Hannafin (1987) reported a significant difference between practiced and non-practiced items on the learning of cued and uncued information presented via computer-based instruction. Phillips et al. (1988) found a significant difference favoring practice over no practice in an interactive video in which practice items were embedded questions. Hannafin et al. (1987) noted that practice effects were more pronounced for facts than for application items in computer-based instruction. Participants who received intellectual skills practice in a cooperative learning environment performed significantly better than those who received verbal information practice (Klein & Pridemore, 1994).

Practice provides an opportunity for feedback that confirms the student's answer as being correct or indicates that is incorrect. This feedback strengthens the probability of correct responses and reduces the probability of subsequent incorrect responses (Philips et al., 1988). Simple forms of feedback are effective when learners are able to answer items correctly. More elaborate forms such as providing and explaining the correct answer and explaining why a wrong answer is incorrect are helpful when learners answer incorrectly (Kulhavy, 1977). Simple forms of feedback are most effective for simple verbatim and verbal information types of learning (Kulhavy, White, Topp, Chan & Adams, 1985).

Examples

Examples are verbal or graphical information that provides additional clarification of rules or information presented to learners. Kruse and Kevin (1999) include examples, non-examples, graphical representation and analogies as guidance strategies that can be used to further clarify new content that is presented.

Few studies have been conducted to examine effects of examples in a graphical representation form. Sullivan and Maher (1982) found a significant difference favoring the use of imagery over no imagery in prose learning by intermediate grade students. Walczyk and Hall (1989) reported a significant difference for participants who received examples over those who did not in comprehension assessments. Freitag and Sullivan (1995) found that adults who received examples in a training program significantly outperformed those who did not. A considerable amount of research has been conducted recently on the effects of worked examples as an instructional aid (Atkinson, Catrambone & Merrill, 2003; Atkinson, Renkl & Merrill, 2003; Renkl, Stark & Gruber, 1998).

Review

The review process typically provides an outline of the key information that was presented to learners. It is intended to reinforce learning, at the end of the instruction, often just before students are tested. Reiser and Dick (1996) cite the value of reviews to bring closure to instruction and to help reinforce the skills and knowledge students should have acquired.

Research has suggested that reviews benefit learning of incidental material because instructional stimuli are introduced after the content has been presented and initially processed (Kaplan & Simmons, 1974). The use of reviews to summarize salient information has been shown to enhance learning (Hartley & Davis,

1976). In studies on prose learning, reviews of relevant information yielded significantly better performance than when the information was presented without review (Bruning, 1968).

Purpose of Current Study

Many of the studies reported above were conducted to examine the effect of a single instructional event. In general, these studies found that the presence of the event under investigation resulted in a positive effect on student learning. It was also noted, however, that the effects of some of these events may be reduced considerably when they are combined with other events into a more complete and generally more appropriate program of instruction.

The purpose of this study was to investigate effects of several of Gagne's events of instruction when they were combined in a systematic manner with other events from the Gagne set. One event, information, was constant across all of the program versions in the study because information is a crucial element of instruction that cannot sensibly be deleted from it. The other events of instruction investigated in the study – objectives, practice with feedback, examples and reviews were combined into six different versions of an instructional program in a manner that permitted investigation of the effectiveness of the program when each event was present and when it was absent.

The six different versions of the instructional program were as follows:

1. Full program (Information + Objectives + Practice with Feedback + Examples + Review)
2. Program without Objectives (Information + Practice with Feedback + Examples + Review)
3. Program without Examples (Information + Objectives + Practice with Feedback + Review)
4. Program without Practice (Information + Objectives + Examples + Review)
5. Program without Review (Information + Objectives + Practice with Feedback + Examples)
6. Lean program (Information Only)

The primary research questions for this study are listed below.

1. Which of Gagne's events of instruction investigated in the study significantly affect student achievement?
2. Which of Gagne's events of instruction investigated in the study significantly affect student attitudes?

The researchers anticipated that the four versions of program that included practice would have a positive effect on achievement partly because of the consistently favorable effects found for practice in other research and partly because of our own beliefs about its importance. Whether positive effects would be obtained for the other variables when they were combined with practice was unclear prior to the study.

Method

Participants

Participants were 256 freshman and sophomore undergraduate students enrolled in a computer literacy course at a large Southwestern University. The students enrolled in this course had varied background knowledge on computers and were from different majors including education, communication, journalism and others.

Materials

Six different versions of a computer-based lesson on the topic *Input, Processing, Storage and Output of a Computer (IPSO)* were developed using Dreamweaver. IPSO explains the primary operations of the computer. An introduction section was included before the primary operations were explained in detail. This section introduced what a computer is and classified it based on size, power and generation. It also explained the IPSO cycle. The next four sections described the concepts of the Input, Processing, Storage and Output operations in a computer and explained the function of the different components associated with that operation. The content used in this study was part of the required content for the course. The computer-based lesson was pilot tested with five students before it was used in the study.

The material was designed in six different versions that included various combinations of Gagne's instructional events as described above. The six versions consisted of (1) a full version that contained information plus all events investigated in the study, (2) a version without objectives (3) one without examples, (4) one without practice, (5) one without review and (6) a lean version containing information only. The systematic deletion of individual events permitted the study of the program both with and without each event.

Procedures

Eighteen sections of students ($n = 256$) enrolled in the Computer Literacy Course were randomly assigned to the six treatment groups based on pretest scores. The pretest, which took approximately 15 minutes to complete, was administered three weeks prior to the study. The classes were blocked into three groups (high, medium and low) based on their mean pretest scores, and one class within each block was randomly assigned to each of the six treatments.

The participants participated in the web-based IPSO lesson during the sixth week of the semester. Participants met in a regular computer lab for instruction and were directed by the instructor to the web address for the instructional program. Each class was routed directly to its treatment version of the program. Students worked through the program at their own pace, averaging approximately one hour. Then they took the posttest and the attitude survey online. All six treatment groups followed the same procedure. Thus, the experimental differences in treatments occurred exclusively in the materials themselves and not in the procedure.

Criterion Measures

The criterion measures consisted of a posttest and a student attitude survey. A pretest was used to assess subject's knowledge of the content prior to the instruction and to randomly assign classes within ability blocks to treatment.

Pretest - The pretest consisted of 20 multiple-choice questions covering the content with four response choice questions. The overall mean score on the pretest was 8.68 or 43%, indicating that participants were not very knowledgeable about the content prior to instruction. Thus participants had relatively little knowledge of content prior to instruction. There were no significant differences across the six treatment groups in pretest scores.

Posttest - The posttest consisted of the same 20 multiple-choice questions that were on the pretest. It was judged to be unlikely that the pretest would have an effect on posttest scores that could be a threat to validity (Campbell & Stanley, 1963) because of the three-week interval between test and the fact that feedback was not given on the pretest. The posttest score was counted towards their course grade, and this motivated the learners to learn from the web-based lesson.

Attitude Survey - The attitude survey assessed student attitudes towards the instructional program and the presence or absence of the instructional elements. The 12-item survey consisted of Likert-type questions that were rated strongly agree (scored as 4) to strongly disagree (scored as 0). The survey was administered after the lesson and the posttest were completed.

Data Analysis

A one-way ANOVA was conducted to analyze the posttest data for statistical significance. A MANOVA was conducted on the 12 attitude questions. Both analyses revealed significant differences. Therefore, Scheffe tests were performed for both data sets to test for significance between groups. Alpha was set at .01 for all statistical tests because of the large number of comparisons.

Results

Achievement

Table 1 shows the mean scores and standard deviations by treatment for achievement on the posttest. The table shows that the mean scores for subjects in each of the four treatments (full program, program without objectives, program without examples, and program without review) were above 17 items correct, whereas the scores for the other two treatments (program without practice and lean program) were below 15 correct. The table also shows that the mean posttest score across all six treatments was 16.44 items correct.

Table 1 *Means and Standard Deviations for Posttest Scores by Treatment*

| Treatment | Posttest Mean | Posttest SD |
|----------------------------|---------------|-------------|
| Full Program | 17.61 | 1.99 |
| Program without Objectives | 17.36 | 1.75 |

| | | |
|--------------------------|-------|------|
| Program without Examples | 17.16 | 2.34 |
| Program without Review | 17.17 | 2.76 |
| Program without Practice | 14.98 | 2.66 |
| Lean Program | 14.73 | 3.21 |
| Total | 16.44 | 2.75 |

A one-way ANOVA conducted on the posttest data yielded a significant difference between the treatment groups on the posttest, $F(5, 250) = 11.689, p < .01$. Follow-up Scheffe tests revealed that each of the four groups with means scores above 17, as listed above and shown in the table, scored significantly higher than the two groups identified above that scored below 15. There were no significant differences between the four groups scoring above 17 or between the two scoring below 15.

Attitude

Table 2 shows means for responses to the 12 Like rt-type items on the attitude survey. The items were rated on a 5- point Likert scale from strongly agree (scored as 4) to strongly disagree (scored as 0).

Table 2 *Attitude Scores by Treatment*

| <i>Attitude</i> | <i>Questions</i> | <i>*FP</i> | <i>NO</i> | <i>NE</i> | <i>NR</i> | <i>NP</i> | <i>LP</i> | <i>Total</i> |
|-----------------|--|------------|-----------|-----------|-----------|-----------|-----------|--------------|
| 1 | The goals of the program were clear to me. | **3.3 4 | 3.40 | 3.22 | 3.34 | 3.17 | 2.77 | 3.21 |
| 2 | I knew what I was supposed to learn at the start of each section of the program. | 3.07 | 3.16 | 3.11 | 2.98 | 2.96 | 2.68 | 2.99 |
| 3 | The program included enough pictures and examples. | 3.20 | 3.38 | 2.41 | 3.10 | 3.06 | 2.43 | 2.93 |
| 4 | The graphics helped me understand the content well. | 3.17 | 3.32 | 2.30 | 3.12 | 2.83 | 2.36 | 2.85 |
| 5 | The review at the end of each section helped my learning. | 3.63 | 3.74 | 3.43 | 3.39 | 3.17 | 2.68 | 3.34 |
| 6 | The program had enough opportunity to review the content. | 3.17 | 3.18 | 3.07 | 2.76 | 2.77 | 2.48 | 2.91 |
| 7 | The practice in the program helped me learn the content. | 3.34 | 3.52 | 3.28 | 3.05 | 2.15 | 2.39 | 2.96 |
| 8 | The program gave me enough opportunity to practice what I was learning. | 3.05 | 3.20 | 3.04 | 2.56 | 2.13 | 2.25 | 2.71 |
| 9 | I learned a lot from this program. | 3.02 | 3.22 | 2.91 | 2.88 | 2.63 | 2.64 | 2.88 |
| 10 | I would recommend this program to other students. | 3.07 | 3.30 | 2.72 | 2.83 | 2.52 | 2.45 | 2.82 |
| 11 | I would enjoy using other computer programs like this one in future lessons. | 2.85 | 3.26 | 2.80 | 2.56 | 2.58 | 2.36 | 2.74 |
| 12 | The overall quality of the program was good. | 3.20 | 3.34 | 3.11 | 2.98 | 2.88 | 2.70 | 3.04 |
| Average | | 3.18 | 3.34 | 2.95 | 2.96 | 2.74 | 2.52 | 2.95 |

review) on achievement and attitudes. College students enrolled in a computer literacy course used a computer-based lesson delivered on the web to learn about input, processing, storage and output of a computer (IPSO).

Results indicated that among the instructional events, practice had the most impact on both learner achievement and attitudes. Participants who used one of the versions of the computer program that included practice (full program, program without objectives, program without examples and program without review) performed significantly better on the posttest than those who did not receive practice (program without practice and lean program). Furthermore, students who received practice in their program had consistently more positive attitudes than those who did not receive it.

Achievement

Practice was clearly the instructional event that had the strongest positive effect on achievement among the events manipulated in this study. Participants in all four treatments that included practice scored significantly higher on the posttest than those in the two conditions that did not include it. Whereas the removal of practice from the full program resulted in a significant decline in posttest performance, removal of any one of the three other events (objectives, examples, review) did not have such an effect.

Practice of the type in this study is effective because it gives learners the opportunity to perform a similar or identical learning task to that assessed on the posttest. This practice combined with feedback, as it was in the present study, enables learners to confirm their correct understanding and to identify their incorrect ones. Thus, the probability of retention of correct responses is increased and the probability of incorrect responses is reduced when the practice is aligned with the subsequent posttest assessment (Philips et al., 1988; Reiser & Dick, 1996). Practice also has the advantage of eliciting overt responses from the learner, a form of active participation not directly provided by the other elements of instruction investigated in this study.

Whereas practice elicits overt responding from learners, the other elements investigated in the study either provide information that is additional to that contained in the information screens (that is, the objectives) or that is supplementary (examples) or primarily redundant (review) to the information. The absence of each of these elements individually in one of the three different treatments in the present study (program without objectives, without examples or without review) consistently yielded a posttest score between 17.16 and 17.36 that varied only slightly and non-significantly from the score of 17.61 for students in the full program. Thus, there is no evidence from this study that any of these three elements individually contributed to increased student learning. Hannafin (1987) noted that when computer-based instruction is systematically designed, the presence of objectives for students may not increase their achievement. Nevertheless, the presence of objectives may be essential for the instructional designer to design the instruction systematically.

Attitudes

Turning to attitudes, results revealed that most participants had a favorable impression about the computer-based lesson used in this study. In general, they agreed with statements such as, "I learned a lot from this program," "I would recommend this program to other students," and "The overall quality of the program was good."

Results for attitudes were generally consistent with findings for achievement. When the items on the attitude survey were analyzed to examine differences between treatment groups, participants who used the lean program had the most negative attitudes toward their treatment followed by those who used the program without practice. Combined with results for achievement, this study suggests that practice not only increases learning, but the absence of it also diminishes students' attitudes toward instruction.

Student responses to the attitude survey showed that they were sensitive to the absence of some of the instructional elements investigated in this study. Participants who received practice in their program agreed significantly more with items related to the amount and helpfulness of the practice than students who did not receive practice. Furthermore, participants who received examples throughout the program agreed more with items related to the amount and usefulness of the examples than students who did not receive examples. These findings suggest that students are aware when practice and examples are left out of computer-based instruction and that excluding these elements has a detrimental effect on their attitudes.

However, this pattern was not found for the attitude items related to objectives. Students in the no-objectives treatment had the most positive responses to the two items related to the goals and objectives of the program. They also had significantly more positive attitudes toward their treatment when their results were compared with students in several of the other treatments. This finding suggests that students may be unaware of the absence of objectives when other elements such as practice are included in the program.

In addition, students may not always be aware of the absence of review in computer-based instruction.

Participants in the no-review treatment and those in the lean treatment did not receive review throughout their program. Nevertheless, students in the no-review condition had significantly more positive response than those in the lean group on the item, "The review at the end of each section helped my learning." It should be noted that when asked what they liked best about the program, students most frequently listed the element of review.

Implications and Future Research

This study has implications for the design and development of computer-based instruction. Practice was the one consistently effective instructional event for enhancing student achievement in the study. This suggests that it should be included in computer-based instruction especially when students are tested using items aligned with the objectives and practice items. However, the lack of effect produced by the one-at-a-time removal of objectives, examples and review from individual treatment versions should not, of course, be interpreted as an indicator that one or more of these elements should routinely be deleted from an instructional program. If a program is well conceptualized, none of the three is very costly in terms of writing time by the designer, amount of text space in the lesson, or length of reading time by the learner. These three elements were included and removed systematically in the present study in order to investigate their effects in a controlled instructional environment. Their desirability, and possibly their effects, may vary in other settings depending on such factors as the age and motivation of the learners and the complexity of the subject matter.

Future research should continue to focus on the impact of instructional events in various instructional settings. Additional research should examine how instructional events in computer-based instruction influence outcomes such as problem solving and complex learning tasks. Furthermore, the recent proliferation of web-based and Internet-based instruction suggests that studies should be conducted to examine the effect of objectives, examples, practice and review in these settings. As was done in this study, research in these settings should include measures of student achievement and attitudes. Studies of this nature will continue to inform designers about the influence of instructional events on learning and performance.

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Dynamic Selection of Learning Tasks According to the 4C/ID-Model

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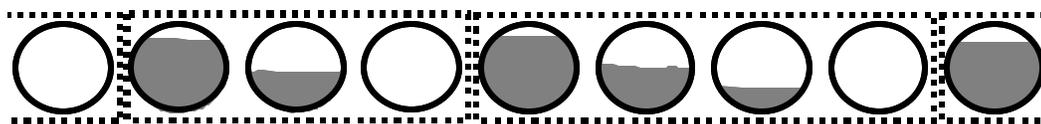
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Introduction

Recent instructional theories tend to focus on authentic learning tasks that are based on real-life tasks as the driving force for complex learning (Merrill, 2002; van Merriënboer & Kirschner, 2001). The general assumption is that such tasks help learners to integrate the knowledge, skills and attitudes necessary for effective task performance; give them the opportunity to learn to coordinate constituent skills that make up this performance, and eventually enable them to transfer what is learned to their daily life or work settings. This focus on authentic, whole tasks can be found in several educational approaches, such as the case method, project-based education, problem-based learning, and competency-based education. Van Merriënboer's four-component instructional design model (4C/ID-model, 1997; van Merriënboer, Clark, & de Croock, 2002) describes how learning tasks fulfill the role of a backbone for an integrated curriculum (Figure 1: the "circles" represent learning tasks). Two requirements for this backbone are: (a) learning tasks are organized in easy-to-difficult task classes (the dotted boxes around sets of learning tasks), and (2) learners receive guidance for the first learning task in a task class after which support slowly disappears in this task class.

Figure 1. A sequence of learning tasks, organized in easy-to-difficult task classes and with fading support in each task class



It is clearly impossible to use very difficult learning tasks right from the start of a curriculum or educational program because this would yield excessive cognitive load for the learners, with negative effects on learning, performance, and motivation (Sweller, van Merriënboer, & Paas, 1998; van Merriënboer, Kirschner, & Kester, 2003). The common solution is to let learners start their work on relatively easy learning tasks and progress towards more difficult tasks. In a whole-task approach, the coordination and integration of constituent skills is yet stressed from the very beginning, so that learners quickly develop a holistic vision of the whole task that is gradually embellished during the training. This is akin to the "global before local skills" principle in cognitive apprenticeship (Collins, Brown, & Newman, 1989, p. 485) or the "zoom lens metaphor" of Reigeluth's elaboration theory (1999). There are categories of learning tasks or task classes, each representing a version of the task with a particular difficulty (the dotted boxes in Figure 1). Learning tasks within a particular task class are equivalent in the sense that the tasks can be performed on the basis of the same body of generalized knowledge. A more difficult task class requires more knowledge or more embellished knowledge for effective performance than the preceding, easier task classes. In other words, each new task class contains learning tasks that are in the zone of proximal development of the learners (Vygotsky, 1934/1987). It is essential that the equivalent learning tasks within the same task class show a high variability, that is, differ from each other in terms of the saliency of defining characteristics, the context in which the task has to be performed, the familiarity of the task, or any other task dimensions that also vary in the real world (Paas & van

Merriënboer, 1994). Variability is a key factor for reaching the necessary level of generality and facilitating transfer of learning to daily life or future work settings.

Furthermore, when learners start to work on a new, more difficult task class, it is essential to give them guidance and support. This support diminishes in a process of “scaffolding” as learners acquire more expertise (see the filling of the circles in Figure 1). One powerful approach to scaffolding is known as the “completion strategy”. In this strategy, learners start to work on fully worked-out examples that confront them not only with a given problem state and a desired goal state, but also with an example solution. Questions and evaluation assignments stimulate the learners to reflect on the strong and weak points of the given solution. Studying worked-out examples focuses the learners’ attention on problem states and associated solution steps and so enables them to induce generalized solutions or schemata. Then, learners may proceed to work on completion tasks that present a given state, a goal state, and a partial solution that must be completed. There is still a sizeable support, because the given part of the solution provides direction to the problem solving process. Finally, learners receive conventional tasks without support – only then, they have to construct complete solutions. Several studies showed positive effects on learning for the completion strategy (Renkl & Atkinson, 2003; van Merriënboer & de Croock, 1992).

In a flexible curriculum, it should be possible to take differences between students into account. Some students are better able to acquire new complex skills or competencies and need therefore less practice and support than other students. In addition, elsewhere-acquired skills of new students should be taken into account. And complex skills or competencies are not coupled to separate courses or modules but developed throughout the curriculum or educational program, which makes it even more important to be able to select suitable learning tasks for students. In the 4C/ID-framework sketched above, this means that for each individual student, it should be possible to select the best task class to work on, and to select within this task class a learning task with the optimal level of support, at any given point in time. Electronic learning environments allow for such dynamic selection of learning tasks.

Dynamic Task Selection on the Basis of Mental Efficiency

Models for dynamic task selection typically take learner’s performance as their input, defined in terms of the number of correctly answered test items, the number of errors, or the time on task. However, the 4C/ID-model stresses that other dimensions are at least equally important for the assessment of expertise. They include mental load, which originates from the interaction between task characteristics (e.g., task format, multimedia, task difficulty) and learner characteristics (e.g., age, prior knowledge, spatial ability) and so yields an a-priori estimate of cognitive load, and mental effort, which refers to the cognitive capacity that is actually allocated to accommodate the demands imposed by the task (Paas & van Merriënboer, 1993, 1994b). Especially mental effort may yield important information that is not necessarily reflected in mental load and performance measures. For instance, it is quite feasible for two persons to attain the same performance levels with one person needing to work laboriously through a very effortful process to arrive at the correct answers, whereas the other person reaches the same answers with a minimum of effort. While both people demonstrate identical performance, ‘expertise’ may be argued to be higher for the person who performs the task with minimum effort than for the person who exerts substantial effort.

An appropriate assessment of expertise should thus at least include measures of mental effort and performance. Paas, Tuovinen, Tabbers and van Gerven (2003) discuss different measurement techniques for mental effort, including rating scales, secondary task methods, and psychophysiological measures. On the basis of a comprehensive review of about 30 studies, they conclude that “...the use of rating scales to measure mental effort remains popular, because they are easy to use; do not interfere with primary task performance; are inexpensive; can detect small variations in workload (i.e., sensitivity); are reliable, and provide decent convergent, construct, and discriminate validity” (p. 68). For the measurement of complex performance, several methods that assess and weigh different aspects of performance have been developed (see Hambleton, Jaeger, Plake, & Mills, 2000). However, most methods are very time-consuming. To make the assessment of complex performance more time-effective, Kalyuga and Sweller (in press) proposed a “rapid assessment test”, which asked students to indicate their first step toward solution of a complex task. High correlations (up to .92) were found between performance on “rapid assessment tests” and traditional performance tests that required complete solutions of corresponding tasks.

A final step in the assessment of expertise is the difficult task of combining a student’s mental effort and performance measures, because a meaningful interpretation of a certain level of invested effort can only be given in the context of its associated performance and vice versa. Paas and van Merriënboer (1993; see also Paas et al., 2003) developed a computational approach to combine measures of mental effort with measures of

associated performance to compare the mental efficiency associated with instructional conditions – under the assumption that learners’ behavior in a particular condition is more efficient if their performance is higher than might be expected on the basis of their invested mental effort or, equivalently, if their invested mental effort is lower than might be expected on the basis of their performance. Using this approach, high task performance associated with low effort is called high mental efficiency, whereas low task performance with high effort is called low mental efficiency. Unfortunately, this approach can only be used after all data of a group of students, working in different instructional conditions, have been gathered. Alternative methods are needed for the continuous assessment of expertise of individual learners. Such alternatives are currently under development in the context of adaptive eLearning.

Adaptive E-Learning

Salden, Paas and van Merriënboer (in press) discuss the value of the 4C/ID-model for adaptive eLearning, with a focus on the dynamic selection of learning tasks. They describe adaptive eLearning as a straightforward two-step cycle: (1) assessment of a learner’s expertise, and (2) task selection. With regard to the ongoing assessment of expertise, they differentiated between a learner who needs to work laboriously to attain a certain performance level (low mental efficiency) and a learner who attains the same performance level with little mental effort (high mental efficiency). Only the second learner who solved the problem efficiently should be presented with a more difficult and/or less-supported learning task. With regard to task selection, given the learner’s mental efficiency one might select tasks (1) that provide less, equal, or more support to learners than the previous task(s); (2) that are less, equally, or more difficult than the previous task(s), and (3) that vary with regard to both support and difficulty.

Selecting Learning Tasks with Different Levels of Support

In a study reported by van Merriënboer, Schuurman, de Croock, and Paas (2002), participants received a 3-hour introductory computer-programming course in the computer-based learning environment CASCO (Completion ASsignment COnstructor; van Merriënboer & Luursema, 1996). Participants received no support (i.e., conventional programming tasks; n = 8), support (i.e., completion tasks; n = 10), or adaptive support (n = 8). In the no-support and support conditions, each new learning task was selected from a database of tasks in such a way that the selected task offered the best opportunity to practice those programming concepts that were not yet mastered by the student. In the adaptive support condition, students selected completion tasks based on a subjective estimate of their mental efficiency: The tasks could range from fully worked-out examples to conventional tasks, that is, in their level of build-in support. All tasks that could be presented to the learners were of roughly the same difficulty level, and thus only differed with regard to the programming concepts that had to be practiced and, for the adaptive condition, the amount of given support. Learning tasks consisted of a problem statement and (1) explanations, concerning new programming concepts that were necessary for writing the program, (2) specific subtasks that could help to write the program, and (3) questions that were relevant for the task at hand. For completion tasks, a partial, to-be-completed program was presented in a full-fledged editor window; for conventional tasks, this editor window was empty. The CASCO interface is presented in Figure 2.

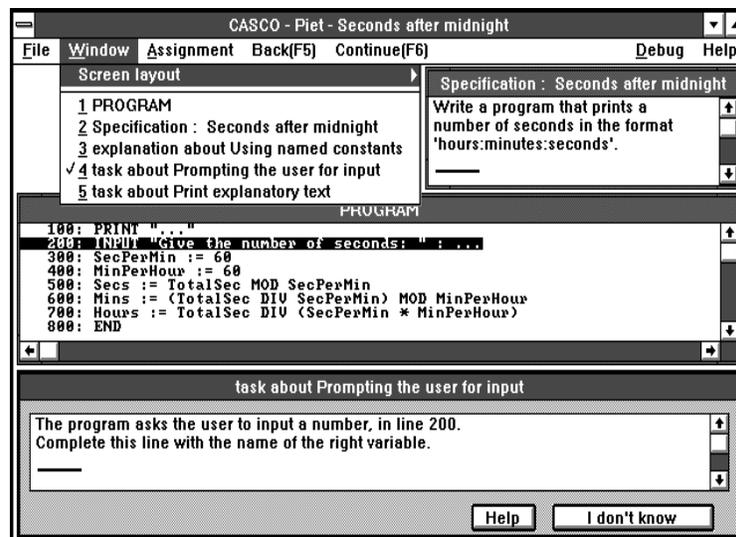


Figure 2. The CASCO Interface.

Practice data show that learners in the support group finished the highest number of learning tasks in the three-hour practice phase ($M = 28.1$), compared to the no-support group ($M = 8.3$) and the adaptive support group ($M = 21.3$; $F(2, 26) = 13.7$, $MSE = 66.4$, $p < .001$). In post-hoc tests, using Tukey's HSD, it was found that both the no-support and the support group ($p < .001$) and the no-support and the adaptive support group ($p < .01$) differed significantly. For a transfer test that was performed after the training, the proportion of correctly used programming concepts was .33 for the no-support group, .39 for the support group, and .55 for the adaptive support group. ANOVA indicated a significant difference between conditions, $F(2, 26) = 3.6$, $MSE = .03$, $p < .05$. As predicted, the adaptive support group outperformed the support and no-support groups. Concluding, adapting the level of support to the learners had beneficial effects on learning and transfer test performance.

Selecting Learning Tasks with Different Levels of Difficulty

In the domain of Air Traffic Control (ATC), Camp, Paas, Rikers and van Merriënboer (2001) and Salden, Paas, Broers and van Merriënboer (2004) compared the effectiveness of a fixed easy-to-difficult sequence of learning tasks with dynamic task selection based on mental efficiency. In the mental efficiency condition, learners received ATC tasks at possible 10 levels of difficulty, starting at the lowest level. Depending on the assessment results, the next task was selected. For instance, a student who attains a performance score of 4 while his or her mental effort is 3 will be presented with a learning task that is one difficulty level higher than the previous task; another student who attains a performance score of 4 while his or her mental effort is only 1 will be presented with a learning task that is two difficulty levels higher than the previous task. In both studies, dynamic task selection yielded more efficient transfer test performance than the use of a fixed sequence of tasks. The mental efficiency condition was also more effective during training than the fixed condition: Participants needed fewer learning tasks to reach the highest difficulty level, reached a higher difficulty level, and made larger jumps to higher difficulty levels than students in the fixed condition.

In a just completed study, participants learned to use a Flight Management System (FMS) according to either (a) a fixed easy-to-difficult sequence of 16 learning tasks ($n = 10$), (b) a system-controlled mental efficiency condition ($n = 11$), and (c) a learner-controlled mental efficiency condition ($n = 10$). Prior to training, the thirty-two learning tasks were categorized into eight difficulty levels (four tasks per level; note that only two of those four tasks were used in the fixed condition). In the system-controlled mental efficiency condition, performance and mental effort were measured and used to determine the difficulty of the next learning task according to a table that specified the increase/decrease in difficulty for each combination of mental effort and performance. For instance, if a participant had a mental effort score of 2 and a performance score of 5 (both measured on a 5-point scale), task difficulty was increased with three levels (+3); if a participant had a mental effort score of 5 and a performance score of 3, task difficulty was decreased with two levels (-2), and so forth. In the learner-controlled mental efficiency condition, participants were free to select the next task based on a subjective estimate of their mental efficiency. The tasks were performed in a realistic computer simulation of a Boeing 747 FMS developed by the National Aerospace Laboratory NLR (see Figure 3). Each task presented flight information of a certain route from airport A to airport B that learners had to program into the FMS simulation. A simulated flight had to be executed after entering all information. At certain points during the task, changes in the flight route were required and made it necessary for the trainees to adjust the original flight route.



Figure 3. The simulation of a Flight Management System (FMS).

Practice data show that learners in the mental efficiency conditions needed substantially less than the 16 learning tasks in the fixed condition to complete the training: $M = 7.27$, $SD = 1.19$ for the system-controlled condition ($t(20) = -4.6$, $p < .001$) and $M = 6.50$, $SD = 1.35$ for the learner-controlled condition ($t(19) = -4.3$, $p < .001$). In line with this finding, the mental efficiency conditions also needed less training time to reach the highest difficulty level than the fixed condition ($F(2, 28) = 28.37$, $MSE = 444.40$, $p < .001$, $\eta^2 = .67$. $M = 149.60$, $SD = 22.77$ for the fixed condition, $M = 117.35$, $SD = 25.61$ for the system-controlled mental efficiency condition, and $M = 78.69$, $SD = 11.64$ for the learner-controlled condition). For a test with five transfer tasks after the training, an ANCOVA with number of learning tasks and time-on-task as covariates indicates that participants scored 2.89 ($SD = .38$) in the fixed condition; 3.21 ($SD = .20$) in the system-controlled mental efficiency condition, and 3.16 ($SD = .22$) in the learner-controlled mental efficiency condition (M s are estimated marginal means). Whereas visual inspection indicates higher scores for the mental efficiency conditions, this difference does not reach statistical significance. However, the data clearly indicate that the mental efficiency conditions yield at least the same test performance with less practice tasks and in less time than a traditional fixed condition.

Selecting Learning Tasks with Different Levels of Support and Difficulty

Kalyuga and Sweller (in press) conducted a study in which both the difficulty and the given support of the next task were adapted to the mental efficiency of the learner. They took a somewhat different approach to combining performance and mental effort measures than the previous studies. In the domain of algebra, a ‘rapid assessment test’ was used to measure performance and a 9-point rating scale was used to measure mental effort. Cognitive efficiency (E) was defined as a combined measure for monitoring learners’ progress during instruction and real-time adaptation of instructional formats to changing levels of expertise. Cognitive efficiency is simply defined as $E = P/R$, where R is the mental effort rating and P is the performance measure on the same task. This indicator has similar general features as efficiency defined by Paas and van Merriënboer (1993), in that it is higher if similar levels of performance are reached with less effort or, alternatively, higher levels of performance are reached with the same mental effort. Students were presented tasks at different levels of difficulty, and for each level a critical level of cognitive efficiency (E_{cr}) was arbitrarily defined as the maximum performance score (which was different per task level) divided by the maximum mental effort score (which was always 9). It should be noted that this technique makes it unnecessary to use a baseline group (previous studies used the “fixed” group to set this baseline). Cognitive efficiency is positive if $E > E_{cr}$ and negative if $E < E_{cr}$. The rationale for this definition is that if someone invests maximum mental effort in a task but does not display the maximum level of performance, his or her expertise should be regarded as suboptimal. On the other hand, if someone performs at the maximum level with less than a maximum mental effort, his or

her expertise should be regarded as optimal.

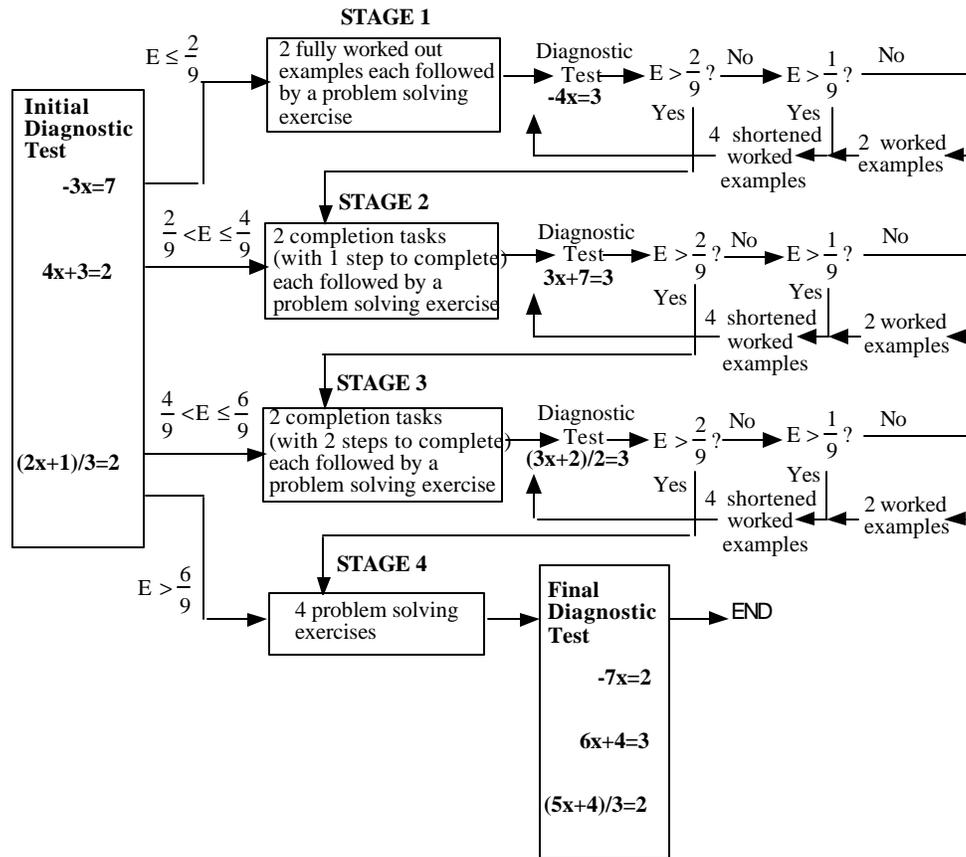


Figure 4. Selection algorithm governing the selection of learning tasks with different levels of difficulty (stages 1-4) and support (worked-out examples, completion tasks, and conventional tasks/problem solving exercises). Adapted from Kalyuga and Sweller (in press)

In the adaptive group, learners were presented algebra tasks at three different difficulty levels. If their cognitive efficiency was negative for tasks at the lowest level, they continued with the study of worked examples; if their cognitive efficiency was positive for tasks at the lowest level but negative for tasks at the second level, they continued with simple completion tasks; if their cognitive efficiency was positive for tasks at the lowest and second level but negative for tasks at the third level, they continued with difficult completion tasks, and, finally, if their cognitive efficiency was positive for tasks at all three levels, they continued with conventional problems. Similar adaptive methods were applied when students were working on the worked examples, completion tasks, or conventional problems (see Figure 4). Each student in the adaptive condition was paired to a student in the control condition, who served as a yoked control. Kalyuga and Sweller (in press) report higher gains in algebraic skills from pretest to posttest and higher gains in cognitive efficiency for the adaptive eLearning group than for the control group. Thus, in agreement with the other reported studies, adaptive eLearning was found to be superior to non-adaptive learning.

Discussion and Conclusion

Modern instructional models stress the use of whole, meaningful learning tasks as the driving force for complex learning. However, learners are easily overwhelmed by the complexity of such tasks. It is thus critical to select each new learning task in such a way that it is best adapted to the individual needs of the learner. According to the 4C/ID model, adaptation mainly refers to (a) the—build-in—support that is provided to learners while they perform the task, and (b) the difficulty of the task (i.e., the task class it belongs to). As an additional constraint, the whole set of tasks that is provided to the learner must display a high level of

variability. In order to determine the optimal level of support and difficulty of a next learning task, an indication of the learner's performance is insufficient. After all, if two learners reach the same performance but one needs to put in a lot of effort (low mental efficiency) and the other does it almost effortlessly (high mental efficiency), the selected new task should be easier and/or contain more support for the first learner than for the second learner.

We discussed several empirical studies, which indicate that adapting the level of support, the difficulty of the learning task, or support as well as difficulty has beneficial effects on learning and transfer test performance. Thus, adaptive instruction is more effective than non-adaptive instruction. Three conclusions can be drawn from the presented studies. First, both the level of available support and the difficulty of the learning task are important dimensions to take into account for dynamic task selection. Second, performance alone is often an insufficient basis for task selection and should be complemented with, for instance, invested mental effort so that mental efficiency drives the task selection. Third, the 4C/ID-model proved to be not only useful to develop fixed training programs but also to develop adaptive forms of instruction.

While the presented results are promising, they also yield important questions for future research. A first question pertains to the complex relationship between difficulty and support. If a learner's mental efficiency is suboptimal, should we present a next task that is equally difficult as the previous one but with more support; should we present a next task that is less difficult than the previous one but with the same level of support; or should we vary both the available level of support and its difficulty? The 4C/ID-model suggests to vary only the support until the learner can perform the task without any support, according to relevant standards and criteria, and not until then to continue with more difficult learning tasks (i.e., progress to a next task class). However, strong empirical support for this claim is yet missing. Second, it is important to replicate our findings on dynamic task selection with lengthier tasks in real-life environments. Especially the measures of mental effort may be much more difficult to realize for such tasks and settings. Finally, an important issue for future research pertains to the level of control that learners should be given over task selection. The development of metacognitive skills and higher order skills is increasingly seen as an important goal of education, and this includes the ability to select yourself learning tasks that best help to reach educational and personal goals. The question is not if new learning tasks should be selected by the teacher (or another intelligent agent) or by the student, but how teachers can select learning tasks for students who are not yet able to do this, how they can help students to take more and more responsibility for selecting their own learning tasks, and how they can help students with this by giving advice and providing guidance. We will only be able to answer those questions if we understand the mechanisms of good learning task selection.

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What Teachers Use; What Teachers Want

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Abstract

The demand for the integration of technology into our K-12 schools dictates the technology curriculum in higher education. Since the evolution of new technologies is continuous and rapid, it is an ongoing challenge to keep post-secondary education current. Teacher education programs are no exception. Today's pre-service teachers are the classroom teachers of tomorrow. They must be prepared for the near and distant futures.

To this end, faculty and staff in higher education continuously strive to be on the cutting edge. There is a constant alert for what's new today and what's coming tomorrow. One is always looking ahead of the curve in order to be prepared for the future. In order to provide information for the updating of a college curriculum, the following study was conducted.

Introduction

The purpose of the study was to identify technology skills and knowledge that are used and taught by public school teachers and others working in the educational field. This information was intended to be used to in the planning and revision of technology courses in higher education but could also be used for the planning of in-service training in the public school systems.

The challenge to planning programming today is not only being prepared for what is to be 2, 3, 5 or 10 years down the road, but what is needed right now. How do we address the very practical needs of today yet be prepared for what's coming? To ascertain present and future needs, public school teachers and others working in the educational field were surveyed. The group included teachers, administrators, librarians, and technology professionals currently enrolled in graduate courses. Participants were asked about their use patterns in the following categories: hardware, media/communications, professional development, software, and other.

Rationale

While it is essential to prepare pre-service teachers for future technology, it is important not to lose sight of the current tools of the classroom. Teachers still use the overhead projector, copy machines, audiocassettes, and various other technologies not considered high-tech. Since there is great diversity in the available technology in classrooms across the country and future teachers cannot anticipate where they will be employed, multiple contingencies must be anticipated. Higher education teacher preparation programs must provide a wide range of knowledge and skills ranging from the simple to the complex.

It is important to be current yet forward-looking for a number of reasons. First of all, if new teachers are not prepared and comfortable with various technologies they have in their classrooms, they will likely not use them. If there is a general feeling of incompetence, they are less likely to try new things as well. In a report by the National Center for Education Statistics (U.S. Dept of Education, 2000) entitled, *Teacher's Tools for the 21st Century*, researchers found that teachers who spend more time in technology training, as opposed to teachers who spent less time, felt well or very well prepared to use it for instruction, and teachers' use of technology was related to their training...." It is then likely that there would be impacts on the quantity and quality of teaching and learning in the classroom.

The overall scope of technology training in teacher education programs is still unknown. According to the National Education Association (NEA, 1998), "At least 50% of today's teachers have not had adequate training and technical assistance in the uses of technology." The NCES report found that 93% of public school teachers in elementary and secondary education indicated that independent learning or being self taught was the most frequent way they were educated in technology. Though 88% received training through professional development, only half of all teachers reported that college and graduate work prepared them to use technology. The NEA implies that many teachers enter their profession with minimal technology training that prepares them for using it in their classrooms and/or curricular area. The report states: "Most teacher preparation programs provided by schools, colleges, and departments of education do not have written, funded and regularly updated technology plans." The data suggests that more technology programs in higher education should be offered and

updated to provide technology training programs to pre-service and public school teachers.

This study included most current technologies, knowledge and skills which may potentially be taught at the college level. Although current data from this study may be used to update existing curricula, it is worthy to reiterate the changing, flexible, and unpredictable nature of this field. Such studies and inquiries should be made regularly. Those who plan programming should avail themselves of such resources and data in order to update programs on a regularly scheduled basis.

Methodology

Research Design

The research design was as a descriptive study. In May 2001, a graduate faculty member at a local university piloted the original survey with teachers at a local elementary school in the southwest Missouri area. One year later, the survey was modified to make it more efficient. The surveys were distributed via e-mail during the summer of 2002. A second distribution occurred during the early part of the fall 2002 semester via post office mailing due to a low return rate. A self-addressed, stamped envelope was also included along with the survey and a letter reintroducing the study. The participants were asked to mail the survey back within a week.

Participants

The participants were graduate students in higher education at a Missouri university during the summer 2002 semester. They were enrolled in the following graduate level classes: Library Science, Educational Administration, Introduction to Educational Research, Educational Counseling, Field Experience, and Career Development from the Department of Guidance and Counseling. Participants included a mixture of male and female graduate students of different ages, positions, interests and training. Consent forms were distributed and privacy insured. Participants selected which technology they use, which technology they teach to others, which technology they neither use nor teach to others (therefore would require no formal training), or which participants would like formal training on (See Table 1).

Table 1. *Sample of instrument for first four items of the Hardware category.*

| Hardware Category | I use this technology myself | I teach this technology to others | I neither use nor teach this technology | I would like formal training on this |
|--------------------------|------------------------------|-----------------------------------|---|--------------------------------------|
| 1. Paper cutter | | | | |
| 2. Copy machine | | | | |
| 3. Overhead projector | | | | |
| 4. 16 mm projector | | | | |

Results

Thirty-four (N) out of 63 participants responded to the survey via e-mail and postal mail. The participants included teachers, school counselors, case managers from a local behavior health care clinic, other working professionals, and full-time graduate students. The majority, 19 out of 34 of the participants were teachers (Figure 1). Grade levels taught by participants ranged from pre-school to college. The majority, 63% of the participants, were elementary school teachers (Figure 2). Other working professionals included a tax payer services representative and an accountant. These were treated as outliers and were not included in the data analysis.

Demographics

Participants were counselors, case managers, teachers, full-time students, and other working professionals who were graduate students in higher education at a Missouri university. The survey instrument was pilot-tested twice with a small group of teachers who were graduate students in the College of Education. After the second revision, surveys were ready for distribution. The participants volunteered to be in the study during the summer 2002 semester after the researcher presented the study to their graduate classes. Surveys were first distributed via e-mail but, after a low response rate, they were redistributed via postal mailing. Thirty-four out of 60, or 57% of the participants, responded after the second distribution of surveys.

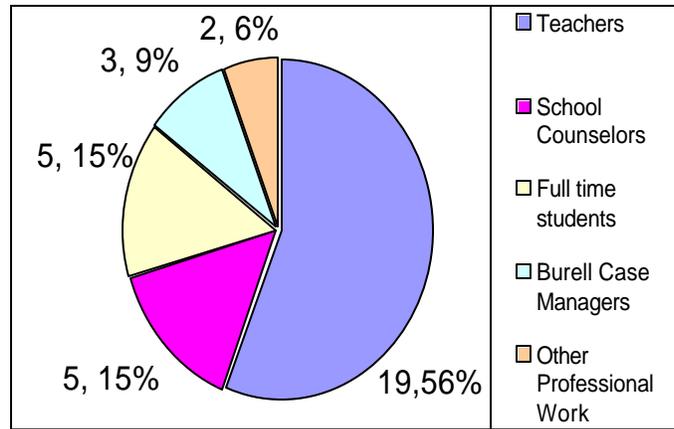


Figure 1. Job Position and Title of Participants.

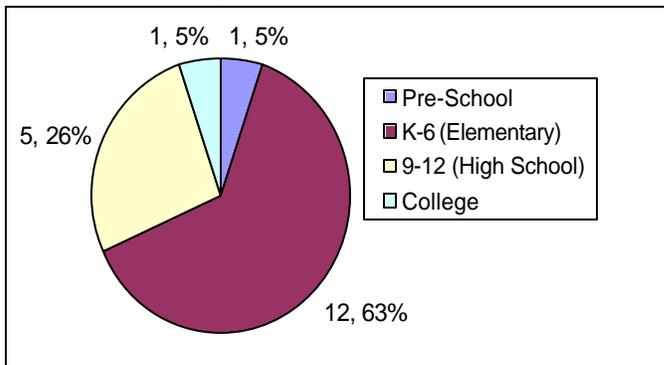


Figure 2. Grade level of teacher participants

taught or take advantage of workshops to further their technical skills. It is assumed that most of these were through in-service programs in their schools. However, this was not asked. They may also have taken courses from other sources such as community colleges.

Other Data Analysis

The technology questions on the survey were organized under the following main headings: Hardware, Media/ Communications, Professional Development, Software, and Other. Each participant was asked to mark the column that *mostly* applied to them: “I Use This Technology Myself,” “I Teach This Technology to Others,” “I Neither Use Nor Teach This Technology,” or “I Would Like Formal Training On This Technology.” Therefore, they could only choose one column. The most frequent responses from a total of 34 are discussed in this chapter. The column “I Teach This Technology to Others” was not discussed due to an insufficient number of responses under this option.

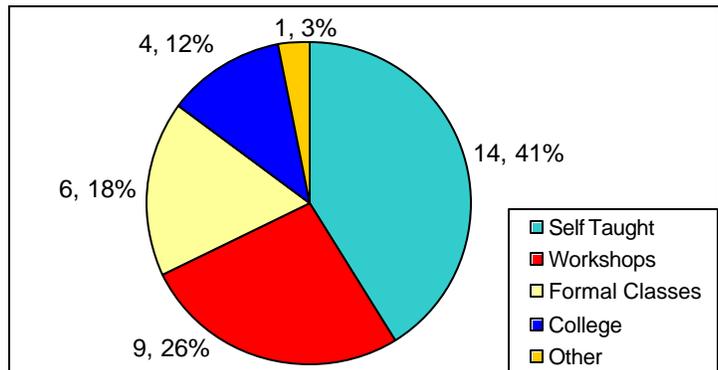


Figure 3. Sources of technology training.

I Use This Technology....

The top three items for each heading in the “I use this technology” column are summarized in Table 2. The results for Hardware were somewhat expected as all of these are common office and educational

technologies. In the Media/Communications area we also can see some of the most often used media including Bulletin Boards, a low-tech medium. The internet seems to play an important part in Professional Development as the data suggests it is used as a student and teacher resource as well as for collaboration. Word processing ranks number one in the Software category followed by internet searching and finding technology resources and spreadsheets which tied for third place. The Other category may suggest some needs as troubleshooting computers as well as other equipment and technology and diversity issues rank at the top. We could surmise that they spend a significant amount of time in these activities and/or are concerned with these topics.

Table 2. *Top three data rankings for the “I use this technology...” column.*

| Hardware | | Total of 34 |
|---------------------------------|---|--------------------|
| Rankings | | |
| 1 | Copy machine | 33 |
| 2 | VCR and TV-VCR setups | 32 |
| 3 | Printers | 31 |
| Media/Communications | | |
| 1 | E-mail | 32 |
| 2 | Transparencies | 27 |
| 3 | Bulletin boards (design and display) | 24 |
| Professional Development | | |
| 1 | Student resources on the web | 20 |
| 2 | Teacher resources on the web | 18 |
| 3 | Collaborative resources on the Internet | 18 |
| Software | | |
| 1 | Word processing | 30 |
| 2 | Internet searching (search engines) | 26 |
| 3 | Spreadsheets | 24 |
| Other | | |
| 1 | Troubleshooting computers | 11 |
| 2 | Technology and diversity issues | 10 |
| 3 | Troubleshooting a variety of equipment | 9 |

I Would Like Formal Training...

Table 3 shows the most frequent requests for formal training for each of the headings. In the Hardware area, thirty-two percent (11/34) wanted training on Desktop Videoconferencing and other newer technologies such as electronic whiteboards/Smart Boards and interactive television (ITV). This may suggest there is an awareness of their capabilities and potential applications. These technologies may or may not be available on the job or may not be used due to a lack of knowledge and skills. Web site development, not surprisingly, was a major area of interest in Media/Communications. In the Professional Development area it was surprising to find that Locating Free Materials was of high interest. Perhaps this is a reflection of budgetary constraints and a need for instructional materials and information. It was also not surprising that PowerPoint was the #1 Software training request. In the Other technologies category participants were primarily concerned with troubleshooting and repairing all types of technologies. There were also indicators of interest in management issues such as diversity, privacy, and limited access. It is apparent that educators in various settings have concerns and needs not only with hardware and software operations but also the ramifications of its effective, efficient, and lawful use.

Table 3. Data rankings for “I would like formal training on....”

| Hardware | | Total of 34 |
|---------------------------------|--|--------------------|
| Rankings | | |
| 1 | Desktop videoconferencing | 11 |
| 2 | Interactive TV (ITV) and Electronic White Boards “Smart” | 10 |
| 3 | Scanner | 8 |
| Media/Communications | | |
| 1 | Web site development | 14 |
| 2 | Desktop publishing (flyers, forms, etc) | 8 |
| 3 | Dry mounting and video as a teaching/learning tool | 5 |
| Professional Development | | |
| 1 | Locating free materials | 9 |
| 2 | Online training sites | 7 |
| 3 | Student resources on the web; collaborative resources on web | 6 |
| Software | | |
| 1 | Presentation (PowerPoint, etc.) | 11 |
| 2 | Interactive Learning Systems; Authoring (Hyper Studio, etc.) | 9 |
| 3 | Databases; Simulations | 8 |
| Other | | |
| 1 | Troubleshooting computers and variety of equipment | 9 |
| 2 | Privacy and limited access (internet issues); equipment repair | 8 |
| 3 | Technology and diversity issues | 7 |

Comparative Analysis

In the area of Media/Communications we looked at those who selected “Neither used nor taught” vs. “Would like training.” By examining the convergent and divergent points we made a number of observations. In the Desktop Publishing area, the number of “Neither use nor teach” responses (7) was very close to “Would like training” (8). This could suggest that, even though it is not used, there are a nearly equal number of people interested in learning these skills. It could be surmised that training in this area would increase use and performance.

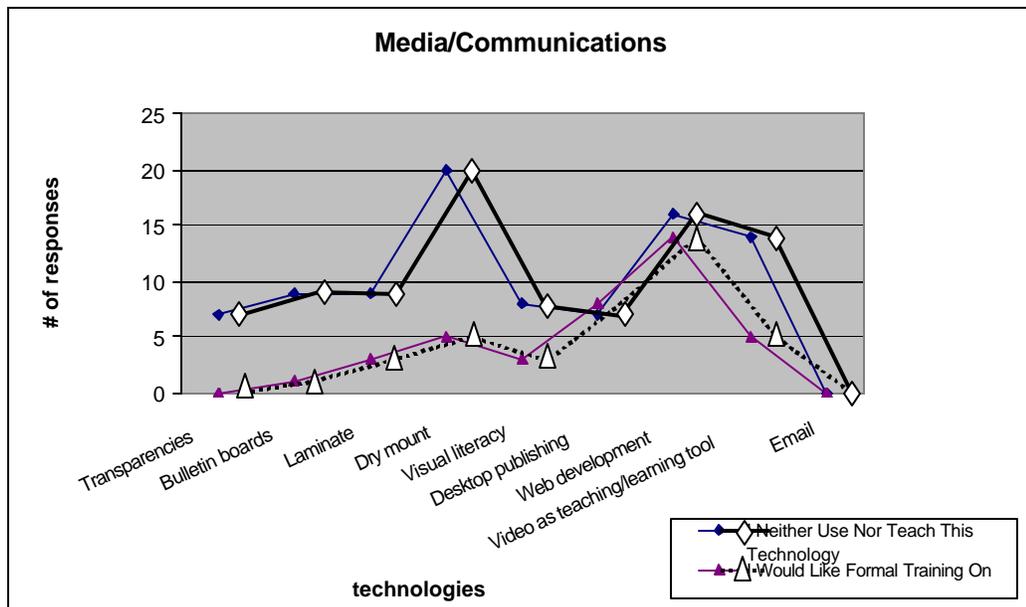


Figure 4. Media/Communications comparisons of “I neither use nor teach” vs. “I would like training.”

Likewise, in the Media/Communications section (Fig. 4), Web Site Development (16) was identified as an area that was not used nor taught but 14 requested training. Similar close relationships may be observed for: Digital camera, Scanner, Desktop Publishing, Student Resources on the Web, Locating Free Materials, Spreadsheets, Databases, Presentation Software (ex. PPT), Internet Searching, and Loading Software. For Dry Mount, Video as a Teaching /Learning Tool, and Visual Literacy a small number of participants requested formal training even though most neither used nor taught these. In this case, even though the number of responses was low, it could be that there was little knowledge of these topics thus resulting in this response pattern. It was surprising that some interest was indicated perhaps warranting a close look at these areas.

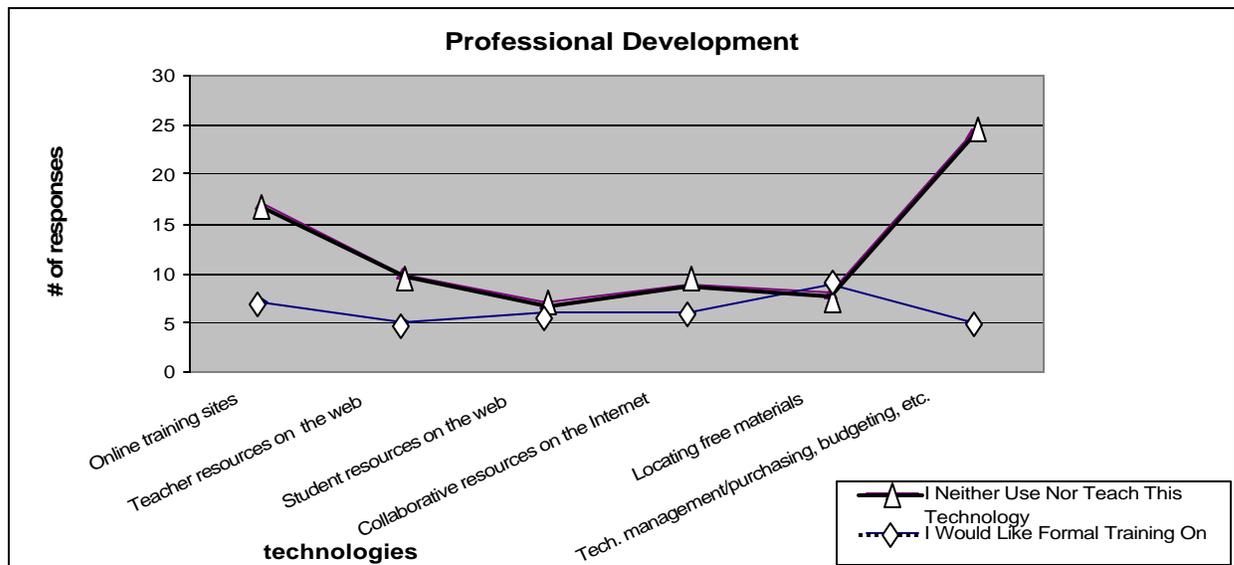


Figure 5. Professional Development comparisons of “Neither use nor teach” vs. “Would like training.”

Professional Development comparisons (Fig. 5) for the same response choices showed some rather dramatic convergent areas between Student Resources on the Web and Locating Free Materials and divergent patterns with Online Training Sites and Technology Management, Purchasing, etc. One may conclude that, for those areas that closely correlate such Internet Resources and Collaborations, participants may increase their use given information and training. On the other hand, for those areas that diverge such as in the Management and Online Training Site areas, it would seem that participants do not engage in these activities and are not interested in training. For example, 24 of 34 neither use nor teach in the area of technology management/purchasing, budgeting, etc and only 5 indicated an interest in learning more about these areas. Given this disparity in numbers, it would seem logical that this would not be an area of great concern for training. However, administrators may want to target these small groups for specialized sessions. It would seem reasonable that convergent areas should be addressed in training programs in higher education and in-services whereas those that diverge would not be as critical.

In the Software category (Fig. 6) we looked at actual use patterns and the desire for training. Again, the pattern of relationships had interesting implications. Apparently, high use areas such as Finding Technology Resources thru the Library and Internet Searching are comfort zones which seem to suggest training in these areas is not needed. The chart shows highly divergent patterns. However, further study is advised as Librarians may have a different perspective on this. Topics that closely correlate or come together on the chart such as Presentation Software (Ex. PowerPoint), Authoring Software (ex. Hyper Studio), Interactive Learning Systems, Simulations, Evaluation of Software, Evaluation of Web Sites, Inspiration, and Kidspiration show a nearly equal number of those who are users and those requesting training. With nearly equal numbers in these areas, it would be logical to address these areas in training programs.

There is another interesting crossover pattern in the Simulations area. More would like training than are actual users. Again, even though the numbers are low, this seems to suggest that more training and information would increase use.

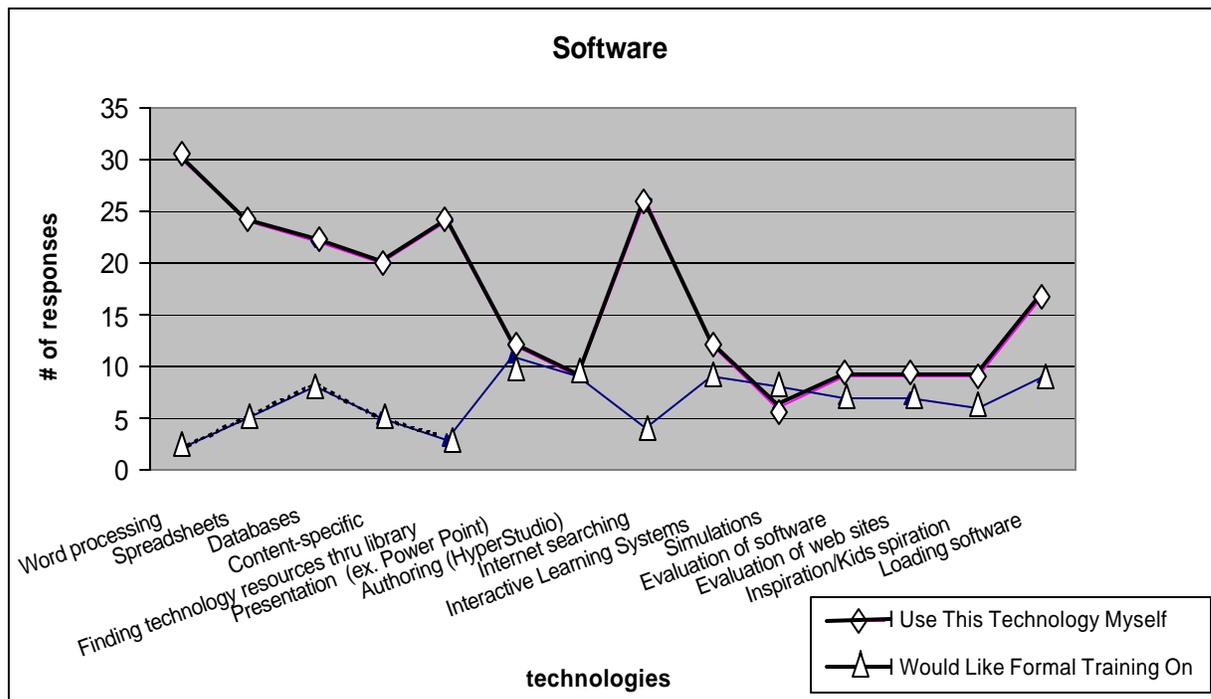


Figure 6. Software comparisons of “I Use This Technology Myself” vs. “I Would Like Formal Training.”

The “Other” category (Fig. 7) included management topics that are not so much “technology” as issues surrounding its use, ex. troubleshooting, maintenance, diversity, privacy and limited access, and purchasing. This chart shows the relationship of “Use” vs. “Neither” vs. “Want training.” It is evident that the majority of participants are not involved in these activities. However, there is seems to be a relationship between “Use” and “Want training.” Two coordinating points are in the “Troubleshooting equipment” area. It appears that users also want to be able to troubleshoot. On the other hand, there are more who indicated they are not “Users” of Internet Privacy and Limited Access topics than “Would like training.” Perhaps, given information and training, more would concern themselves with these issues.

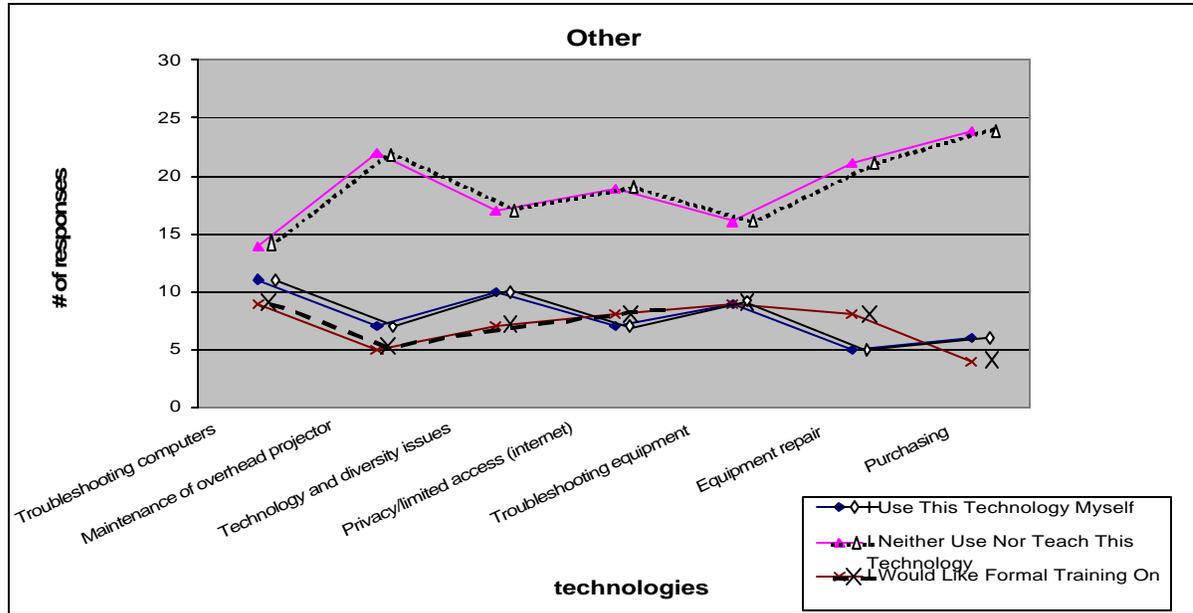


Figure 7. Comparisons of “Use,” “Neither use nor teach” and “Would like training” in the Other category.

Data Summary

The top three choices in each category are a mixture of old and new technologies and topics. From a sample population of 34, note the actual counts in parentheses within the table.

Table 4. Top three rankings for the “I use this technology” response.

| Category | Ranked #1 | Ranked #2 | Ranked #3 |
|-----------------------------|-----------------------------------|--|--|
| Hardware | Copier (33) | VCR setup (32) | Printers (31) |
| Media/ Communications | E-mail (32) | Transparencies (27) | Bulletin Boards (24) |
| Professional Development | Student Resources (20) | Teacher & Collaborative Resources (tied-18) | Locating Free Materials (16) |
| Software | Word processing (30) | Internet searching (Search engines) (26) | Spreadsheets & Finding technology Resources through the Library (tied-24) |
| Other | Troubleshooting Computers (11) | Technology & Diversity (10) | Troubleshooting other equipment (9) |

Table 5. Top three rankings for the “I would like formal training” category.

| Category | Ranked #1 | Ranked #2 | Ranked #3 |
|----------------------|-----------------------------------|---|--|
| Hardware | Desktop Videoconferencing(11) | Interactive TV & Electronic white boards (tied-10) | Scanner (3) |
| Media/Communications | Web site Development (14) | Desktop Publishing (8) | Dry Mount & Video as teaching/learning tool (tied-5) |

| | | | |
|--------------------------|------------------------------------|---|--|
| Professional Development | Locating Free Materials (9) | Online Training Sites (7) | Student & Collaborative Resources (tied-6) |
| Software | PowerPoint (11) | Authoring software, Loading, Interactive Learning Systems (9) | Databases & Simulations (tied-8) |
| Other | Troubleshooting all Technology (9) | Privacy and limited access & Equipment repair (tied-8) | Technology and Diversity Issues (7) |

Table 6. *Data summary comparing present use and areas where training is desired.*

| | Hardware | Media/ Communications | Professional Development | Software | Other |
|---------------|--------------------|-----------------------|--------------------------|-----------------|--------------------------------|
| Use Now | Copier | E-mail | Student Resources | Word processing | Troubleshooting Computers |
| Want Training | Video Conferencing | Web Development | Locating Free Materials | PowerPoint | Troubleshooting all technology |

Discussion

It is important to note that technologies that are used often should also be considered in training programs. Although this population was not asked if they had training in these areas, one could reasonably assume not all have had in-depth training in even the most commonly used technologies such as word processing. Versions and needs change as well as operating systems and uses. A well-rounded program, whether in higher education or an in-service, would address all areas of potential need. It is also important to note that. We must remember that techniques, presentation tips, design skills, and foundation principles do not change over time and should be included in all programs that educate teachers. In higher education it is especially important to teach the foundational theories of the field of instructional technology as applied to present tools as well as those on the horizon.

Although the data in the areas referring to older technologies may show little interest in training in these areas, it is important to remember that: 1) initial training in the technology may have been inadequate (few know more than basic skills in word processing or how to create a simple one-layer transparency); 2) software is continuously being updated requiring re-training; and 3) new skills and theories in the application of technology require continuous education for our teaching professionals.

Summary

The purpose of this survey was to gather data concerning the knowledge, skills, and technology teachers are using in the K-12 public school setting. Demographic data showed 56% or 19 of the 34 respondents were K-12 teachers followed by school counselors, full-time students, case managers for a behavioral institute, and two undeclared. All were graduates in university courses. Questions focused on what they use themselves, which they teach to others, which they neither use nor teach, and those for which they would like training. This information could then be used to determine changes and updates to the technology curriculum for pre-service teachers at the university level. Although this was a limited survey, it did suggest some possible trends and relationships which seem to be in alignment with current beliefs.

Results were predictable in some ways. The most used technologies were the most available in schools: copy machines, overhead transparency, paper cutters, etc. Conversely, those that were identified as "Neither use nor teach" were either older and/or no longer available (16 mm projectors), managed by a specialist or coordinator (networks, budgets, etc.), or so new they were not likely available (electronic white boards). The latter was evident in the "I would like training...." response as they were mostly the newer technologies. The "Other" category revealed a desire for more troubleshooting knowledge and skills.

Several recommendations are being made. Since 67% of the participants indicated most of their technology skills were self-taught or gained through workshops, it is evident that higher education must

continue to be diligent in the training of our pre-service teachers. Until that portion of the workforce with limited knowledge and skills retires or is trained and/or the current generation becomes the majority, there will be a need to continue with broad-spectrum pre-service technology training programs.

It would also behoove us to remember that those established technologies and media which have a proven track record as being effective and reliable (bulletin boards and transparencies) will continue to be integral in the education of our students. As the data showed, teachers in the classroom are aware of this and are requesting training in these areas. There are many subtleties to the efficient production and use of these media which are not likely learned on the job. Visual literacy skills as well as production skills are required for classroom teachers to communicate with students in an efficient, clear manner regardless of the technology being used. Teachers must be able to create and interpret visually in order to create effective instructional materials. Instructional design and technology faculty, art teachers, and communication specialists in many areas may assist with this very important task of training both visual and verbal communication skills.

This may be accomplished in several ways. Partnerships of various types including those with universities, school districts, community colleges, the private sector, etc. may provide the financial resources and other opportunities required in basic and advanced training programs at all levels. With continuing restrictions on budgets in any one institution, it would seem that these kinds of collaborations would be mutually beneficial.

In order to keep current with the changes in the field of education and technology it is important to conduct surveys such as this as an assessment activity. Items, categories, and needs will change continuously. In as little as two years this picture could change. Therefore, it is recommended that this type of evaluation be used at all levels of education including post-secondary. This would also provide important data for accreditation purposes. It would also be helpful to ascertain not only use pattern but also what they would like training on by allowing participants to select more than one response choice instead of only the one.

Conclusion

In a report by the National Center for Education Statistics (U.S. Dept. of Education, 2000) entitled, "Teachers' Tools for the 21st Century," researchers found that teachers who spent more time in technology training, as opposed to teachers who spent less time, felt well or very well prepared to use it for instruction and, teachers' use of technology was related to their training...." Our challenge as those who prepare educators for the classroom is to be aware of the changing needs in learning and technology and how this may impact our programs while establishing practices based on sound theories and techniques. Diligent observation and feedback is required to meet this challenge.

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Brain-Based Learning With Technological Support

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Introduction

Utilization of technology in secondary schools is varied and depends on the training and interest of the individual instructors. Even though technology has advanced way beyond its utilitarian roots of being viewed solely by educators as a useful machine for teachers to key exams and worksheets on, there are still many secondary educators who still only view it as such. These educators have not recognized the growing role that technology is taking on in today's classrooms of being a cognitive tool that when partnered with learning theory can help educators enhance learning and maximize the learning potential of their students. As a teacher education professor, I was experiencing this lack of acceptance of technology's new role in my students. When I asked them if they utilized technology in their classrooms, they would say that, of course they do. Then, when I would ask them how they utilized it, they would say, to type exams, worksheets, and have their students type papers. They do not utilize it as a cognitive tool to enhance learning. Concerned with this phenomenon, I proposed to find and research teachers who did recognize and utilize technology as a cognitive tool to enhance learning for their students. My search resulted in an investigation of instructors who believed in and implemented Brain-Based Learning with technological support and had positive results. The primary question guiding this study was, "How is Brain-Based Learning with technological support being implemented by selected teachers in their classrooms?" The corollary questions included: What is the nature of the environment, that is, the classroom, in a Brain-Based Learning environment utilizing technology? What is the role of the instructor in a Brain-Based Learning classroom utilizing technology? What is the role of the students in a Brain-Based Learning classroom utilizing technology? What are the roles of the school administrator and technology coordinator in the Brain-Based Learning classroom utilizing technology? and What are the problems encountered by teachers when utilizing Brain-Based Learning with technological support in the classrooms and how can these problems be overcome?

Literature Review

Brain-Based Learning Research

Researchers, such as Geoffrey Caine and Renate Nummela Caine, recognized that the brain has a virtually inexhaustible capacity to learn, and that each healthy human brain, irrespective of a person's age, sex, nationality, or cultural background, comes with the following features: the ability to detect patterns and to make approximations; a phenomenal capacity for various types of memory; the ability to self-correct and learn from experience by way of analysis of external data and self-reflection; and an inexhaustible capacity to create. They could not, though, understand why, if everyone has these features, we are struggling with the ability to educate. Caine and Caine (1994) found the answer to this was that educators did not know and understand the complexity and elegance of the way the brain learns, especially when it is functioning optimally. Their research presented this information and how it could be utilized to enhance learning for all students. For example, teachers need to provide learning activities and experiences that immerse learners in curricular content and context, such as encouraging them to talk, listen, read, view, act, and value what is being learned (1994). In other words, they needed to implement a brain-based education for all students. A brain-based education, according to Caine and Caine (1994), involved designing and orchestrating lifelike, enriching, and appropriate experiences for learners and ensuring that students process experiences in such a way as to increase the extraction of meaning. This, they indicated, could be accomplished by providing a variety of learning activities and projects, and choices where those activities and projects would take place.

Another researcher, Howard Gardner (1999), added to the concept of Brain-Based Learning by establishing his theory of "multiple intelligences," a theory that indicates that there is not just one form of intelligence based on verbal and reasoning abilities, but rather eight different intelligences, each having a unique neurological pattern and course of development. The eight intelligences include: linguistic, musical, logical-mathematical, spatial, bodily-kinesthetic, interpersonal, intrapersonal, and naturalistic. Gardner (1999) believed that the educational system of the 1970s favored children who were skilled at reading and writing, and

did not address a student who was considered “poor” in school due to his/her limited reading and writing skills, but who could, in fact, operate a film projector without instruction, which takes spatial intelligence. In other words, Gardner felt that there were too many children just like this one whose educational needs were not being met due to the narrow view of intelligence. To meet all children’s learning needs teachers needed to present a variety of learning activities, such as individual and group projects, apprenticeships, and hand-on activities, which addressed all eight of the intelligences.

Lastly, a researcher and educator, Kathy Nunley (2001), who was concerned that teachers did not have the education and training to help them find new ways to meet the needs of their increasingly diverse groups of students with a wide variety of abilities, cultures, and languages, began to research a way to provide these for them. Her research, based on knowledge of the brain and Gardner’s Multiple Intelligences Theory, resulted in the development of a curriculum entitled “The Layered Curriculum.” This curriculum involves presenting students with learning in three distinct layers. Each layer represents a different depth of study in a topic or unit of learning as it is geared toward a different kind and level of learning. Students can choose how deep they wish to examine a topic and which way best fits their learning style and ability, thereby choosing the grade (A-F) they will earn as well. Also, there is a broad range of learning tools available to the student to assist in completing their assignments. These tools include a wide use of technology, from taped lectures to computer programs.

The Role of Technology in the Learning Process

Technology has long been a support tool in education (Lockard & Abrams, 2001). Its functions are deeply embedded in school administrative and instructional environments. Classrooms, too, are places where technology is found. From movie and overhead projectors, televisions, VCRs, and tape recorders, to DVDs and computers, teachers have long found technology to be a tool that enhances content. Its use in the classroom has led to technology being referred to as a cognitive tool. Jonassen and Reeves (1996) stated that “cognitive tools refer to technologies, tangible or intangible, that enhance the cognitive powers of human beings during thinking, problem solving, and learning. Written language, mathematical notation, and, most recently, the universal computer are examples of cognitive tools” (p. 693). Jonassen went on to describe technology as “mindtools.” The idea of technology as mindtools parallels the newer view of learning that has changed from being viewed solely as a passive activity, where learners sit at desks listening, taking notes, studying, and taking tests to measure the learning that has taken place, to being viewed as an active process, where students actively are engaged in the learning process and in constructing their own knowledge. This active view of learning often is called constructivism and it “is grounded in the research of Piaget, Vygotsky, the Gestalt psychologists, Bartlett, and Bruner as well as the educational philosophy of John Dewey” (Woolfolk, 2001, p. 329). Constructivism is defined by Woolfolk (2001) as “a view that emphasizes the active role of the learner in building understanding and making sense of information” (p. 329). Constructivist learning, as an active student centered learning process, has several characteristics. They are that it should involve “complex, challenging learning environments and authentic tasks; social negotiation and shared responsibility as a part of learning; multiple representations of content; understanding that knowledge is constructed; and student-centered instruction” (Woolfolk, 2001, pp. 334-336). Mindtools are cognitive tools that students utilize as they are engaged in a constructivist learning environment.

Brain-Based Learning is student centered learning that utilizes the whole brain and recognizes that not all students learn in the same way. It is also an active process where students are actively engaged in constructing their own knowledge in a variety of learning situations and contexts (Caine & Caine, 1994). Mindtools are the cognitive tools that can support Brain-Based Learning.

Method

Participants

The participants for this case were unique or “based on unique, atypical, perhaps rare attributes or occurrences of the phenomenon of interest” (Merriam, 1998, p. 62). The six teachers were unique in that they had embraced Brain-Based Learning with technological support and were utilizing it in their classroom teaching. They were also a network sample or a “sample that is based on each participant or group of participants referring you to other participants” (Merriam, 1998, p. 63). They were chosen based on recommendations by the principal, as they had studied and embraced Brain-Based Learning with technological support and had implemented its use in their classrooms. The six teachers were from the following disciplines: health education, physics, engineering graphics/CAD/Manufacturing, French, history, and information systems

The administrator constituted a unique sample because he was a strong advocate of Brain-Based Learning with technological support and was instrumental in bringing BBL to his school. He had taken numerous workshops on Brain-Based Learning, had conducted his own workshops on “Creating a Brain-Friendly Instructional Climate” for local educators, and had implemented his concept of a Brain-Friendly Instructional Climate at the high school for the 2000-2001 academic year.

The technology coordinator constituted a unique sample because he was the only technology coordinator at the high school. He worked closely with the principal and the teachers mentioned above to assist in the implementation of Brain-Based Learning with technological support.

Data Collection

Data collection employed the strategies of interviewing, observing, and completing a checklist. The interviews involved meeting with each of the six teachers, the administrator, and the technology coordinator and having them discuss their individual roles in Brain-Based Learning with technological support, how such learning can be implemented, the problems that were encountered, and possible solutions to these problems. The observations involved observing the six teachers as they were implementing Brain-Based Learning with technological support. Lastly, the checklist involved recording the Brain-Based methods utilized by teachers in the classrooms during the observations.

Results

The data collected from interviews, observations, checklists, and questionnaires were analyzed and consolidated, and the findings organized and presented as they relate to the research questions.

Corollary Question 1

Corollary Question 1 asked, “What is the nature of the environment, that is, the classroom, in a brain-based learning environment utilizing technology?” The data indicated that the nature of the classroom in a brain-based learning environment is one that is active and learner-centered. It is visually appealing, warm, and conducive to interaction, whether it be student-to-student or student-to-teacher. It is an environment where students are not just sitting passively taking notes and listening to a teacher lecture. It is where students are actively engaged in learning, interacting with a variety of learning tools, their peers, and the teacher. The teacher is not only seen in the front of the classroom, but is frequently seen walking around the classroom talking to students and helping them with problems, answering questions, and offering feedback. The BBL classroom is an environment where as students enter through the classroom doors, they are transported into the world of the subject being taught. Lastly, it is an environment that is computer-based. All of the classrooms have computers in them or have access to a computer lab, where students frequently are actively engaged in working through learning modules, in doing research, or in a variety of creative endeavors.

Corollary Question 2

Corollary Question 2 asked, “What is the role of the instructor in a Brain-Based Learning classroom with technological support?” The data indicated that the role of the instructor in a Brain-Based Learning classroom with technological support is as a guide and facilitator to the students as they are actively engaged in the learning process. In this role the instructor provides direction, answers questions, guides collaborative problem solving, and offers feedback. The instructor has as his/her philosophy the knowledge that all students are individuals with individual brain dominance and intelligence(s), information processing abilities, and learning styles, and that learning needs to be adapted so that all students can have learning experiences that enable them to learn to the best of their abilities. This can be accomplished through varying activities, learning tools, and approaches.

Corollary Question 3

Corollary Question 3 asks, “What is the role of the students in a Brain-Based Learning classroom with technological support?” The data indicated the role of the students in a Brain-Based Learning classroom with technological support is that of active learners engaged in the learning process, learning to the best of their individual abilities.

Corollary Question 4

Corollary Question 4 asked, “What are the roles of the school administrator and technology coordinator in the Brain-Based Learning classroom with technological support?” The role of the administrator

committed to Brain-Based Learning with technological support is, according to the principal, “to try to create a risk free climate where a teacher is not afraid to try something new or different, and to provide the support elements for that teacher who wants to try it. If a teacher wants to try something with technology, then they have to have the technology, they have to have the skills, and they have to have the training. So, as an Administrator, my responsibility is to facilitate that climate so that that teacher can take advantage of those things so they can utilize it and have a better opportunity for success.”

The role of the technology coordinator in a Brain-Based Learning environment with technological support is, according to the technology coordinator, someone who wears “many hats.” He oversees all hardware and software purchasing and budgeting for both the administrative and the teaching sides of the building, and he coordinates all the technology within the building. One of the additional hats the technology coordinator wears is that of helping teachers who want to utilize technology in the learning/teaching process.

Corollary Question 5

Corollary Question 5 asked, “What are the problems encountered by teachers when implementing Brain-Based Learning with technological support in the classrooms and how can these problems be overcome?” The data indicated that the problems encountered by the teachers involved in the implementation of Brain - Based Learning with technological support in classrooms were of two types. They were: (1) technical problems and (2) student problems.

The technical problems encountered by the teachers when implementing Brain-Based Learning with technological support were: (1) the network was down, (2) the CD was not working, (3) there was a lack of color printing capabilities, (4) the font was too small, and (5) there was software incompatibility. These problems were observed to be intermittent and none interrupted the teaching/learning process for very long. In most cases, the instructor was able to work around these technological problems by having an alternate method for accomplishing a goal or changing to another task for the class.

The student problems encountered by teachers in using technology to support Brain-Based Learning were: (1) the students were “surfing” the web, (2) there were multiple simultaneous questions, and (3) there were noisy students. As with the technical problems, these problems were observed to be intermittent and none interrupted the teaching/learning process for very long. In most cases, the instructor was able to work around these technological problems by having an alternate method for accomplishing a goal or changing to another task for the class.

Discussion

During the months of collecting and analyzing data and reporting the findings of this study, as the researcher, I found that my personal beliefs and thoughts on secondary education and how it could be improved to meet the needs of our increasingly diverse high school student population were reinforced and strengthened. I would like to discuss some of the more important ones.

First, learning for secondary students can no longer be considered a passive activity where teachers lecture and students sit in desks taking notes, studying, and taking tests. Instead, learning should be viewed as a constructivist process, an active and engaging process, one that emphasizes the active role of learners in building, understanding and making sense of information and reality (Woolfolk, 2001). As active learners, students may work independently and, at times, cooperatively on a variety of learning activities utilizing many different learning materials and modes of instruction. Their teachers in the learning process no longer just stand in front of the classroom. They now move about it, stop by students and answer questions, help the students problem solve, and offer them feedback. They are viewed as guides, facilitators, managers, supervisors, and models.

Second, each student processes information differently and learns differently, so a “one-size-fits-all” curriculum is no longer the way to plan instruction. As the principal in this study stated, “We have students that walk into this building and it doesn’t make a difference what we do, they’re going to perform at high levels. But it is public education’s responsibility to deliver the educational services to all of the students who walk in, not just the smart ones, not just the pretty ones, not just the ones who get along with people, all the students who walk into this building. In order to do that, from my experience and from what I’ve learned, and things like that, the way to do that is to create that brain friendly environment, that environment that has mutual trust and respect, where students feel connected, where their whole basic needs are met so they can move forward from the emotional to the intellectual and things like that. That’s the only way to do it.” This means that teachers need to change their view of teaching and what it involves.

Third, teachers in their new roles and with their new views of teaching and the learning process need to

recognize that this involves no longer depending solely on lectures and books to deliver knowledge. They need to utilize a variety of cognitive tools, technology among them (Jonassen & Reeves, 1996). As Howard Gardner (1999) states: "One fact that will make individually configured education a reality in my lifetime: the ready availability of new and flexible technologies. Technology can be 'smart': It can adjust on the basis of earlier learning experiences, ensuring that a student receives lessons that are optimally and individually crafted" (pp. 153-154).

In addition to being a tool that can adapt to individual learners, technology is a tool that creates new opportunities for curriculum and instruction by bringing real-world problems into the classroom for students to explore and solve. For example, students no longer just read about people, places and events. They can, via technology, visit specific parts of the environment that they have studied to explore them more fully, to test ideas, and to receive feedback (Bransford, Brown, and Cocking, 1999). They can work on projects independently or cooperatively with technological components including databases, spreadsheets, semantic networks, expert systems, multimedia/hypermedia construction software, computer-based conferencing, collaborative knowledge construction environments, computer programming languages, and microworlds (Jonassen & Reeves, 1996). They can utilize "visualization and modeling software that is similar to the tools used in non-school environments, increasing their understanding and the likelihood of transfer from school to non-school settings" (Bransford, Brown, and Cocking, 1999, p. 195), or in other words, students can acquire knowledge of tools and experience in school that can be transferred to the real world environment of work.

Fourth, this study, examined a high school, its administrator (principal), and its technology coordinator, all of whom had embraced Brain-Based Learning, were utilizing it in their classrooms to meet the varied learning needs of their students, and were encountering very few problems in the process. It provides some of the needed supporting evidence for Brain-Based Learning with technological support to be viewed as a viable alternative to the traditional "one-size-fits-all" thinking present in many of today's classrooms.

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Experience of Using Laptop in Higher Education Institutions: Effects *with* and *of* Ubiquitous Computing under Natural Conditions

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Abstract

This study provides an in-depth description of adult learners' perceptions and experiences using laptop computers in higher education institutions. The study also examines the influence on human beings' cognitive activity by using laptops. The results are organized into seven themes and four classifications: usage, benefits, limitations, and cognitive impacts.

Introduction

Portability characteristic, wireless connection, and sophisticated functions of laptop computers provide users more mobility and freedom of choice. Using laptop computers is leading to a new kind of learning format. Educators employ the term "M-learning" to emphasize cognitive, pedagogical, and social aspects of mobile technology-using for educational possibilities. Many schools and corporations such as Microsoft, Toshiba, Apple, Netschools, etc., have set up projects to promote the use of laptop computers for educational use. Laptop computers, along with other portable technology, have become tokens of a new learning format.

While technological advances have made "anytime, anywhere" learning feasible, few studies have been conducted to examine in-depth views of the learners who are using laptop computers. If we adopt Vygotsky's (1978) socio-historical perspective that using new tools gives rise to new social structures and mental structures, we can further conclude that learning and cognition, which are based on mental structures and are reflection of social existence, will also change correspondingly. Therefore, it would be valuable to study such changes in mobile learners during the transitional period from e-learning to m-learning.

Research Questions

The purpose of this study is to examine the experiences of adult users who use laptop computers to support their daily learning activities in higher education institutions. Researchers are interested in knowing how laptop computers serve as mobile learning tools. Researchers attempt to provide an in-depth description of learners' perspective and experiences about integrating these mobile devices into educational use.

Four specific questions are: How have laptops been used in academic activities? What benefits do learners get by using laptops? How laptop computers change learners' cognitive activities? What problems exist during using laptops for educational use? The results from the study may provide implications for more effective technology services and mobile learning pedagogy, design, and development.

Literature Review

Sophisticated laptop and wireless technology, as alternatives of desktop and wired technology respectively, have gained much importance in the recent years. Inspired by the improvements in portable computing technology and examples of successful pilot programs, more and more schools and corporations have initiated projects to promote use of laptop computers (Belanger, 2002). Laptop computers, just like desktops, integrate not only productivity tools, such as Word, Excel, Access, and PowerPoint, but also audio and video functions. With a microphone, video camera, and the Internet, a laptop can be used as a voice talking tool and a video communication tool. Other application software also enhances functions of a laptop. Instant messaging, like MSN, Yahoo Messenger, and ICQ, has a value of presence detection and has become a very popular tool for text, voice, and video communications in both one-to-one and group formats (Wainhouse Research. & First Virtual Communications, Inc., 2002). Other applications that may facilitate learning activities and interactions, such as file transfer, stream media, whiteboard, desktop sharing, and tele-control, can also be easily installed on a laptop computer. The trend of wireless connection further fosters the growth of "ubiquitous computing" on campus (Molenda & Sullivan, 2002). With wireless connected and sophisticated laptops, digital being and physical being are merged together. Ubiquitous computing provides new educational

possibilities. Mobile learning is one such term to describe a learning format via portable technology (especially a laptop) and wireless connection in the context of ubiquitous computing.

While technological advances have made mobile learning and teaching feasible, cognitive, pedagogical and social level challenges have emerged. Compared to other research in the field of instructional technology, few of solid research studies have been done in terms of mobile learning. Articles related to laptop-using appear more online than in journals and most of them are of the nature of evaluation projects. Through these limited research studies, we can still learn the usage, benefits, and barriers regarding laptop computer-using, which would provide us a historical perspective and assist us in attacking research questions for this study. One of the most high-profile initiatives is Microsoft's Anytime Anywhere Learning Program, which was published as the Rockman Report (Belanger, 2002). In their study, Rockman et al. (1998) reported significant learning and accomplishments in skill development, applications of technology for schoolwork, and improved critical thinking by using laptop computers. Rockman et al. (2000) compared two groups of laptop-using schools and non-laptop-using schools. The findings indicate that laptop-using students have more technology literacy and skills, better performance on writing assessment, and more positive attitude toward computers. There are also many other research studies on the effect of students' achievement by using laptops (Gardner et al., 1994; Stevenson, 1998; Siegle & Foster, 2001). Gardner et al. (1994) got mixed findings that laptop-using had a positive effect on science achievement while no effect on achievement for mathematics and English. Gardner et al. also report that students with laptop computers are more motivated and are quicker to gain technology literacy. Stevenson (1998) did an evaluation with focus on a standardized achievement test. The findings included that laptop participants significantly outscored their non-participating peers on test and laptop participants have better school attendance. Siegle and Foster (2001) investigated the effect of the using of laptop by high school students in an anatomy and physiology course. Two groups were compared by using a quasi-experimental method. The findings show that the experimental group benefited from full-time access to laptop computers, has overall higher achievement and increased understanding about the subject matter. Siegle and Foster also indicated that laptop computers can bridge the gap of the access to technology both at school and at home, and therefore increase opportunities to use technology as an authentic integral part of learning. Still other studies (Carey & Sale, 1997; Hardy, 1999; Healey, 1999) discussed laptop using in terms of a larger social context, such as equity issues, and educational paradigm change. Carey and Sale (1997) reported the benefits of using laptops for students with severe disability in cognitive development. Hardy (1999) discussed issues of equity of using laptops in school. Healey (1999) stated that laptop using would benefit student-centered learning and facilitate constructivism paradigm.

From the studies discussed above, we can see that most studies of using laptop computers using focus on formal school situations. Usually laptop computers are provided by schools, corporations, or agencies, rather than by students themselves. The use of laptop computers usually link to specific subjects. These subjects include English, writing, science, mathematics, geography, social studies, etc. Some benefits have been recognized in those studies:

- (1) Improvement in students' abilities to communicate persuasively, to organize ideas effectively, and to use vocabulary effectively (McMillan & Honey, 1993).

- (2) Laptop using improves students' technology literacy, and enhances students' motivation and independence (Gardner, Morrison, Jarman, Reilly, & McNally, 1994).

- (3) Benefit for students with disabilities (Carey & Sale, 1997).

- (4) Improves students' writing skills and fosters collaboration; allows students to work at their own pace and get more involved in schoolwork (Rockman et al., 1998; Rockman et al., 2000).

- (5) Integrates visual presentation with written notes and acquiring information with processing information; bridges school and home (Siegle & Foster, 2001).

As mentioned above, most studies center on formal learning situations, while few studies focus on informal learning environments. Then, why is an informal situation important? The reason is that the situation of laptop using has changed. Distributing computers by schools or agencies limits the sense of ownership, even if the students are allowed to take the laptops home. Just as Siegle and Foster (2001) report that students were concerned about damaging the computers, laptops in those studies are still not fully accessible and exploitable. With a limited use, a laptop is just like a desktop, not movable. Learner experience is still not totally that of movable learning. In recent years, with decrease in cost, a laptop has become a personal tool. Nowadays, we can see quite a few of learners bring their own laptops to classrooms, libraries, or conferences. Different from laptop studies mentioned above in which schools or corporations distribute laptop computers to learners, learners have a total ownership of laptops. Total ownership makes difference. Laptop computers will not be used as an experimental variable in instruction. No teacher present, no curriculum requirement, and no

explicitly measurable objectives. Learners use their laptops spontaneously for their learning. Just like most media research focuses on formal situations, research regarding laptop using also falls into this same case. Research on the role of laptops in the informal learning environment is needed. As Salomon et al. (1991) pointed out cognitive effects of technology using are reciprocally interrelated with culturally prescribed functions and modes of activities, and to detect technology under natural conditions may reveal us what happens otherwise we will not detect under experimental context. Thus there is a gap in the literature of mobile learners' experience with laptops in an informal situation or in other words, natural conditions. This study aims to fill such a gap with the focus on mobile learners in higher education at the graduate level.

Research Design and Methodology

This study is a qualitative study primarily consisting of interviews as its major methods. Three semi-structured interviews were conducted to obtain the perspectives of adult learners in higher education institutions who were using laptop computers. Each interview was conducted individually, face-to-face, and audio-taped.

Context and Participants

This study takes place in a large research-oriented university. Some buildings and facilities in the university have begun to provide wireless connections for more than one year, which are free to public. Due to low cost and easiness to build WiFi (Wireless Fidelity) network, more and more wireless access zone are being built around the downtown next to the university, such as in coffee shops, McDonalds, and other entertainment areas. "Going mobile" is becoming a hot topic for technology pioneers and fans in the university.

Three male participants, David, in his 20s, Gary, in his 40s, and Sawn, in his 30s, are all currently working on their PhD programs in the college of education in the university. They all meet participant selection criteria that a participant must use his or her own laptop along with wireless connection for more than half-year. Meanwhile, they all value and enjoy their experience of using laptop for their study, work and research.

David is a fourth year doctoral student and teaches several web design and development courses for assistantship in his department. He didn't like laptop very much until he bought one two years ago. Now he is very exciting about using laptop, especially wireless connection. He enjoys doing academic working in the coffee shop and see there as his office, since he does not have working space at home any more with the birth of his second child. He believes that laptop gives him much convenience and saves him lots of time. He is concerned that the screen size of the laptop is still too small for him to do graphic design work.

Sawn is a first year doctoral student, a previous second language teacher, and has owned a laptop for more than five years. His initial thought to buy a laptop was to learn some computer applications, like Photoshop or Excel. However, in fact, he just didn't learn them but uses laptop mostly for writing, literature searching, and doing presentation. He loves to use laptop for writing because he believes that the laptop computer produces better documents than handwriting does. Although he uses laptop very frequently, he remains skeptical of some new things on the Internet, like Instant Messaging, Blog, online chatting. He almost never uses laptop in the public area, except in classrooms. In addition, he still wants to keep formally sitting on a chair and the laptop on the desk. He thinks he grew up very traditionally and he still likes to use laptop traditionally.

Gary is a second year doctoral student and a lifelong Georgia resident. He loves technologies and is always ready for new things. He has owned two laptops since 1998. He loves to learn and never feels trouble being motivated to learn new things. He is happy that the laptop provides him a third office so that he does not need to copy files between his home office and school office. However, he agrees that it's a big challenge to get back to work when the Internet always take him away from his original work.

In sum, researchers attempt to focus on people who are actively involved in the laptop along with wireless connection in higher education institutions. In this paper, we call them mobile learner.

Data collection process

Semi-structured interviews were conducted to obtain the perspectives of mobiler learners in higher education institutions. The interview protocol (see Appendix), which focused on the experiences of mobile learners and the potential impacts on cognitive activity by using laptop computers, was used to guide the whole interview process.

Researchers identified three participants through daily observation in the college of education. The criteria to choose a participant are that the learner must be a graduate level student and must own a laptop and wireless connection for more than half-year. Interview sites were in the building where the

college of education located. Two interviews took place in the interviewee's office, and one interview took place in a lounge room of the researcher's department.

Researchers conducted three interviews during the work day of the mid-spring semester, 2004. Each participant was expected to have an one-hour face-to-face interview, which would be audiotaped. However, actually, Sawn's interview last longer than one-hour, and Gary's interview last only about thirty-five minutes because he had another appointment right after the interview. The consent form was distributed to the participants before the interview started. The participants was asked to read and signed up the consent forms. All interviews went along very well than researchers expected; all participants seemed very active to express their feelings and perspectives about laptops and mobile learning. It was the limitation of the record tape or time (in the case of Gary) that stoped the conversation. In the case of Sawn, when the interview was over, he continued to show some of his real work on the laptop. He demonstrated how to create a writing project by manipulating his previous works on the laptop. So besides the interview data, I also collected this kind of additional observation data.

Data analysis

Audiotapes collected during interviews were all transcribed. During the process of transcribing, I already begun to write my initial thoughts and reflections on a separate document. I also highlighted some typical sentences and keywords on the transcripts during transcribing. After all transcribing tasks are done, the transcripts then be coded by low-level labels for index, and typical sentences and keywords on the transcripts are highlighted. After that, the codes were integrated for each participant according to the research questions, and then were input into a two-dimension table. One dimension is the three participants and another is the four major questions: usage, benefits, limitations, and cognitive impacts. So, that is 3*4 table as an approach to reduce data and seek meaning. Typical sentences and keywords were also put into each related cells. The two-dimension table provides a basis for comparison among cells. Sometime, I adjusted sentences in the cells and sometime went back to the original transcripts again for double check. At the same time, I began to formalize the themes when manipulating the table. I initially developed fourteen themes. I went back to the transcripts and questions again to check the themes and make revision. For some themes, especially on cognitive effects, I went back to check related literatures and then made revision on the themes.

In addition, during the period of data analysis, I talked informally to other people who were using laptop. I talked about my findings and asked their perspectives on using laptop in higher education institutions. I also attended a mobile learning presentation and talked with people who were showing their mobile learning projects. These conversations in fact also helped me analyze data and refine themes.

Research Findings

During the research process, we realized some functions participants experienced and described are not necessary confined to a laptop. The functions like cut and paste, or file system, or the Internet access are also integrated in a desktop computer. However, a laptop makes such functions more personally intimate to mobile learners, which help form a more intimate relationship of "intellectual partner"(Salomon et al., 1991), therefore, learners' experience with those functions are aggravated in a laptop situation.

Theme 1: Laptop serves as a "Mobile Office" and provides possibilities of "Anywhere, Anytime Working".

Participants all enjoy freedom, mobility, and portability coming with laptops and wireless connections. One biggest advantage of owning a laptop over a desktop is that a laptop serves as a bridge connecting home and office. Gary described the experience before and after owning a laptop,

"I have continuously a problem with something I need while I am here in school is not here, it is in my home office. But something I need where I am working in my home office is not with me because I left it in my school office. So the laptop builds a bridge between those two."

"Having laptop give me the flexibility to work at my office, keep my work take home conveniently work at home and come back again. So, it is much more efficient arrangement for me to have one laptop which is, in a way the laptop is my third office, or it's my primary office maybe."

Moreover, the locations of using laptop are already beyond office and home. Such locations cover library, classroom, conference site, and some public areas, like beaches. With a laptop, adult learners can move among different locations freely. David described such freedom and convenience.

“Having everything with me, I think, no matter where I am, I can work on the couch. I could be in my office. I could go to coffee shops. Wherever I am, my whole office is with me. I have all my emails. I have all my notes that I have written. I have all my papers that have been written in the past. I have all the website that I work on. Everything is there.”

Meanwhile, the portability of a laptop also has a benefit of accommodating users' different preferences. Sawn is glad that, with a laptop, he can enjoy working at home now.

“I am not dependent on the computer lab being open. I'm not dependent on facilities being open.”

Interestingly, participants see a laptop more as a working tool than a learning tool. Their major motivation to purchase a laptop was to have something to work on. Correspondingly, they describe their experiences of using laptop more as “Anytime, Anywhere working” than “Anywhere, Anytime Learning”. When asked, “how do you use laptop as a learning tool?” Gray showed a perplex about how to link laptop to learning tool, and said

“I use my laptop primarily as a productivity tool. It does help me to generate the products related learning, like writing papers and creating web projects.”

“I think it is more as of a thinking tool, that whatever kind of task maybe involved in there's always some way that a laptop can assist in.”

Main tasks performed on laptops include literature locating, paper writing, research, teaching, information access, and communications. Maybe because they are graduate-level students, participants seldom use laptop for online chatting or some entertainment activities. This may be a same reason why the participants would like to describe the experience of using laptop in terms of working. The participants are adult learners at a graduate level. They usually have multiple roles, as a graduate student, a research assistant, a teaching assistant, and a self-responsible adult. They are more autonomous in the decision of using a laptop as a tool, unlike a K12 student who will use a laptop to fulfill teachers' expectation. Meanwhile, their learning is interwoven with working, rather than an isolated behavior. They prefer to learn from working or doing in some real tasks. The vocabulary of working definitely matches more their roles and autonomy.

Theme 2: laptop provides learners a “shortcut” and allows learners to have instant access and instant action.

Laptop not only provides connection between physical locations, but also provides a connection between thoughts and action, which here I referred to as a “shortcut”. All participants reported that they use the Internet and World Wide Web to find information they need. When an adult learner comes up with a question, laptop provides a shortcut to gain information through the network. It also makes instant access possible in the classroom activity. Laptop serves as a short cut between questions and answers when the topic involves online resources. Gary gave an example in which using laptop for the Internet access is a part of the classroom discussion and conversation.

“We can verify answers to some questions, or check some schedules, or check some information online.”

The shortcut may also refer to as information access on learner' own laptop. Gary described the advantage of using endnotes for references,

“Once records is there, it's wonderful to be able to access very quickly when I work on the new document for citation purpose.”

The shortcut implies instant actions as well. When an idea comes up, the participant usually will set up a framework of what is going to be done in a very short time and then start writing or creating a project more quickly. Sawn illustrated his writing process,

“Because of the storage system on the laptop and I was able to cut and paste parts of it. And so I was already half ways done.”

Instant access implies that learner's behaviors and classroom activities are changing. This may also provide feasibility of new instructional models, say, resources-based learning. However, instant access may also have some negative influences. Gary said,

“My habit that actually go to the main library or science library to access material there, that habit

has suffered”

Theme 3: Laptop facilitates three-dimension of writing, a metaphor of clays and sculpture.

One major task on laptop is writing. Writing on the laptop is changing the composing process. A vivid metaphor for the writing process on the laptop can be seen as a sculptor manipulating the clays to make a sculpture. The change of writing process results from at least three factors. First, because of the function of “cut and paste”, the writing process is no longer linear, and therefore, thinking during writing process is less linear. Sawn described,

“It becomes more of organics, piece that you can manipulate in ways that you can’t with a pen on paper, for definitely”

“I love cut and paste because it is just like, why not change everything because you have the old one.”

Second, the previous works stored in the laptop make writers to create a new document faster, and therefore, proportion of writing is more about revision.

“Because of the storage system on the laptop and I was able to cut and paste parts of it. And so I was already half ways done. And then what I found too was the revision, let’s see, I was thinking about revising this piece, or making it to something different.”

“I used some pieces to start a new piece or to start a new project, and it is just, I found it, I found it to be real useful.”

Third, the editing and revision process happen simultaneously. Learners enter the whole writing process quicker. As Sawn stated,

“When I began writing something, I already revise it in a very visional way and in a very, and editing it and start spell check on grammar check, already begin on revising and editing, and where’s handwritten thing you don’t do that, no.”

Therefore, mobile learners are experiencing much freedom in writing. The paper-based linear writing process is changed, and the composition process of writing a paper is more like manipulating some pieces. This nonlinear writing process may favor students who are not good at traditional writing.

Theme 4: Search and organization function of a laptop is a plus of brain retrieval system.

Search and organization function is one of mobile learners’ most favorite functions. The function can also be found in the desktop, however, laptop users keep everything on the laptop and therefore, the function seems more beneficial for them. The search and organization function definitely shares the cognitive load for users who are in need of managing materials and projects. Sawn is very happy about this function,

“The laptop itself simplified tremendously. In terms of storage, in terms of finding what you wrote or piece that you did even when it was five years ago.”

Gary shares very similar feeling,

“I’m looking for a document on my computer something I created three months ago or some resources, the search function in my computer is the obvious way to help me.”

Such function is not just for searching and organizing the word documents, but also includes all other materials on the laptop, like PDF or HTML files. It serves as a whole resource center or system for the mobile learners who have begun to give up using paper-based medium to store and organize their academic works. David described his experience in this way.

“I figure out a good system that I could have. I could look up the endnotes, and then I get number, the catalog number I get it, and I know if I have it printed it out in my cabinet. Where it is? If I have a PDF version, where it is?”

“And I index any notes that I put in. I index all my research notes. Any reading notes I take, I index.

All my papers get indexed.”

Gary gives an example of using DreamWeaver as an organizing tool.

“The tool like DreamWeaver gives you that automatic organizing of the hierarchical relationship of those documents and the hyperlink kind of relationship with the documents. That is lots of easier for me to conceptualize with the program’s help, then for me just to deal with, do way that designer just has to do it, which is just folder and documents, and then keep tracking of everything in your brain.”

Certainly, participants are satisfied with using laptop to organize the materials and projects. They feel like,
“It surely makes me more organized researcher.”

“That’s reason why I like using notebook so much, it serves to develop my system from the ground up with the notebook as a factor, I didn’t translate from paper based system.”

Computer-based searching and organizing system simplifies the management and retrieval of materials. It serves as an extension of mind by sharing lower-level workload so that learners can focus more on meta-level management, design level activity, or higher-level activity.

Theme 5: No game, no entertainment, but participants still feel trapped by the Internet and email.

Those mobile learners all use their laptops for academic purposes. They all reported that they rarely used laptops for entertainment. However, they feel easy to get lost in the cyberspace. It has been a consistent problem for learners who have the Internet connection. Gary described such trouble,

“I think, overall, it still help me more productive; however, the laptop in front of me connected to the Internet is always temptation to other kind of distraction. The World Wide Web is there, waiting for you, so there is a little person concerns with this.”

“ During any given day, I am spending too much time, just checking news, checking the weather, checking email, umm, and you know, kind of browsing, and that kind of thing, instead of intending to my next task.”

David also agreed that the Internet was so distractive and expressed the same feeling that the Internet eats up lots of time,

“It’s great to have wireless, though. If you really need to write, not having the connection is nice, sometimes.”

If temptation of the Internet access happens in classrooms, then it introduces the off-task behavior. David described his feeling when using laptop for note taking in the classroom,

“When it (laptop) is on in front of me, I am looking at it, you know, I have a hard time to look away.”

Of course, such consistent problem caused by the Internet does not mean that school should cut off the Internet connection. However, in the mobile learning pedagogy, we do need to address this issue to avoid too much off-task behavior.

Theme 6: Using laptop for note taking in the classroom still presents two folders for mobile learners.

Currently, quiet a few of students begin to bring their laptops to classrooms. They mainly use it for note taking. Learners prefer to use a laptop as a note-taking tool for several reasons. One reason is that the laptop generates better notes than handwriting, and another reason is that computer-based notes are easier to manage. Sawn said,

“I don’t have to write it by hand and then copy into computer. I can do it in computer. It cuts the time, and then I found the notes were a much better.”

“Actually, I think it was really a great idea, because what I used to do is I take notes on paper and then I lose the paper. Or I have to carry all that notebooks to class and it was too heavy.”

However, not all participants feel totally comfortable using laptop for note taking in classrooms. There are some psychological factors existed, such as be afraid of being thought as impolite or as doing some other

businesses. Gary described such factors,

“People notice you have it, if you type, then there is some sounds, although mine is very quiet, but still is not silent, so when I type, there’s still some noise it makes. It also the screen, the laptop screen tends to block my view a little bit of instructor or other people in the room.”

“I am rather sensitive to, I don’t want to be impolite or I don’t want to be disrespectful to my professor or my classmates. So, I don’t let myself do very much.”

In addition, laptop itself does introduce off-task activities, at least, for some learners. David described, *“It’s certainly like putting a TV in front of me. I have a hard of time to pay attention to the instructor. I want to be watching TV. And that’s same thing with computer. When it is on in front of me, I am looking at it. I have a hard time to look away.”*

Theme 7: Not being able to see the whole thing and losing a certain level of interaction are two major concerns for those mobile learners.

Besides many other concerns like lasting period of battery or computer virus, the two concerns mentioned in the subtitle seem more related to inner mental functioning. Those participants all reported that they would like to have printed documents in some cases, especially when they want to have a whole picture of a larger document or want to make comments in the document. Printed documents provide some interactions that laptop can not provided. Sawn feels that it is necessary to see the whole document in the writing process. He said,

“Sometime I like to see whole document at once, like spread out on the table, where is laptop still doesn’t allow me to do that.”

“That’s a limitation, which is why I still like to print thing out when I am on drafting, when I feel I have a good draft, because I want to look at the whole piece. I want to be able to page and hold one page and look at the other page.”

“Periodically, after been working on it for two or three days, I’ll print out it and take a look, because I’ll see things that I won’t find on the laptop. So maybe they compliment each other, I guess.”

David described the difficulty of putting comments on computer documents.

“It’s a good feel (to hold a printed document) on your hand. Hold the marker. Underline and make a little note. You lose that ability on the computer.”

“I can put notes into Adobe Acrobat file, and I could circle something in it, but I got to the menu, click draw tool, and circle it, put note in. You just could not do it. I keep on grading my students assignments on the computer, and nine out of ten, I’d print them out, because it’s just so much faster, just mark, mark, mark, A minus, you know, rather than focus on how are you going to put comments in.”

Definitely, these two concerns come with the technology and also depend on the advance of technology. They also reflect the needs for cognitive functioning, which have to be addressed in technology-based learning environments.

We have described several themes emerged from mobile learners’ experience, behavior, and perception. As a summary, more details on mobile learners’ experience are presented in Table 1. These experiences are usually interwoven. Take the metaphor of mobile office as an example. It can either be seen as a usage, an effect or a benefit of using laptop. On the other hand, however, it may be a byproduct to learners with a concern of “anywhere, anytime working”.

Table 1. *The experience of mobile learners*

| Behavior, Outcomes, and Patterns regarding Laptop Using | |
|--|--|
| <i>Usage</i> | Write papers, e.g. spell check, and grammar check, cut and paste Do research, e.g. field notes for observation; grand applications Do assistant work, e.g. lesson planning Search information and access the resources on the Internet Store and organize materials, e.g. keeping notes, using Endnotes Use for communications, e.g. email, presentation Support team working, e.g. using track change and comments Take notes in class Prepare all class work, including comprehensive exam Create web projects Do graphic design |
| <i>Effects with</i> | Better quality and format of documents Less repetitive works Replace for handwriting and paperwork A coherence form to organized files Shortcut between thoughts and action. Mobile office |
| <i>Effects of</i> | Three Dimension of writing: manipulating the writing pieces Accommodation for personal preference and habit Be a productive constructor of the knowledge More like a designer, rather than a learner in front of a laptop Motivated to be organized Intimate partner and tool |
| <i>Limitations</i> | Battery dies; (Mobile learners like to have power outlets in rooms) Temptation from the Internet Email eats up time Note taking in class is still not comfortable Reading on the laptop loses a certain level of interaction compared to reading on the printed materials Not being able to see the whole thing |
| <i>Identity</i> | Productivity tool, thinking tool, extension of capability and the brain. |

Final Words

Because of its portability and mobility, a laptop computer has become a personally intimate partner for a learner. Impacts of mobile technologies have many direct effects, like better quality and format of documents, or less repetitive works, as well as many latent effects, like promoting collaboration among peers or increasing motivation of a learner to be more organized. Such an intimate relationship is two folds. It provides convenience and instant access for learners. However, it may also eat up time of learners or become a distracting factor during the learning process. Partnership may be a most significant characteristic of mobile learning environments comparing to other technology based learning environments. Educational computing has undergone a change of focus from e-learning to mobile learning. More research studies should be done regarding how psychologies factors are influenced by this characteristic of partnership. Future research could also look into the relationship of mobile technologies and learners in a broader mobile learning space.

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Problem-Based Learning (PBL) In Distance Education: A Literature Review of How the Distance Education (DE) Environment Transforms the Design of PBL for Teacher Education

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Abstract

This paper expands on a poster presentation about the results of research in PBL in distance education environments integrated in the PBL design model as defined by traditional literature. The results will be laid out as they are relevant to each stage of the process. Research on discrete aspects of its design process is necessary to enlighten understanding of the particular areas that need to be modified when PBL is implemented over distance education. Nevertheless, these results need to be consolidated into design models that will guide designers in their pursuit of creating online experiences that benefit from constructivist principles of learning. A related goal is to make evident current strands of research and highlight possible directions for continued research that enlightens instructional designers as they translate the methodological specifications of PBL into DE environments. Continued study and incorporation of findings in this way can even provide evidence for the continued adoption of traditional PBL models for the DE design or the need of departure from them to create a specialized PBL for DE model.

Introduction

PBL has been characterized as an example of constructivist thinking (Duffy & Cunningham, 1996). The design principle of rooting educational activities in a realistic situation that embodies the knowledge and skills that students need to learn is one of the ways in which it implements constructivist principles. The use of this kind of authentic situation stimulates students to go beyond memorizing facts. It encourages them to analyze and evaluate facts and skills and integrate them into a cohesive approach to transform the current state of the situation into an ideal one according to the circumstances. Students are transformed into active role players with responsibilities that are similar to the ones they would assume in the world of practice. The pursuit of knowledge now becomes a dynamic undertaking that motivates students because of the immediacy and evident relevance of its application. Consistent with its goal of making learning a mirror of practice, most implementations encourage collaboration and communication among learners during this process. Learners bring together their previous experiences, skills and current understandings into a negotiation process that should contribute to strengthen students' response to the learning situation. The process of consultation of sources of information, negotiation of understandings and design and refinement of the solution is backed up by continuous reflection on content and process. It is improved on an ongoing basis by input from multiple sources and perspectives of assessment. The result constitutes an informed response of students to address the situation.

Distance education is becoming a realistic alternative for many to further their academic careers. The benefits that authors have attributed to distance learning have spanned at least financial, accessibility and academic reasons (Belanger & Jordan, 2000). One of the long-standing concerns with it is whether the quality of education parallels that of traditional classroom-based education (Birnbaum, 2001). An approach to try to ensure this is to design educational experiences that benefit from the educational principles that are deemed to yield effective learning. PBL is one of the educational methodologies that have emerged from practice in traditional classroom-based environments as a successful approach to strengthen learning. Therefore, designing distance learning experiences with PBL can be one of the alternatives by which institutions provide equal quality distance education to their student populations.

Different strands in communication theory advocate the preponderance of media in the delivery of messages (Meyrowitz, 1994). Authors like Marshall McLuhan are cited for his ideas of the influence media has in the delivery of messages (Deibert, 1998). Other authors stress the inherent importance of physical immediacy in human interaction (Boden & Molotch, 1994). In light of the ideas of these currents of thinking, the intention of fostering collaborative problem-based learning environments at a distance needs the special consideration of the affordances and challenges that the medium of delivery attaches to it. Synchronous communication that could bring the benefits of copresence is technology-mediated. Asynchronous communication that brings the

advantage of reflective thinking entails delays in the exchange of ideas. These situations suggest that implementation of such distributed examples of problem-based learning need to be informed by research that considers the new factors that come to play in it.

One of the common denominators in problem-based learning models is the use of collaborative learning groups during the process. Cooperation in learning has been defined as “working together to accomplish shared goals” (Johnson & Johnson, 1996). These authors stress the importance of various aspects that characterize group work. The first aspect they mention is positive interdependence. It has to do with the idea of working towards the accomplishment of a shared goal. They also talk about the importance of both individual and group accountability. Another important aspect is the development of interpersonal skills. Yet another aspect is the ability to self monitor group work to ensure consistent progress towards the goal and to discontinue patterns of behavior that impede this progress. However, the last item that these authors mention is what constitutes one of the challenges that this kind of inquiry wishes to explore. They explicitly incorporate face-to face interaction as one of the defining aspects of group work. When learning necessarily has to occur with a separation of space and/or time, educators then need to know how to facilitate such experience with the lack of immediacy between distance learners and teachers.

The Literature Review

Research and evaluation literature on the development of PBL in DE has already begun. Researchers and practitioners have started to help identify possible limitations and / or advantages of this combination. This section describes the findings of several research undertakings as they zoom into general or more discrete relevant portions of the PBL design and implementation process.

Teachers and Students

Sage (2000) studied the overall PBL experience from the perspective of students and instructors involved in the process. She focused on a set of elements each with a continuum of possible values, the combination of which has an impact on the online PBL experience. Courses that attempt to implement online PBL will encounter several starting characteristics of teachers and students that will be somewhat given. These cannot necessarily be changed during a single learning experience. Teachers and students bring their assumptions, skills and preferences related to both teaching and learning. They also bring their previous experiences and abilities in teaching and learning in traditional, constructivist, PBL and online environments. The more experienced both teachers and students are in all the factors that compose the PBL experience, the more flexibility educators will have to implement experiences that are closer to the models of this methodology that view students as more self-directed.

Taplin (2000) reports on the experiences of educators who are beginners in the transition from more traditional educational methods to the implementation of online PBL. She also points out the importance of considering student characteristics in the design of the course particularly regarding their flexibility to devote time to identifying and evaluating resources by themselves, individual accountability and group work. The limited schedules of distance learners is what makes them turn to anytime anywhere flexible opportunities for learning. Their availability needs to be taken into account and balanced with provision of resources and the design of group experiences so the assumed highlights of such undertakings do not turn into deterrents of learning. Teacher experience and availability to facilitate is also deemed important by this author.

Poon (1997) describe a hybrid environment in which educational efforts are triggered by problems that depict what students can do within a subject domain instead of what students should know. The distance learning technologies together with face-to-face experiences help deliver the content that students will use in order to solve the problems. The face-to-face component is also the setting in which students encounter the problem and initialize the process of problem definition and process organization. Then students undergo the iterative process of consulting sources of information and devising the solution. In the final stage, students not only construct the solution, but also reflect about what they have done and relate it to future practice.

These authors focused on feedback from tutors at the end of the first stage of work. This feedback covered areas such as ability of tutors to discern the scope of content they needed to care for based on the problem, understanding of the nature and purpose of PBL, the need of both training and practice to internalize the approach, time demands imposed by new teaching skills, reinforcement of change in student roles (from passive to active), shift in the role of teachers (from providing knowledge to questioning, making resources available, and refocusing) and problem generation. This experience underscores the need for teacher development when attempting to implement PBL designs. It also highlights the usefulness of considering teacher feedback to improve the design of such environments.

Readiness to Work in a PBL Environment

Readiness to work in a PBL environment not only benefits performance in learning but also in professional practice (Björck, 2002). His study focused on the nature of interactions as a way to evidence the level of appropriation and mastery of the process. The researcher studied issues of participation: amount and content of messages. Findings suggested a relationship between the volume and nature of interaction and the level of mastery of online PBL. Mastery was signaled by richer communication, more and detailed, critical but respectful questioning of classmates' standpoints, openness to feedback, continuous and spontaneous discussion. A shift in the facilitator's role with progressively less intervention evidenced students' level of confidence in their skills to undergo the process.

This author concludes that multiple online behaviors exhibited by students describe their level of mastery of online PBL. Nevertheless, for students to display the highest level of those characteristics, it takes several iterations of participating in the process. Initial scaffolding may be crucial in whether mastery of online PBL may be accomplished among students but eventual fading will characterize their achievement of it. The findings of this author seem to indicate the need of finding ways for strengthening student mastery of the process in the PBL design because of the dual benefit for the process itself and for future professional performance.

Institutional Arrangement and Support

Sage (2000) also explored the influence of the virtual structural environment of the course. The structural environment suggests that the course will have a previously specified amount of students and length and will be backed up by certain types of support from the institution. Therefore, educators need to adjust those PBL experiences based on the combined constraints and / or particular advantages that these elements will afford. Taplin (2000) had similar findings in that the overall commitment and support of the relevant administrative and academic departments is seen as crucial for the successful online PBL experience.

Subject Matter

The nature of the subject matter will also impact the design of the experience (Sage, 2000). The amount and level of complexity of the information that students are expected to learn helps to define the kinds of problems that can be adopted as starting points for learning. Then the characteristics of the problem (e.g. level of definition) and the amount of resources provided by the instructor also have an impact in design decisions.

Technology Literacy and Infrastructure

The technology access and support that the course receives is yet the last aspect that Sage (2000) describes. The type of communication and collaboration tool that the course uses together with its advantages and disadvantages for supporting PBL contributes to strengthen or debilitate the PBL implementation.

McAlpine & Dudley (2001) studied an implementation of online PBL in a course that consisted of 5 PBL experiences two to three weeks long each. It used online communication to support the exchange of ideas towards the resolution of the problem. They found that both students and the institution lacked the appropriate technology infrastructure to support the process. Technology literacy, access and support can become important obstacles in the development of effective online PBL. Technology requirements are at the threshold of an educational experience: it is a supporting element that must be transparent to all users so it will not severely limit learning benefits. This is consistent with Sage's (2000) findings.

Impact of the PBL Problem in Interaction

The connection between the type of problem that underlies a PBL experience and the amount and nature of interactions that occur during its process is the area of interest of Ronteltap & Eurelings (2002). Learning issues identified by students based on the problem were classified as theoretical or practical. The authors analyzed quantitatively the amount of interactions generated by type of issues. They also focused on their level of cognitive activity (e.g. low for copy and paste and high for original contributions). The study relied on student and instructor interviews and analysis of discussion board transcripts as multiple sources of information to corroborate findings.

According to this study, practical learning issues increased the amount and quality of interaction between students. The need for continued research on this is established due to a small sample. Nevertheless, these results could be supporting the view that learning that consists of memorization of facts only yields

enough interaction to achieve their reproduction. Furthermore, educational experiences that aim at developing increased scholarly interaction in quality and quantity should utilize practical problems as their starting point. This study provides useful pointers for educators looking for ways to increase interaction especially to avoid the sense of isolation that some distance learners experience.

Group Development

McConnell (2002) utilizes analysis of online discussions, products and student interviews to examine the development of PBL groups throughout the process. The course guides students to learn the design and evaluation of learning that occurs through PBL (which constitutes experiential learning). They are given ownership in determining the focus of the problem, direction of their efforts, monitoring their process, and simultaneously evaluating and redesigning the process in which they are participating. The facilitator becomes a co-participant in the process relinquishing most of its traditional authority in making decisions.

The author's findings point to the development of groups in three consecutive but overlapping stages. The first stage was characterized by negotiation of understandings and organization decisions. The second stage comprised the research related to devising the solution. The third stage corresponds to the development of the final product. This author found iterations within the first stage and simultaneous interaction among members of the group and its subgroups. This author describes implications of his research for the design of online PBL. Because of the affordances of the online environment, the development of groups' stages occurs simultaneously as the technology tools provide for accomplishing simultaneous work for different purposes. The amount of time that students take to undergo understanding, research and resolution differs and therefore designers need to account for this. It also has implications for facilitator increased or decreased intervention per stage as need.

Cognitive Tools

Technology tools that support PBL experiences can also be explored in a dimension that goes beyond their technological characteristics. Orrill (2002) deals with a technology-based tool to support metacognition during the collaborative inquiry during PBL. This tool used threaded discussion with message labeling to promote metacognition. The aim of the development of the tool was to support PBL thinking as opposed to mere logistics management. The focus of the course was technology integration in K-12 education. The length of the PBL portion of the course was three weeks. The analysis of interactions in the Asynchronous Conference Tool (ACT) comprised discussions that occurred during the first phase of the project (approximately 11 days). The researcher conducted an analysis of the character of interactions: whether messages focused overall on defining the problem / discussing issues (e.g. present student thinking, asked content-related questions), tasks (e.g. verify due dates, corroborate aspects of assignment, focus in course-related aspects of the problem) or other (e.g. supportive messages).

Student use of the tool as a process manager provoked less complaints about it in comparison with use to directly support problem solving inquiry. The author suggests that this indicated a more limited support of the tool for the later purpose. She concluded that it was apparent that PBL can be successful and worthwhile in distributed learning environments. Nevertheless, there was an evident need for a more robust system for supporting communication, organization of resources and issue development. Recommendations for continued research spanned finding ways to support simultaneously online PBL and its process management, and design considerations on how to structure the discussion space for promoting meaningful conversation which is critical to success.

Assessment

Assessment is an issue that demands special consideration. Constructivist approaches to assessment suggest embedding it in the learning experience and incorporating students as designers of the assessment mechanisms as well. Sage's (2000) findings indicate that educators need to consider individual and group performance in the online environments. Taplin (2000) also brings into consideration the importance of rethinking assessment in the online problem-based learning environment. She suggests further research to investigate effective ways to evidence knowledge construction within this setting.

Conclusions

Several authors assert that distance learning environments seem more prone to implement constructivist principles (Crumpacker, 2001; Orrill, 2002; Poon et al., 1997). Several benefits are highlighted. Learners from around the world could work together benefiting from their multiple perspectives. Continuous collaborative work could be guaranteed even if some group members are temporarily unavailable for physical

proximity due to job-related or other circumstances. Its resemblance to workplace problem-solving is highlighted by its advocates. Conversely, Taplin (2000) considers divergent opinions about its feasibility. The lack of physical proximity and challenges in student support are reasons proposed by those who do not necessarily support this approach in online learning. The transition from face-to-face to online PBL has been regarded as having “obstacles” (p. 41) that need to be addressed (Orrill, 2002).

Because of the innovation of the combination of distance learning context and problem-based approach, McConnell (2002) asserts that course designers and tutors will need to understand its implications for learning and teaching. This author claims that it is a complex and yet little understood form of distributed learning. Therefore, he makes the case for ongoing research that is “exploratory, descriptive, grounded in real learning situations and contexts, addressing both broad themes and micro issues” (p. 80) to help increase understanding. Sage (2000) briefly explores the possibility of the need for differentiated forms of online PBL tuned to the nature of their contexts. Other authors explore the idea of the need for understanding online learning as it constitutes a different enterprise than its face-to-face counterpart in its very nature (Birnbaum, 2001). A current of educational thinking maintains that not only action but also thought are reshaped by the tools that support interaction (Wertsch, 2002). Communication theory also supports that idea. Computer-mediated communication within online PBL implementations may be such an agent for that transformation. Therefore, continuous research on its relevant design components should constantly inform practice.

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Building Bridge between Learning and Positive Emotion: How to Apply Emotional Factor in Instructional Designing Process?

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Positive emotions and Cognitive process

For millennia, emotional states¹ have been viewed as avoidable impediments to rational thinking (Ellis & Newton, 2000). Several reasons have been pointed out. The lack of consensus of the definition on emotion that tend to conflict with each other was suggested as a main reason (Price, 1998). Also the difficulty of research methodology such as direct observation of private internal emotional experience and the experiment setups which often hide away the true nature of real emotional experience were indicated as additional reasons (Gadanhó & Hallam, 2001). Yet, even with those restrictions, the research on emotions has been conducted in various academic fields including politics, business administrations, economics, organizational science, computer science, and medical science

Except the case of medical science, the emotion related researches are mainly focused on the effect of emotion, especially positive emotions² on the cognitive process. Positive emotions are usually considered as “pleasant”, but the others are considered as negative (Gadanhó & Hallam, 2001). This series of researches have been providing the evidences that the positive emotions has a crucial effect on diverse cognitive processes such as information processing, communication processing, negotiation processing, decision-making processing, category sorting task and even creative problem solving process. For example, Isen and Baron (1991) summarized based on the program of empirical researches that “persons who are feeling happy are more cognitively flexible, more able to make associations, more able to see potential relations among stimuli than other persons in a neutral state” (Isen, Means, 1983; Isen & Daubman, 1984; ; Isen, Johnson, Mertz, & Robinson, 1985; Isen, Dubman, & Nowicki, 1987). In her Broaden-and-Build Model of positive emotions, Fredrickson (1998) identified four positive emotions such as joy, interest, contentment, and love, and further suggested that positive emotions broaden the scope of attention, the scope of cognition, and the scope of action. The theory holds that, over time, the broadening triggered by positive emotions builds a range of personal resources, including physical resources (e.g., physical skills, health, longevity), social resources (e.g., friendships, social support networks), intellectual resources (e.g., expert knowledge, intellectual complexity), and psychological resources (e.g., resilience, optimism, creativity) (Fredrickson, 1998). Forgas (1998) also found that person in a positive mood formulated action plans that were more cooperative and integrative, and achieved agreements of higher quality than did neutral or negative mood participants.

On the other hand, there are some other researchers who argue that positive emotion and negative emotion plays different role in cognitive process. Bolte, Goschke, and Kuhl (2003) insisted the positive and negative emotions are accompanied by qualitatively different information processing models based on the personality systems interaction theory (Kuhl, 2000). According to this theory, an increase in positive affect supports a holistic processing mode, which is characterized in memory by the activation of wide semantic fields, which include weak or remote association. In contrast, an increase in negative affect supports an analytic processing mode, which is characterized by a more restricted spread if activation to close associates and dominant word meanings. Furthermore, positive mood states have been found to impair some aspects of cognition, causing poor performance on tasks assessing memory, deductive reasoning, and planning (Oaksford, Morris, Grainger, & Williams, 1996; Seibert & Ellis, 1991)

Emotion in instructional design

In learning context, emotion has been regarded as a relatively less significant factor affecting on successful learning than cognition has, even though there have been some critiques insisting that cognitive theories lack an adequate conceptualization of the impact of motivation and emotional factors in learning (Csikszentmihalyi, 1990; Krapp, 1992). Emotion is not generally recognized by the disciplines that address the broad issues of understanding complex systems and complex behavior, especially in the presence of learning (Kort, Reilly & Picard, 2001). However, like other academic field, the issue of emotion has investigated without being highlighted.

In recent times especially, the research on emotion in learning context has been conducted actively from two different approaches. One approach has been focused on fostering affective dimensions of human learning and development by designing instruction on affective domain that is consisted of six different categories such as emotional development, moral development, social development, spiritual development, aesthetic development, and motivational development (Martin & Reigeluth, 1999). Emotion is proposed as one category of affective domains that needs to be developed properly. Emotional development includes understanding own and other's feelings and affective evaluations, learning to manage those feelings, and wanting to do so (Martin, 1999). Bloom (1964) had identified three domains of educational activities and described affective domain as five major categories includes the manner in which we deal with things emotionally, such as feelings, values, appreciation, enthusiasms, motivations, and attitudes. This series of studies is called as "instructional designing in affective domain". The studies on emotional that also have dealt with key questions mentioned above are in the same vein of research (Salvory, 1997).

The other approach of emotion related researches concentrated on how to moderate emotions that could arise during the learning course. These kinds of study, unlike the first approach, doesn't consider emotional development, but try to integrate learner's emotion states in learning context aiming at how to handle learner's unstable emotional aspects to be more appropriately maintained during entire learning course. Generally, in this scope of researches, emotions are assumed being scattered on some position from positive emotions to negative emotions (Astleitner, 2000; Astleitner, 2001; Kort, Reily & Picard, 2001). Astleitner (2000) suggested that there are five emotions needed to be considered in learning context, which are fear, envy, anger, sympathy, and pleasure. He added that instructional designer need to consider those emotions to optimize the learner's emotion states during learning process. Kort, Reilly and Picard (2001) also proposed model relating phases of learning to emotions. They divided emotions into positive affect and negative affect according to the cognitive dynamics of the learning process. Therefore, all possible emotions will be allocated in four different quadrant, which are constructive learning - positive affect (e.g., awe, satisfaction, curiosity), constructive learning - negative affect (e.g., disappointment, puzzlement, confusion), unlearning - positive affect (e.g., hopefulness, fresh research), finally unlearning - negative affect (e.g., frustration, discard, misconceptions). This model assumed that there is a process of specific emotions and equivalent cognition in learning context and those emotions are derived from 30 different emotion states.

From the viewpoint of general emotion related research, the problems are twofold. First, it is not quite easy to figure out what emotions have to be considered in learning context. Second, it is also questionable how the emotions could be categorized to help instructional designer utilize emotions into actual designing of learning process. Regarding the first question, Ekman (1999) provided several characteristics that basic emotions have to contain in general. However, figuring out the basic emotions in learning context is not a main concern to an instructional designer, because not only basic emotions but also other related emotions can be possibly occurred during learning context. As mentioned previously, how to optimize learner's emotion states is the key question for instructional designer.

Considering the previous researches on the effects of positive emotion on the cognitive process, it might be one reasonable way to categorize the emotions into positive emotions and negative emotions, since it is quite obvious to differentiate positive emotions from negative emotions. As a matter of fact, this classification of emotion has been broadly used in the research area of motivation and emotion in learning context.

To clarify the definition of positive emotions in the learning context, we need to understand two facts. One is the context of positive emotion, and the other is the characteristics of positive emotion. First, the positive emotion has to be considered in the context of learning. Referring the emotion sets in learning context shows that there are several types of positive emotions such as confidence, intrigue, epiphany, enthusiastic, excited, hopeful, curiosity, enlightenment, thrilled, anticipatory, comfort, interest, insight, satisfied and calm (Kort, Reilly & Picart, 2001). Those emotions are assumed to be helpful for learner to concentrate on the learning. However, we have to be careful with saying that "All of these positive emotions that we can verbalize have to be considered in instructional designing process!", because again, we are faced with the critical question, what are the positive emotions. Thus, the characteristics of emotion also need to be taken into account in defining positive emotions. In designing robot learning context, Gadanho and Hallam (2001) described some of the characteristics of emotion in learning process. First, emotion have valence that is, they provide a positive or negative value. Second, emotions have some persistence in time that is, it is not allowed to have sudden unrealistic swings between different emotions, particularly when the emotions in question differ a lot. Finally, emotions color perception in that what is perceived is biased by the current emotional state.

Given those two facts, positive emotions are well understood as the emotions which help learner concentrate on the learning task, which does not swing to different emotion suddenly, and which can be affected

by previous emotional states. For example, when the learner is not familiar with the learning task or contents, he/she will probably feel confused or frustrated at beginning of the learning. This emotion states will be automatically changed to the anxiety, if the task is not optional but required step for the learning. However, if the learner is getting knowledgeable with the specific tasks or contents, he/she will feel comfortable and furthermore, be satisfied with what he/she is doing, finally be enjoy working on the learning tasks. Of course, these are reasonably explained well when only the learning context is considered. There might be a lot of different factors which affect the learner's emotional states such as instructor, classroom atmosphere, weather, and personal issues. However, if we only think about the learning context, which is the interaction between learner and learning task, positive emotions will be one of obvious predictors that can positively affect learner's motivation and even performance.

Two positive emotion states and instructional design

There has been several emotion states suggested in the research of motivation field. The researches on motivation have been conducted from diverse topics such as expectancy, control, engagement, interest, goal, attribution, value, self-worth, self-regulation, and volition (Eccles & Wigfield, 2002). Among those themes, intrinsic motivation-related topics are mostly covering the emotion issues. When individuals are intrinsically motivated, they participate in activity because of learning interest and activity enjoyment (Eccles & Wigfield, 2002). For example, Deci and Ryan (1985) proposed self-determination theory in which two perspectives on human motivation are integrated, one is the optimal level of stimulation and the other is basic needs for competence. Csikszentmihalyi (1990) also defined the intrinsic motivation with the concept of "Flow", which describes experience of fully engagement in terms of an emotional state. Keller (1983) also suggests some emotional aspect with his ARCS model. According to his ARCS motivational design model, attention included perceptual arousal and inquiry arousal. However, the other components of ARCS model contain also some degree of cognitive process. Among those theories and models, learning interest and flow has been thought as an important part of intrinsic motivation (Eccles & Wigfield, 2002). Since the motivation is considered as the combined construct between emotional process and cognitive process together, it is very difficult to differentiate the former from the latter. However both of the interest theory and flow theory put an emphasis on the emotional aspect of motivation. Interest also has been considered as one of the positive emotions in learning and life (Kort, Reilly & Picard, 2001; Fredrickson, 2001).

Learning interest

Among the various emotions that have been studied in learning context, the role of interest and its implications for learning was studied from the beginning of the 20th centuries (Dewey, 1913). Since then, there have been a relatively large number of new empirical studies concerned with both the influence of interest on learning and development and the origin and transformation of interests (Krapp, Hidi & Renninger, 1992). The studies conceptualized interest in a variety of ways based on research questions and methods they had used in psychological or educational setting.

However, most common assumption of the concepts is that interest is a phenomenon that emerges from an individual's interaction with his or her environment (Krapp, 1992). Based on the common assumption, psychologist considered the characteristics of interest as followings (Izard & Ackerman 2000). First, Interest motives exploration and learning, and guarantees the person's engagement in the environment. Second, Interest is the only emotion that can sustain long-term constructivist or creative endeavors. These two significant features of interest imply that interest and motivation has very strong relationship. For example, Keller's ARCS model (1987) contains the interest as one of the motivational aspects, attention.

In learning context, the issue of interest has been investigated under different name such as epistemic curiosity, perceptual curiosity, cognitive interest and emotional interest, Berlyne (1965) suggested distinction between epistemic curiosity and perceptual curiosity. According to his distinction, epistemic curiosity concerns enquiry about knowledge and is shown when one puzzles over some science problem. Perceptual curiosity concerns increased attention given to objects in the environment such as symmetrical figure. He concluded that curiosity related to work in school setting seems to belong more to epistemic rather than perceptual curiosity.

The concept of cognitive interest and emotional interest was proposed by Kintsch (1980). According to the cognitive interest, cognitive interest adjuncts such as explanative summaries, influence learner's cognition by promoting the reader are structural understanding of the explanation. On the other hand, emotional interest is explained by that the addition of interesting but irrelevant material to a textbook lesson energizes learner so that they pay more attention and learn more overall. However, the results of the two experiments about emotional

interest and cognitive interest show that emotional interest doesn't influence learner's actual learning performance. It is quite attractive because those two researchers tried to explain two similar concepts with two different names.

Lot of researches on interest in reading education field have showed that two viewpoints of interest are assumed, one is individual interest and other is situational interest (Krapp, Hidi & Renninger, 1992).

From the view of Individual interest, Interest is implied as a characteristic of person. It is specific to individuals, developed slowly, tends to be long lasting, and triggered by individual's predisposition. For example, learners who are interested in topic or an activity pay more attention and acquire more knowledge than participants without such interest. Therefore, it is extremely time intensive and effort consuming to design learning environment in terms of individual interest. Finding out every possible individual interest and defining it to design learning environment are huge challenge.

Situational interest is generated as a result of interestingness. It is caused primarily by certain conditions and concrete objects in the environment, triggered by environmental factors, possibility of prescription, elicited by certain aspects of a situation, and it is assumed to contribute to the interestingness of the situation.

In summary, individual interest is a relatively stable evaluative orientation towards certain domains, and situational interest is an emotional state aroused by specific features of an activity or a task.

The (Figure 1) illustrates the relationship between individual interest and situational interest. As described, individual interest also can be affected by two aspects, feeling-related valence and value-related valence (Schiefele, 1999). Feeling-related valences refer to the feelings that are associated with an object or an activity, for instance, involvement, stimulation, and flow. Value related valences refer to the attribution of personal significance or importance to an object or an activity. Since those two aspects are highly correlated each other, it is hard to say from which aspect the learner feels interested in. However, it is obvious that some learners do the activity because they like it primarily based on feeling, and others do the activity because they think the activity is important for other purpose. Most of the researches on situational interest have focused on the characteristics of academic tasks that create interest (Hidi & Baird, 1986). Following features have been found to arouse situational interest and promote text comprehension and recall: personal relevance, novelty, activity level, and comprehensibility.

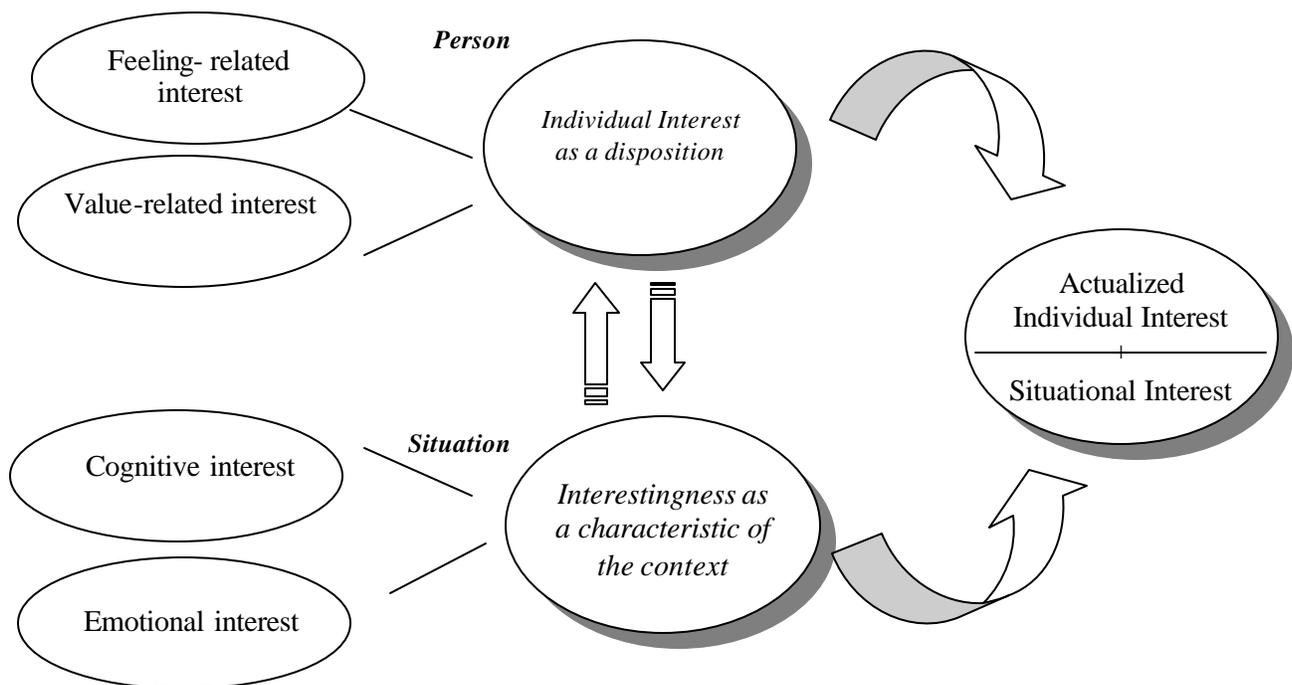


Figure 1. Individual interest and Situational interest

According to the distinction between cognitive interest and emotional interest, those are interest state derived by specific feature of a text. Therefore, both of cognitive interest and emotional interest will be counted as aspects of situational interest.

Flow

According to Watson et al (1988), positive affect refers to the extent to which an individual feels active, enthused and alert. It also reflects emotional states such as enthusiasm, drive, alertness, interest, joyousness, being self-determined, and therefore the ability of the individual to enjoy his or her surroundings, make use of and enjoy given opportunities (Konradt, Filip, & Hoffman, 2003). As already mentioned in the first paragraph of this paper, positive affect support cognitive flexibility, which means that person in a positive affect are superior in tasks requiring creativity in comparison to subjects being negatively aroused.

Flow is a state of experience which is characterized by an experience of intense concentration and enjoyment (Csikszentmihalyi, 1990). When people reflect on how it felt when they were in flow, they mention at least one, and often all, of these aspects: (a) sensing that one's skills are balanced by challenge, (b) engaging in a goal-directed activity, (c) receiving clear feedback, (d) feeling in control, (e) intensifying concentration, within a sense of (f) merging awareness, (g) disappearing of self-consciousness, (h) distorting the sense of time, and (j) perceiving the experience as intrinsically rewarding (Csikszentmihalyi, 1990).

In learning context, the term "flow" is used to refer to "optimal experience" events. The earliest writings on flow have signaled the expectation that flow is particularly important concept is an educational setting. It is also supported by the more recent researches showing that flow occurred more often during study and schoolwork than other daily activities (Massimini & Carli, 1988).

The flow state can be represented as a "channel" on a plot of challenge versus skills, separating the states of anxiety and boredom (Figure 2).

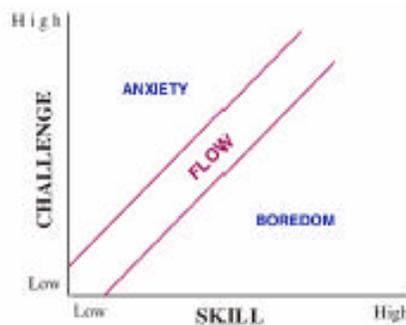


Figure 2. Csikszentmihalyi's original model of flow

According to this model, only a relative balance of challenge and skill is relevant to flow, not the absolute values. That is, if the challenge of a task decreases, it might become boring. However, if the challenge increases but one's skills do not improve to meet the challenge, then one might get into a state of anxiety. A learning activity might produce a progression up to the flow channel as new skills are learnt and greater challenges are sought on which to exercise those skills (Csikszentmihalyi, 1990). This model has been refined to include four, eight different states with the concept of channel.

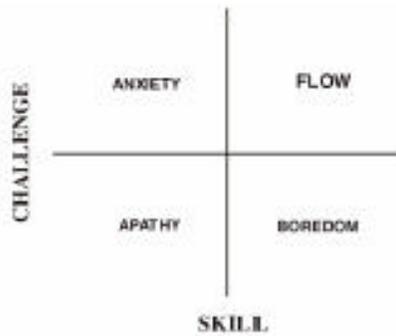


Figure 3. Four channel model of flow (Massimini & Carli, 1988)

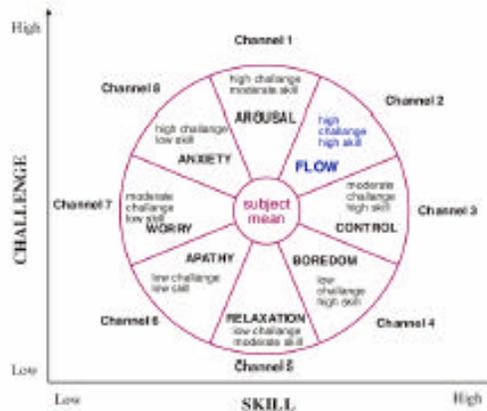


Figure 4. Eight channel model of flow (Massimini & Carli, 1988)

Recently, a series of researches have been conducted to apply the concept of flow in instructional technology field (Chen, Wigand, & Nilan, 1998; Chen, Wigand, & Nilan, 1999; Chan, Repman, 1999; Konradt & sulz, 2001; Konradt, Filip, & Hoffman, 2003). Since the concept of flow has been defined as an optimal experience, which is the balance of challenge and skill of learner, these studies tried to investigate how the learner's experience has changed while they are working on the tasks in web environment and hypermedia environment.

For measuring methods of flow, several approaches have been suggested and employed. First, ESM (Experience Sampling Method) was developed in which respondents were electronically paged about 8 times a day for a week to prompt them to a questionnaire (Csikszentmihalyi & Larson, 1987). A digital implementation of the ESM also developed and used in every day web activity (Chen & Nilan, 1998). To measure overall state of flow, FSS (Flow Status Survey) also has been developed and validated (Chan & Repman, 1999).

An ongoing issue in measuring flow is to find a method which makes it possible to measure flow independently from the positive states of consciousness such as happiness, concentration, control, lack of self-consciousness, and lack of distraction. One way was to use a measure of the balance between the challenge of an activity and the learner's perception of their own skill to do the activity. These two variables have been reported to be reliable indicators for measuring flow (Novak & Hoffman, 1997).

¹In this paper, the term emotion has been used to specify the feeling states which refer to specific states for the specific object. Mood usually refers to more general feeling states without any specific object. Affect refers to more stable, dispositional feeling states. However, researchers usually use the term mood and affect without clear distinction.

²The plural form of emotion (emotions) was used instead of the singular form of emotion (emotion), because there can be more than one positive emotion and negative emotion depending on the context. For example, Fredrickson (1998) chose joy, interest, contentment, and love as positive emotions. Ekman (1992) used the term "emotional families" to explain this.

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The Effect of Graphical Representation on the Learner's Learning Interest and Achievement in Multimedia Learning

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Abstract

The purpose of this paper was to investigate the effects of different types of visual illustrations on learner's learning interest, motivation and achievement, especially in multimedia learning. The participants were drawn from two classes of an "Introduction to Educational Technology" course and randomly assigned to one of the three treatments: one with cognitive interest illustrations which were designed to signal the structure of the explanation and another with emotional interest illustrations which are interesting but irrelevant illustration to understand the structure of text. The last one only contained text information. Result revealed that the post interest was different between learners in cognitive interest illustration group and text-only group, and also different between learners in emotional interest illustration group and text-only group. However, the types of illustration didn't have an effect on learner's achievement in terms of information recall and achievement test. There were also no significant differences between learner's motivations among three illustration groups. The features of the type of illustration that may have contributed to the findings are discussed.

Introduction

The effective use of graphical illustration in designing instructional material has been suggested as an important facet of instructional message design (Anglin, Towers, and Levis, 1996). Using illustration in instructional material is an effective method to support learning because it can be used as interest-getting device and it also helps learner interpret and remember the context of illustrated text. Since Spaulding (1955) reviewed sixteen research studies on the topic of using illustration in instruction conducted between 1930 and 1953, many researchers have studied the effects of illustration on knowledge acquisition in instructional setting (Samuels, 1970; Holiday, 1973; Concannon, 1975; Schallert, 1980; Levi & Lentz; 1982, Brody, 1984; Mayer, 1989; Levin & Mayer, 1993; Mayer, Steinhoff, Bower, & Mars, 1995; Harp & Mayer, 1997). After reviewing those studies, Anglin, Towers and Levis (1996) summarized that visual illustrations can facilitate the acquisition of knowledge when they are presented with text material concurrently.

However, it has been pointed out that the results of illustration related researches can not be integrated across all studies because of the lack of connections in terms of function of the illustration in the instructional treatment (Anglin, Towers, and Levis, 1996). It means that each illustration related study was focusing on the one function of illustration that might be different from the function of other illustration related research. In order to avoid the generalization of the results of illustration related researches, the functional framework has been suggested. The functional framework provides assistance in classifying visual illustrations into meaningful functional categories. Using this framework, the research results can be combined and generalized differently depending on the function of illustration. Therefore it is critical to determine the specific function of illustration before conducting actual research on the effect of visual illustration.

Regarding the function of illustration, Levie and Lantz (1982) suggested a functional framework that includes classifying illustrations in text based on how they impact a learner. According to them, framework contains four major functions which are attentional, affective, cognitive, and compensatory (Levie & Lentz, 1982). The attentional function attracts or directs attention to the material. The affective function enhances enjoyment or affects emotion and attitude. The cognitive function serves to facilitate learning text content through improving comprehension, increasing retention, or providing additional information. The last function, the compensatory function, is used to accommodate poor readers. Among those four functions, the previous researches usually were focusing on only the cognitive function of illustration. It has not been answered clearly what effect the visual illustration have on learner's emotion and attitude and how the illustration need to be designed to improve affective function of illustration.

In terms of affective function of illustration, Kintch (1980) insisted that the visual illustration has an effect on the learner's affective status in two different ways depending on the features of illustration. According

to his cognitive interest and emotional interest theory, visual illustration improves learner's cognitive interest and it promotes learner's emotional interest as well depending on the characteristic of it. The cognitive interest influences learner's cognition by promoting the reader's structural understanding of the explanation. On the other hand, emotional interest is explained by the addition of interesting but irrelevant material to a textbook lesson. It energizes learner's arousal so that they pay more attention and learn more overall. Therefore, cognitive interest illustration is defined as the illustration that signals the structure of the explanation. The emotional interest illustration is defined as the illustration which refers to interesting but irrelevant illustration to understand the structure of text. However, it plays an important role from the motivational aspect, because it increases emotional arousal and further influences the learner's cognitive process.

In a same vein, Levie and Lentz (1982) reviewed previous researches comparing three separate research area concerning the role of illustration in learning. The first research area was concerning learning illustrated text information, the second was about learning nonillustrated text information, and the last was about learning using a combination of illustrated and nonillustrated text information. According to the cognitive interest theory, the illustrated text information is similar with the cognitive interest illustration. Also, the nonillustrated text information is comparable to the emotional interest illustration. They concluded that learning would be facilitated when the information in the written text is depicted in the illustrations and learning of text material would not be helped nor necessarily hindered with illustrations that are not related to the text. However, they didn't consider the affective function of illustration separately.

Harp and Mayer (1997) examined the effects of emotional interest adjunct and cognitive interest adjunct on information retention, learning transfer, and learning interest. They reported that learners in the base text group recalled the most, whereas learners who read passages containing the base text along with emotional interest text and illustrations recalled the least. This result was consistent with the prediction of cognitive interest theory and inconsistent with the prediction of emotional interest theory. However, the learners' achievement was measured based on the procedural information of scientific phenomenon, not based on the factual information. In addition, the instructional material was paper based material and the participants were not allowed to read the passage more than once.

Therefore, two important issues can be raised. The first issue is that it is doubtful if the instructional material is delivered through multimedia presentation. In the multimedia learning, courseware screens are consisted of text, graphic such as still illustration and/or animation, and video clip. The learners can navigate each screen through the navigation buttons. Thus learner can go back to previous contents text or go to next contents text. They are also allowed to read the text more than once. In other word, the learner has control over the process of learning in multimedia material setting rather than paper based material setting. The second issue is that the achievement result can be different depending on instructional material contents. If it contains factual information as well as procedural information, the learners in emotional interest illustration group may recall more concepts than that of the cognitive interest illustration group, because the learner in the cognitive interest illustration group will not be able to get any benefits from studying the instructional material containing the illustration representing the procedural information.

In order to answer those two questions, this study was designed with learner controlled multimedia material containing factual information as well as procedural information. Therefore the purpose of this paper was to investigate the effects of different types of visual illustrations on learner's learning interest, motivation and achievement.

One independent variable, "Visual illustration type" containing three types, was implemented for the research. Two different types of illustration were applied into designing instructional material from the perspective of cognitive interest and emotional interest. The first type was cognitive interest illustration and text. The second type was emotional interest illustration and text. The third type was text -only material without any illustrations, which was the control group. The experimental group and control group were formed as follows. (1) Group 1 contained text information and cognitive interest illustration, (2) Group 2 contained text information and emotional interest illustration, (3) Group 3 contained only text information.

Four dependent variables were examined. The first dependent variable was "Learning interest." The learning interest was measured by one question, which adopted from the research by Harp and Mayor (1997). The second variable, motivation was measured by IMMS (Instructional Material Motivational Survey) developed based on Keller's ARCS model. IMMS contains question items to measure the motivation status from four different aspects such as attention, relevance, confidence, and satisfaction. The third dependent variable was "Learner's concept recall" targeted to measure the number of factual information recalled in limited time. The last variable was "Learner's achievement" developed to measure the procedural information using achievement test on the topic of the instructional material contents.

Since the learner's prior topic interest and prior knowledge were assumed as important covariates that could affect on learning interest and learner's achievement, those prior topic interest and prior knowledge were also measured before conducting research and considered as two covariates in data analysis stage.

Given the characteristics derived from the definition of cognitive interest and emotional interest, the learners in the emotional interest illustration group were predicted to show higher learning interest and motivation than those of the learners in the cognitive interest group and text-only group because of the affective function of illustration. The first hypothesis is justified because, according to the definition, emotional interest is derived from the interesting illustration that boosts learner's arousal level. Therefore the learner pays more attention on the instructional material and is motivated overall as well. In addition, the learner in the cognitive interest illustration group no longer get benefits from using cognitive interest illustration, because the learners in all three groups have control over the learning material. In other words, learners can study the instructional material more than once as the instructional material allows learners to navigate the screens using buttons.

The learners in the emotional interest illustration group were also expected to show higher score in both of the recall test and achievement test, because of the same reason. The learner will pay more attention to the instructional material than the two other groups so that the learners would be able to recall more concepts and achieve higher score than those of the two other groups.

Method

Participants

The participants in the study were 36 college level students who were attending a four-year university in southeastern area in United States. The study took place during the "Introduction to Educational Technology" course which designed to teach how to apply the technology into learning and teaching. Hyperstudio, one of the multimedia authoring tools, was used in this experiment because it was the required software learners need to study in the class. Four of the learners were male and thirty two of the learners were female. All of the learners were sophomore and junior level learners who were willing to apply to the college of education. The participants were drawn from two classes of "Introduction to Educational Technology" and randomly assigned to one of the three treatments. Total number of participants was thirty six excluding four learners who decided not to attend in this research.

Materials

The multimedia instructional material was developed using Hyperstudio to teach the "Life cycle of hurricane." The material consisted of 10 screens containing 6 different concepts covering (1) Unit overview, (2) Origin of Hurricane, (3) Life Cycle of hurricane development, (4) Eye and Eyewall, (5) Hurricane rotation, and (6) Hurricane's demise. Even though the material was designed using multimedia authoring tool 'Hyperstudio', only graphic and text information were applied in order to prevent learner from learning contents with other variables such as sound or animation. The applied illustrations were all colored graphics describing the hurricane development process. The three types of instructional material were developed separately according to the differences among three independent variable types.

Independent variables

The independent variable used for this study included the type of visual illustration used to deliver learners the concept of the life cycle of hurricane. The first level of the independent variable was cognitive interest illustration. The second level of the independent variable was emotional interest illustration. The third level of the independent variable was text-only information without illustration.

The instructional material containing cognitive interest illustration consisted of a screen-based presentation on the topic of the life cycle of hurricane. The design of the cognitive interest illustration was centered on the Kintch (1980)'s cognitive interest theory, According to Kintch, the cognitive interest influences learner's cognition by promoting the reader's structural understanding of the text explanation. Therefore the cognitive interest illustrations need to be designed to signal the structure of the explanation. For example, Harp and Mayer (1997) used an illustrations with explanative summary designed to promote cognitive interest on lightning process. In present research, cognitive interest illustrations were designed to improve the understanding of the four development stage of Hurricane, the required ingredients for a hurricane, and the location of eye and eyewall as shown in [Appendix A]. The illustrations were positioned right after text information. Therefore the participants were able to read the text first and look at the illustration next. Total number of the cognitive interest illustration was six; each illustration was placed on the screen #3, #4, #5, #6,

#7, and #8 with corresponding text.

The instructional material including emotional interest illustration was also consisted of the screens on the topic of the life cycle of hurricane. The design of the emotional interest illustration was based on emotional interest theory insisted by Kintch (1980). According to the theory, the emotional interest energizes learner's arousal so that they pay more attention on the instructional material. Therefore the emotional interest illustrations are interesting but irrelevant illustration to understand the structure of text. Harp and Mayer (1997) used emotional interest illustrations to compare the effect of it with the cognitive interest illustration. In present research, emotional interest illustrations were designed to improve the learner's arousal of the four development stage of Hurricane, the required ingredients for a hurricane, and the location of eye and eyewall as shown in [Appendix B]. As the case of cognitive interest, emotional interest illustrations were positioned right after text information. The position and the number of emotional interest illustrations were same as those of cognitive interest illustrations.

The instructional material containing only text information consisted of a screen-based presentation on the same topic as cognitive/emotional interest illustration material. However, it didn't include any illustrations. Learners had a full control over the navigation using buttons throughout the instructional material.

Dependent variables

Four dependent variables for the study included a learner's post-interest, motivation, the number of recalled concepts, and achievement.

One post-interest question item was used to measure learners' post interest level. This post-interest item was used in previous research designed to see how much the learners feel interest on the contents (Harp & Mayor, 1997). Participants were asked to respond their interest level about instructional material by selecting one of five choices ranging from "Not at all true" through "Very true".

Learner's motivation was measured using IMMS developed by Keller. The survey included 36 items intended to be a situational measure of learners' motivational reactions to instructional material. The response scale ranges from 1 to 5 with 12 Attention related questions, 9 Relevance related questions, 9 Confidence related questions, and 6 Satisfaction related questions. The reliability based on Cronbach's alpha for each subscale and the total scale was Attention: .89, Relevance: .81, Confidence: .90, Satisfaction: .92, and Total: .96.

The recall test was designed to assess the learner's ability to remember hurricane related terms. The recall sheet had the following instruction typed at the top of the page: "Please write down everything you can remember from the passage." Participants were allowed to write down as many as concepts they can recall from the instructional material in 5 minutes limitation.

The achievement was measured using post achievement test. The achievement test was designed to assess the learner's ability to solve the given problems using what they have learnt from the instructional material. Total number of item was ten including five short answer items and five multiple choice items. Items were designed to ask following topics; (a) Four development process of hurricane, (b) Meteorological factors necessary for forming hurricane, (c) Identification of hurricane from real weather pictures, and (d) The structure of hurricane.

Procedures

The instructional material was presented in a computer laboratory with 24 individual personal computers. Participants were drawn from two sections of introduction to educational technology course and randomly assigned to one of three treatments groups: the cognitive interest illustration group, and the emotional interest illustration group, and the text-only group. Participants were asked to fill out the prior knowledge and pre interest survey before processing instructional material. Then they were informed that they would be studying multimedia instructional material on the life cycle of hurricane and that, after they finished reading, they would be asked a series of questions about what they have read. They were instructed to read the material carefully in their normal reading rates. Instructor was present at all times to ensure that they were studying only the multimedia material. Each participant was given the material corresponding to his/her treatment group and told to start studying. They were not allowed to take notes or refer to other resource. As each participant finished studying after 10minutes, the experimenter handed the post interest survey inventory to fill out at his or her own rate. After completing the post interest inventory, participants were given the recall test. The experimenter collected the recall sheet after six minutes had passed. Next, participants were given achievement test sheets and allowed 10 minute to work on test. After final sheet had been collected, the participants were given IMMS to measure motivational level. After this, the participants were thanked for their participation.

The scoring procedure for the recall test and achievement test were administrated as follows. Recall test was scored based on prepared criteria. Since only differences among three treatments was the type of illustration on 6 slides out of 10 slides, the information recalled from only those 6 slides were considered in scoring procedure. When learner described all of development stages (1st stage through final 4th stage) of hurricane on recall sheet, each stage was considered as 1 point. The score for necessary five ingredients for hurricane also scored 1 point each. Lastly, description regarding eye and eyewall was computed 1 point each. Therefore total score ranged from 0 through 11.

Achievement test was graded based on pre determined answer sheet. Total number of questions was 10, but each question had different weight depending on the difficulty of question. Since there are correct answers for all of questions, answer sheet was prepared based on the information from hurricane learning material. Total score ranged from 0 through 19.

Results

Table 1. Means (Adjusted means) and standard deviations of dependent variables across groups.

| DVs | Maximum Score | Treatment groups | | | | | |
|-------------------|---------------|--|-------|--|-------|------------------|-------|
| | | Cognitive interest Illustration (n=12) | | Emotional interest illustration (n=12) | | Text-only (n=12) | |
| | | M (Adj. M) | SD | M (Adj. M) | SD | M (Adj. M) | SD |
| Post interest* | 5 | 3.75 (3.87) | .96 | 3.83 (3.87) | .83 | 3.33 (3.05) | 1.15 |
| Motivation | | | | | | | |
| Attention | 60 | 40.83 | 8.56 | 44.58 | 7.25 | 37.58 | 10.59 |
| Relevance | 45 | 27.92 | 5.43 | 30.42 | 5.68 | 25.25 | 6.98 |
| Confidence | 45 | 37.00 | 4.84 | 37.17 | 5.22 | 34.75 | 6.74 |
| Satisfaction | 30 | 19.08 | 5.20 | 19.25 | 4.58 | 15.92 | 5.43 |
| Total | 180 | 124.83 | 21.44 | 131.42 | 19.29 | 113.50 | 25.07 |
| Recall score | 11 | 5.67 (5.64) | 1.15 | 4.75 (4.71) | 1.05 | 4.83 (4.90) | 1.59 |
| Achievement score | 19 | 12.67 (12.78) | 2.77 | 11.83 (12.00) | 3.16 | 13.17 (12.88) | 1.90 |

* p < .05

Table 2. The analysis of covariance summary

| Source | Sum of Squares | df | Mean Square | F Value |
|-------------|----------------|----|-------------|---------|
| Preinterest | 18.565 | 1 | 18.565 | 42.381* |
| GROUP | 4.340 | 2 | 2.170 | 4.954* |
| Error | 14.018 | 32 | .438 | |

*p<.05

Post interest

Post interest score was collected using one interest survey question item. An analysis of covariance (ANCOVA) was conducted to determine whether the post interest scores for the three groups differed after adjustments were made for pre interest differences. Pre interest was served as a covariate. Table 1 presents the mean as well as the adjusted mean, and standard deviation for post interest scores across all three treatment conditions. With alpha set at .05, and a sample size of 36 (12 per cell), it was determined that the power for determining moderate effects was .54. A review of scatterplot for post interest scores revealed no serious violation of the normality assumptions required for linear regression analysis. Testing for the assumption of homogeneity of variance, a Levene's test revealed appropriate homogeneity of the post interest scores, $F(2,33) = 1.63$, $p=.211$. The assumption of equal regression slopes was tested and found tenable, $F(2,30)=2.09$, $p>.05$.

The ANCOVA indicated at least one pair of means was significantly different, $F(2,32)=4.95$, $p<.05$. A post hoc analysis using a bonferroni multiple comparison, with alpha at .05, showed that the post interest score for the cognitive interest illustration group ($M=3.87$) was significantly higher than the post interest score for the

text-only group ($M=3.05$). Also the the post interest score for the emotional interest illustration group ($M=3.87$) was significantly higher than the post interest score for the text-only group ($M=3.05$). However, there was no score difference between cognitive interest illustration group ($M=3.87$) and emotional interest illustration group ($M=3.87$). Table 2 presents the analysis of covariance summary.

Motivation

Motivation data was collected using IMMS developed by Keller (1993). An analysis of variance was conducted on the participant's ratings of motivation level in terms of attention, relevance, confidence, and satisfaction. Table 1 presents the mean and standard deviation for motivation scores across all three treatment conditions. With alpha set at .05, and a sample size of 36 (12 per cell), it was determined that the power for determining moderate effects was .54. A review of scatterplot for post interest scores revealed no serious violation of the normality assumption. Testing for the assumption of homogeneity of variance, a Levene's test revealed appropriate homogeneity of the post interest scores, Attention, $F(2,33) = .439$, $p=.648$; Relevance, $F(2,33)=.181$, $p=.836$; Confidence, $F(2,33)=2.217$, $p=.125$; Satisfaction, $F(2,23)=.151$, $p=.861$; Total, $F(2,33)=.287$, $p=.752$).

The results of the ANOVA revealed that none of the mean score difference was significant. The each sub scale of motivation score did not differ across the type of illustration group. Sub scale means (with standard deviations in parentheses) for group 1 through group3 were, 40.83 (8.56), 44.58 (7.25), 37.58 (10.59) for attention, 27.92(5.43), 30.42(5.68), 25.25(6.98) for relevance, 37.00(4.84), 37.17(5.22), 34.75(6.74) for confidence, and 19.08(5.20), 19.25(4.58), 15.92(5.43) for satisfaction, respectively.

Recall test

Recall test data was collected by grading the number of hurricane related terms the learner wrote down in limited time. An analysis of covariance (ANCOVA) was conducted to determine whether the recall test scores for the three groups differed after adjustments were made for prior knowledge differences. Prior knowledge was served as a covariate. Table 1 presents the mean as well as the adjusted mean, and standard deviation for recall test score across all three treatment conditions. With alpha set at .05, and a sample size of 36 (12 per cell), it was determined that the power for determining moderate effects was .54. A review of scatterplot for post interest scores revealed no serious violation of the normality assumptions required for linear regression analysis. Testing for the assumption of homogeneity of variance, a Levene's test revealed appropriate homogeneity of the recall test scores, $F(2,33) = .899$, $p=.417$. The assumption of equal regression slopes was tested and found tenable, $F(2,30)=.622$, $p>.05$. The recall test score did not differ across the type of illustration groups, $F(2,32)=1.724$, $p>.05$. According to the second hypothesis, emotion interest group was expected to show higher recall score than those of cognitive interest group and text-only group. However, the result revealed that there were no significant differences among different types of illustration groups.

Achievement test

Achievement test data was collected by grading the number of correct answer for the achievement test. An analysis of covariance (ANCOVA) was conducted to determine whether the achievement test scores for the three groups differed after adjustments were made for prior knowledge differences. Prior knowledge was served as a covariate. Table 1 presents the mean as well as the adjusted mean, and standard deviation for recall test score across all three treatment conditions. With alpha set at .05, and a sample size of 36 (12 per cell), it was determined that the power for determining moderate effects was .54. A review of scatterplot for post interest scores revealed no serious violation of the normality assumptions required for linear regression analysis. Testing for the assumption of homogeneity of variance, a Levene's test revealed appropriate homogeneity of the recall test scores, $F(2,33) = 1.152$, $p=.328$. The assumption of equal regression slopes was tested and found tenable, $F(2,30)=.330$, $p>.05$. The achievement test score did not differ across the type of illustration groups, $F(2,32)=.394$, $p>.05$. It was also predicted that the score of the emotional illustration group will be higher than those of cognitive illustration group and text only group. However, the result showed that there were no significant differences among different types of illustration groups.

Discussion

Supporting the primary hypothesis of the study, the mean score of post interest of learners in the emotional interest illustration group was significantly higher than the text-only group. In addition, the mean score of post interest of learners in the cognitive interest illustration group was significantly higher than the text-only group. This result indicates that learners who were given illustrations feel much interest than the

learners who were given only-text information. However, there was no significant difference between the mean score of cognitive interest illustration group and the mean score of emotional interest illustration group. This finding affirms that when learner is given either cognitive interest illustration or emotional interest illustration, he/she is aroused and feels positive emotion, interest, in the instructional material. This result is consistent with the findings of Harp and Mayer (1997). They pointed out that the failure to find differences in students' ratings of interestingness raises the possibility that the distinction between emotional interest and cognitive interest based on learner's evaluation of how the material was entertaining

The hypothesis predicting a motivational effect for the type of illustration was not supported by data. As shown in Table 1, there was mean differences among three groups, but those differences were not significant. The possible explanation for the type of illustration failing to predict motivation involves the effect of multimedia program. All learners receive the same instruction using same multimedia program. This program was the topic of the "Educational technology" class on experiment day. Therefore it is possible that they are all motivated to the instructional material regardless of the type of illustration, because the material was developed by a new program which learners are motivated.

The failure of type of illustration to affect recall and achievement test can also be explained in the same grounds. Unlike the findings of Harp and Mayer (1997), learners are allowed to navigate the instructional screens with free in this multimedia instructional material. Therefore they could go back to the information screen to confirm that they understand the information correctly and illustration did not play a strong role to emphasize the information.

There were several limitations to the findings of this study. First, learner's individual characteristic regarding the preference to the illustration was not considered. Because learner did not have a control over the illustration type, he/she had to have illustrations along with the text information. Second, the effect of multimedia authoring program was not considered. Since the program was totally new to participants in this research, all participants could be motivated on the same level no matter what illustrations they were given.

Additional research is needed to fill the gaps in our understanding of the interaction between learner's characteristic and the type of illustration in multimedia setting. Future research should also attempt to determine different functions of illustration in terms of cognitive function as well as affective function. Hence it will be possible to compare the different research results on the same topic based on the function of illustration.

The implication of this study involves the importance of visual illustration on learner's affect in multimedia learning, even though this study didn't prove that positive effect of visual illustration on learner's achievement. However, it is clear that using illustration in multimedia instructional material increases the learning interest of learner. Learner's interest is very complex psychological construct (Krapp, Hidi & Renninger, 1992). Instructional designer or educator need to consider the potential benefits of using different types of illustration when they develop multimedia based instructional material.

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Designing and Development of EPSS (Electronic Performance Support System): Case of (CRMT) Course Resource Management Tool

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Introduction

Within the realm of the knowledge-based economy, technology is considered as one of the main force for the contemporary organizational developments. EPSS provides solution when there are specific needs for performing job task effectively. Generally, it provides help, demonstrations, advice, customized templates, access to database, or any other support that the performer needs to perform a task or series of tasks (Brown, 1996; Wager, 2002). EPSS does not only refer to individual performance support system but also encompass organizational performance support system. This is the reason why the EPSS should be tightly linked to the integral part of the task. Starting from this point of view, Course Resource Management Tool (CRMT) was designed and developed to support staff member's performance in managing course resource.

The design and development of Course Resource Management Tool (CRMT)

The performance setting describes a learning resource center in college of education in southeastern area university. The resource center serves the staff and students in college of education. The functions of the department resource center include managing books, journals, CDs/CD ROMs, videotapes and teaching equipment. This resource center's staffing includes a supervisor and five graduate assistants (GA) to run the operation. The resource center has to meet the needs of approximately thirty teaching staff and two hundred students.

The resource center had problems monitoring the resources loaned out to students. The current system of loaning resources is still the traditional pen and paper recording. The center is also facing tedious work in the booking of teaching equipment. There is no system in managing the booking of equipment resulting in huge time consumption and plenty paperwork to be done by GA(Graduate Assistant)s. In order to minimize the unnecessary task process and maximize the performance of staff members, CRMT was designed and developed. The purposes of CRMT are (1) To monitor all resources and equipment using in an efficient and effective electronic system (Annual inventory check and loaning of equipment and resources), (2) To ensure all resources to be accountable by linking with the registrar. (3) To generate reports on the frequency of resources/equipment for future budgeting, planning and procurement, (4) To generate sign in / sign out forms for TA (Teaching Assistant)s. and (5) To monitor servicing schedule for all equipment. The work-flow analysis was broken into three phases for analysis, pre-semester, during semester and post-semester. Since GAs are main staff members of the center, the work flow was described based on the main tasks they have to carry out before the semester, during the semester, and after the semester. The Microsoft Access program was selected as a development tool. During development phase, input and output forms and reports were designed along with detailed database table structure. The formative evaluations were conducted separately with one week after the other. After the first evaluation, researcher did some changes before conducting the second evaluation. They were given the user's guide and the EPSS program, and they were told to open and run the database at their own time and pace without any intervention from us. All inputs (both verbal and non-verbal) were taken and changes were made on those deemed necessary, the amended inputs were consolidated and summarized in a table. Table 1 shows the suggestions made and their corresponding changes. Based on the suggested evaluation results, previous version has been revised and finalized. Finally, user manual and final development report were documented. The target level of this EPSS was work level. For group level, EPSS refers to the electronic system that provides integrated access to information, advice, learning experiences, and tools. The final object of group level of EPSS is to help someone perform a task with cooperation and support from other people. This presentation will provide detailed process of design and development of work level EPSS with tangible examples. Therefore, it will be a good case for the EPSS designer, especially who have been interested in designing work level EPSS.

Performance Opportunity

Currently, the resource center has problems monitoring the resources loaned out to students. The current system of loaning resources is still the traditional pen and paper recording. The center is also facing

tedious work in the booking of teaching equipment. There is no system in managing the booking of equipment resulting in huge time consumption and plenty paperwork to be done by GAs.

Work-flow Analysis

The new work-flow process is broken into three phases for analysis. The three phases are pre-semester, during semester and post-semester.

Pre-semester phase

GAs will receive course and students' information from registry office prior to the commencement of semester. The information includes courses that EPLS offers for that semester, details of courses' information and details of registered students' information. This new Microsoft Access program will require some system integration with existing registrar's database to obtain systems compatibility. The information obtained from registrar will update the new database. Before a new semester begins, GAs will send email to the teaching staff of EPLS to remind them to submit their resources and equipment requirement for their teaching needs for the new semester. The email will include attachment of resources and equipment request form and faculty authorization form. Upon the receipt of resource and equipment (books, journals, CDs, videotapes, and equipment) requests from teaching staff, GAs will do an inventory check and ensure all resources and equipment are available and proceed to update the database. GAs will generate a sign in / sign out file for all teaching assistants to check out the equipment. They will generate lists of existing resources and equipment for documentation purposes. In addition, GAs will generate an equipment schedule. This schedule will allow GAs, who are on duty to prepare the equipment for TAs.

During semester phase

The similar process mentioned earlier will also take place for ad-hoc and last minute request from teaching staff during the semester. The primary tasks that GAs are responsible are transaction of resources, and booking and signing in/out of equipment.

Transaction of Resources Students who are currently registered for courses can check in/check out required book, journals, CDs and videotapes. GAs will request student's ID to check if there is any outstanding fine. They will also check the availability of requested resources using the database. If resource is available and there is no outstanding fine, GAs will proceed to check in or out the resources required by students. GAs will print the receipt of the transaction for the student. The transaction is recorded in the database. When the resource is returned, GAs check in the resource and collect fine if there is any from the student. GAs will place the resources back to the bookshelf.

Booking and Signing In/Out of Equipment During the semester, ad-hoc requests for equipment are likely to occur. GAs will check available equipment before confirming the ad-hoc requests. GAs will prepare equipment for TA's collection on the required day and time. GAs will also ensure all items of equipment are accountable after TAs return the equipment; this includes proper handing and taking over of equipment through proper documentation.

Post-semester phase

GAs have the following responsibilities:

- Ensure all resources are checked in.
- For those overdue resources, GAs will contact the affected students and remind them to pay up by a specific date.
- GAs will send an email to registrar with a list of students who have not paid up their outstanding fines. Registrar will not allow students to register for class until they have paid up.
- Ensure all equipment are checked in and inform TAs who have not returned the equipment.
- Generate report of overdue payment for accounting purposes
- Save information into different file, for example Fall 2005
- Arrange for equipment to be sent for service and repair.

Inputs

- Course Information:

Course Code, Course Title, Course Instructor, Course Day, Course Time, Course Room & Course TA

- Enrollment Information (from Registrar):
Enrollment ID, Student ID & Course Code
- Equipment Information:
Equipment ID, Equipment Type, Purchased Year, Estimated Shell-Life, Servicing Schedule, Servicing Company & Company Contact No
- Equipment Booking Information:
Booking ID, Course Code, Equipment ID & Equipment Status
- Resource Information:
Resource ID, Course Code, Resource Type, Resource Title, Resource Year, Resource Author, Resource Status & Resource Paid
- Student Information:
Student ID, Student Name, Semester, Student Address, Student Major, Student Phone No. & Student Email.
- Transaction Information:
Transaction ID, Resource ID, Student ID, Date Out, Date Due & Check in Date

Outputs

The output (in the form of a report or form) should reflect the above information in addition to the following:

Forms

- Check Out
- Check In
- Add/Edit Resource Information
- Add/Edit Course Information
- Booking of Equipment
- Edit Existing Bookings
- Add/Edit Equipment List
- Sign In/Out

Reports

- Course Resource Report
- Overdue Resource Report
- Annual Resource List
- Overdue Payment Report
- Annual Equipment List
- Servicing Schedules

Data Tables

The data tables include Course, Enrollment (From registrar), Equipment, Equipment Booking, Resource, Student and Transaction. The fields of each table are described below.

Course table and its fields

| Field | Data Type | Example | Notes |
|-------------------|-----------|---------------------------------------|-------------|
| Course Code | Text | EME 6613 | Primary Key |
| Course Title | Text | Electronic Performance Support System | |
| Course Instructor | Text | Walter Wager | |
| Course Day | Text | Thu | |
| Course Time | Text | 12:30 – 15:15 | |
| Course Room | Text | 126 | |
| Course TA | Text | Eileen | |

Enrollment table and its fields

| Field | Data Type | Example | Notes |
|---------------|-----------|---------|-------------|
| Enrollment ID | Text | | Primary Key |
| Student ID | Text | | Foreign Key |
| Course Code | Text | | Foreign Key |

Equipment table and its fields

| Field | Data Type | Example | Notes |
|----------------------|-----------|----------------|-------------|
| Equipment ID | Text | DC0001 | Primary Key |
| Equipment Type | Text | Digital Camera | |
| Purchased year | Date/Time | 3/30/20001 | |
| Estimated Shelf-Life | Text | 5 | |
| Servicing Schedule | Text | Once a year | |
| Servicing Company | Text | SONY | |
| Company Contact No | Text | 8500001234 | |

Equipment Booking table and its fields

| Field | Data Type | Example | Notes |
|------------------|------------|-------------------------------------|-------------|
| Booking ID | AutoNumber | 1 | Primary Key |
| Course Code | Text | EDF 5400 | Foreign Key |
| Equipment ID | Text | DC0001 | Foreign Key |
| Equipment Status | Yes/No | <input checked="" type="checkbox"/> | |

Resource table and its fields

| Field | Data Type | Example | Notes |
|-----------------|-----------|---------------------------------------|-------------|
| Resource ID | Text | BK0001 | Primary Key |
| Course Code | Text | EME5601 | Foreign Key |
| Resource Type | Text | Book | |
| Resource Title | Text | Introduction to Instructional Systems | |
| Resource Year | Text | 1996 | |
| Resource Author | Text | Kanazas & Rothwell | |
| Resource Status | Yes/No | <input checked="" type="checkbox"/> | |
| Resource Paid | Yes/No | <input type="checkbox"/> | |

Student table and its fields

| Field | Data Type | Example | Notes |
|-------------------|-----------|--|-------------|
| Student ID | Text | 9000 | Primary Key |
| Student Name | Text | SangHoon Park | |
| Semester | Text | Fall 02 | |
| Student Address | Text | 2321 Continental Ave #120 Tallahassee FL 32304 | |
| Student Major | Text | IS | |
| Student Phone No. | Text | 8502222223 | |
| Student Email | Text | Psh_fsu@hotmail.com | |

Transaction table and its fields

| Field | Data Type | Example | Notes |
|----------------|-------------|------------|-------------|
| Transaction ID | Auto Number | 1 | Primary Key |
| Resource ID | Text | VI0001 | Foreign Key |
| Student ID | Text | 9010 | Foreign Key |
| Date Out | Date/Time | 10/27/2002 | |
| Date Due | Date/Time | 11/18/2002 | |
| Check in Date | Date/Time | 12/24/2002 | |

Formative Evaluation

Method

The formative product evaluation is the appraisal of instructional sequences and materials during their stage of formulation and development. The major purpose of formative product evaluation is to provide both descriptive and judgmental information regarding the worthiness of an instructional experience (Rothwell and Kazanas, 1992). In this paper, since the purpose of this tool was performance improvement, formative evaluation was conducted in terms of performance experience. Among the four major approaches of formative evaluation, individualized pretests and pilot tests were conducted. Two potential users from the learning resource center offered assistance to be involved in our formative evaluations.

Result

The formative evaluations were conducted separately with one week after the other. After the first evaluation, researcher did some changes before conducting the second evaluation. They were given the user's guide and the EPSS program, and they were told to open and run the database at their own time and pace without any intervention from us. All inputs (both verbal and non-verbal) were taken and changes were made on those deemed necessary, the amended inputs were consolidated and summarized in a following table..

| S/No | Suggestions | Changes |
|------|---|---|
| 01 | Program should be placed on desktop | Resource and equipment tool has been placed on desktop, on clicking the icon, the main switchboard will appear |
| 02 | In all edit/add functions, program should have a FIND button to search for desired items | Previously, our program has only some functions that have FIND button, after the change, most functions have FIND button |
| 03 | To add new record, users who have no knowledge on Microsoft Access do not know how to do it. | User guide has amended to include what to do, where to find the button and also a picture of the button to facilitate users' learning |
| 04 | Functions should be arranged accordingly to the frequent of use | The Check Out and Check In functions have been placed above Edit/Add Course and Resource Information |
| 05 | Users did not understand the significance of Yes and No in the status column in the Booking of Equipment function | A short message is placed beside the column explaining its significance. Amendments were also made to the user's guide |
| 06 | Users did not like the PK and FK on some of the field titles | All PK and FK were removed from the field titles |
| 07 | Title headings should be placed on several sub-forms, for example Booking of Equipment function | All title headings have been amended so that users know what they represent |
| 08 | Users suggested more prompt and short messages to remind the steps involved in a particular function | 1. Steps have been included in Check Out function to assist users 2. Short messages have also been included in all functions to remind users what to do. For example, in the booking |

| | | |
|----|---|---|
| | | of equipment, a short message of “Click Update to check whether booking is confirmed” is added |
| 09 | Users suggested using pictures for equipment | Pictures are inserted for each equipment |
| 10 | Users suggested the layout to be more attractive, they found them too dull and boring | Proper formatting and variety of colors are added to the EPSS to make it more aesthetically appealing |
| 11 | Users suggested that for Check Out, it would be good to remind users to type in the necessary information | Different colors and font are used to distinguish the entry box to key in the data. A brief statement is used too |

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Implementation of a technology-enhanced problem-based learning curriculum: A year-long study of three teachers

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Abstract

This paper describes the experiences of three middle school teachers following a two-week summer workshop in which they were introduced to a technology-enhanced problem-based learning (PBL) pedagogy. Based on their collaborative experiences during the school year developing and implementing a PBL unit, the three teachers increased their confidence in using technology and indicated shifts in their pedagogical beliefs regarding classroom instruction. Results suggest that administrators' continuous support and collaboration with other teachers were keys to teachers' successful implementation of technology-enhanced PBL units.

Introduction

In recent decades, teachers, instructional designers, and other educators have increasingly been urged to adopt a variety of constructivist approaches in order to facilitate student-centered learning environments (Becker, 2000; Howard, McGee, Schwartz, & Purcell, 2000). A particular emphasis of this movement has shifted the focus from teacher to learner, inviting learners to take active roles in their learning (Means, 1995; Reigeluth, 1999). Among various constructivist approaches, problem-based learning (PBL) has been advocated as an exemplar because it promotes students' understanding, integration, and retention of concepts, facts, and skills (Gallagher, 1997; Savery & Duffy, 1995).

A PBL learning approach is based on the use of ill-structured problem situations that are complex, requiring students to develop expertise in information seeking and making decision to solve the problem. Because the problem situations are messy, confusing, and complex, students need to gather information in order to understand, define, and solve the problems. During an authentic problem solving process, students are able to develop their own approaches and set their own goals. Under the guidance and coaching of a skillful teacher, students work collaboratively to inquire, investigate, and plan their activities (Sage, 2000).

This paper describes the experiences of three middle school teachers as they implemented a technology-enhanced problem-based learning (PBL) approach in their social studies curricula for the first time. We describe the challenges they faced as well as the factors that they perceived enabled them to be successful. Furthermore, we describe various strategies they need in the professional development for the technology integration at the different stage.

Theoretical Framework

Technology changes have resulted in the rapid increase of computer usage in schools. According to the National Center for Education Statistics (NCES, 2000), nearly all public school teachers (99 percent) reported having computers in their schools. Internet connectivity in K-12 classrooms increased from 65 percent in 1995 to 95 percent in 1999 (Web-Based Education Commission, 2000). However, NCES reported that nearly 70 percent of teachers still didn't feel well-prepared to use computers and the Internet in their teaching. Teachers' preparation and training to use technology is a key factor to consider when examining their instructional use of computers and the Internet.

In 1998, Lewis listed a number of barriers to effective professional development including opportunities to practice, access to outside resources and expertise, and support from the community, and emphasized the importance of having on-site assistance and support while teachers attempt to develop and implement new instructional practices. According to Trotter (1999), teachers who received instruction related to both technology skills and technology integration ideas felt significantly more prepared to use technology in their teaching compared to teachers who received instruction of just one type.

Sage (2000) contended that a problem-based learning (PBL) approach was an effective way to integrate technology into the classroom. She defined PBL as “experiential learning, organized around the investigation and resolution of messy, real-world problems” (p. 7). Also, Hill (1999) suggested that teacher technology development can be based on the same problem-centered methods that are suggested for students in problem-based learning. Because technology is a critical tool for information searching, modeling task or content decision making, and presenting solutions during PBL activities, technology integration with PBL can be a meaningful learning experience for both teachers and students (Jonassen, Howland, Moore, & Marra, 2003).

Although some literature is available regarding the benefits of staff development focused on promoting a technology-enhanced PBL approach, previous research has not looked at how teachers adapt their classroom practices to implement the suggested strategies over an extended period of time.

Purpose

In this case study we examined the experiences of three teachers’ at three different times during the year following a 2-week technology integration summer workshop involving enhanced problem-based learning (PBL). Specifically, the research questions guiding data collection and analysis included:

- ◆ What are teachers’ perceptions of and pedagogical beliefs about technology-enhanced PBL?
- ◆ What kinds of barriers and support do teachers encounter while implementing technology-enhanced PBL?
- ◆ What strategies are perceived as being most in developing teachers’ ability to implement technology enhanced PBL?

Methods

This study began in July 2002 and continued through June 2003 as part of a Technology Innovation Challenge Grant, funded by the U.S. Department of Education. A 2-week summer institute, focused on technology enhanced PBL, was provided to kick off the staff development process.

Three teachers from the same middle school, located in a small rural community in the Midwest, participated and developed a PBL unit together during the summer institute. The first participant, Carrie, had taught both science and social studies in the sixth grade for four years. The second participant, Jake, was in his second year of teaching sixth and seventh grade social studies. The third participant, David, was in his third year of teaching social studies and reading in the sixth grade.

Preliminary survey data were used to assess the participants’ computer skills, frequency of technology use in the classroom, and teaching beliefs and practices. Participants responded to 55 questions with 5-point Likert scale adapted from the Becker’s survey (e.g., “I ask students to work in a small group.” “Students in my class pursue information related to personal interests.”) (Becker, 2000). These data were collected at the beginning of the summer workshop, 2002 and at the end of the spring semester, 2003.

Qualitative data were collected from various sources including teacher interviews, field notes, and teachers’ journals. The first week of the summer institute focused on an introduction to PBL, a PBL modeling activity, and various software applications (Internet search techniques, web page development, spreadsheets, and an online course management system called ANGEL). During the second week of the institute the teachers worked collaboratively to develop their own PBL unit. A daily reflective journal was kept by each teacher and the first interview was conducted at the end of the workshop. The second interview was conducted in the fall, 2002 semester and the final interview in spring, 2003. The researchers also observed classroom activities and final student presentations that culminated the PBL unit.

Results

Stage 1: The Summer Institute

The participants indicated that overall the summer workshop was very beneficial in improving their technology skills and knowledge and all three reported an increase in confidence levels through hands-on activities. Through the PBL modeling activity, which included collaborative activities completed with k-12 students, teachers gained insights into the role of the teacher and made connections with how PBL can be implemented in their classrooms. Before the workshop they indicated that they felt uncomfortable using technology in the classroom. One indicated that using technology was a hassle and unreliable in improving student achievement. However, after the workshop, they all felt comfortable using a variety of software and demonstrated improved skills in almost every area. Although the participants felt, overall, that the workshop

was very beneficial to them, there were a few areas needing improvement. The teachers wanted to have more examples and evidence of how a PBL unit can actually work in their classrooms. They were concerned with the reality of actually implementing a real unit.

The teachers reported that the collaboration with professors and colleagues using hands-on activities and development of a unit meeting their needs were very positive features.

Stage 2: Changes Following the Summer Institute

Following the summer workshop two of the three participants indicated that they were using technology in the classroom with much greater frequency and all of them felt more comfortable with various software applications.

The researchers hoped that the participants would have implemented their PBL units by this interview, but instead found that the teachers had faced many barriers. The first barrier was losing their common team preparation time. Because of this, teachers could only communicate while passing each other in the hallway or by meeting before or after school. Another barrier was the time needed to prepare students for, and to give, the standardized tests required by the state at the beginning of the semester. This left teachers with little time to introduce technology to the students and to practice mini-PBL strategies during class time. Because of these barriers, none of the participants implemented their PBL units in the fall 2002 semester.

Stage 3: Changes Following Implementation of the PBL Unit

All three participants conducted their three week PBL units in spring 2003, during which time they involved their sixth grade students in questions related to the history of their community. Survey data collected at this time indicated that the teachers increased in their technology expertise ($M= 3.43, SD= .31$) from the summer ($M= 3.05, SD= .30$) and demonstrated shifts in their beliefs about student centered learning ($M= 3.33, SD= .94$) from summer ($M= 3.08, SD= 1.56$) Student computer use in the classroom also increased ($M=2.94, SD= .21$) from summer ($M= 2.44, SD= 0.08$)

Based on qualitative data, teachers perceived that their levels of technology confidence and PBL understanding were higher than before implementation. First, teachers' technology comfort level was improved through using a variety of software; they reported only minor technical problems during the PBL units. Furthermore, the network system was improved and technical support personnel were very quick in trouble shooting any problems. Second, they realized the role of teachers as a facilitator and students as a researcher and instructor to other students actively engaged with ownership and responsibility in their learning.

Although teachers believed they had succeeded with the PBL unit, they experienced barriers related to time and resources. Forty-five minute class sessions were too short for students to use computers for brainstorming, locating information, discussing topics, and organizing information. Teachers were required to work together after school because of losing team preparation time. In addition, the PBL topic, focused on the community's history, made finding online resources difficult and students had to be more dependent on the local library and interviews with community members. Fortunately, the school district has extended class time to sixty-five minutes and re-implemented the team preparation time for the next school year. The local library is also supporting the unit and adding student incentives by displaying the students' work to the community.

Based on their experiences with their PBL units, there was a distinctive change in teachers' pedagogical beliefs pertaining to using technology enhanced PBL. Due to lack of comfort and technical issues experienced in the past, all of the participants used to think of technology as a nuisance unnecessary for student achievement and learning. However, teachers became confident using technology enhanced PBL. They also realized that the students were more actively engagement in learning, and students were learning technology skills more quickly as they helped each other.

Finally, the participants suggested the ideal workshop format for a technology enhanced PBL workshop is one that includes other teachers with different levels of technology and PBL experience. For teachers at the beginning level, hands-on activities combined with developing their own units alongside teachers with previous experiences, was perceived as most beneficial. For the intermediate level, they preferred receiving some practical guidelines that could refresh their knowledge, new technology skills, more hands-on activities with their own units to modify, and feedback from other teachers outside of their own groups.

Discussion and Implications

Through this study, we found changes at each stage of staff development implementation. In the first stage involving the PBL modeling activity and hands-on activity, teachers developed technology skills and described increases in feeling "comfortable" with technology. The researchers interpreted this to mean that they

were no longer scared of encountering technical problems involving software applications and were also more prepared to help students use the technology and implement it in their classrooms. However, one of teachers expressed feelings of being overwhelmed, concerns about time allocation, collaboration with other teachers and technical problems. These are significant barriers that must be addressed before teachers can go back to their classrooms and implement PBL. Technical problems and feelings of isolation can inhibit teachers from ever trying this different approach.

At stage two, we found that two of the three participants were able to talk with each other everyday about teaching issues, technology, and PBL because their rooms were adjacent to one another. As a result of the interview, these two showed new changes in using technology and strategies from PBL where the third missed out on the opportunity to participate in these informal discussions and showed fewer changes. This shows how important the team preparation time is for collaboration among teachers. Administrative support in areas like scheduling can have a large impact on the implementation of new teaching methods.

The largest changes were found in stage three, following the implementation of the PBL units. All three participants showed increases in the frequency of technology use in their classrooms and an increase in comfort, confidence, and shifts in pedagogical beliefs in using technology enhanced PBL. Teachers adopted mini-PBL activities with technology in other units before their three-week PBL collaborative unit. It is important to note that the largest changes in the areas of comfort, confidence, and pedagogical belief came after the teachers had actually experienced leading a PBL unit in their own classroom through collaboration.

How can we encourage teachers to get to the point that they are willing to implement PBL in their classrooms? Data from this study suggested that effective staff development should provide opportunities for teachers to practice with hands-on activities with the unit meeting teachers' needs, and provide opportunities for collaboration with colleagues and experts. Most of all, continuous administrator support in providing team preparation time and creating a school culture that values the sharing of teachers' experiences was perceived as being critical to the success of teachers' efforts to initiate change in their classrooms.

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The Effects of Split-Attention and Redundancy on Cognitive Load When Learning Cognitive and Psychomotor Tasks

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Human working memory can be defined as a component system responsible for the temporary storage and manipulation of information related to higher level cognitive behaviors, such as understanding and reasoning (Baddeley, 1992; Becker & Morris, 1999). Working memory, while able to manage a complex array of cognitive activities, presents with an unexpected peculiarity, in that only a few elements of information can be processed in working memory at a given time. Miller (1956) established that working memory can only maintain about seven elements of information at a time. Additionally, working memory under conditions where rehearsal is limited, may only be able to hold information active for a few seconds (Peterson & Peterson, 1959). In situations involving more complex cognitive tasks, demands placed on working memory that are not directly related to problem solving can hinder learning by exceeding available cognitive resources (Sweller, van Merriënboer, & Paas, 1998). In such situations, instructional principles that avoid overburdening working memory and/or direct the learner's available resources are needed to design efficient and effective instruction.

Cognitive load theory, as conceptualized by Sweller (1988) and his colleagues in the late eighties, is concerned with instructional design and message design methods that efficiently manage the limited processing capabilities of an individual's working memory while capitalizing on the extensive capabilities of long term memory in order to promote schema formation and improve intellectual learning and performance of complex cognitive tasks.

Cognitive load (CL) is defined as the "total amount of mental energy imposed on working memory at an instance in time" (Cooper, 1998, p. 10). This "total" cognitive load is further subdivided into three subcomponents: intrinsic cognitive load (ICL), extraneous cognitive load (ECL) and germane cognitive load (GCL) (Sweller et al., 1998).

Intrinsic cognitive load is the load imposed on the learner by the nature of the instructional material that must be processed and learned. There is evidence to support the indirect manipulation of ICL by incorporating sequencing and layering strategies into the instructional design process and learning task (Pollock, Chandler, & Sweller, 2002).

Extraneous cognitive load is the load imposed by factors such as instructional strategies, message design, interface design, and the quality of instructional materials and learning environments. ECL is readily influenced by instructional design processes and has been the focus of much investigation (Sweller et al., 1998). In simple terms, high ECL equates to a reduction in working memory resources available for learning, while low ECL equates to an increase in working memory resources available for learning. Research related to the physical integration of diagrams and text and the elimination of unnecessary information in order to reduce demands on working memory has been conducted with much success in the knowledge domains of biology, computer-aided design/computer-aided manufacturing, electrical engineering, computer programming and mathematics (Bobis, Sweller, & Cooper, 1993; Chandler & Sweller, 1991, 1996; Kalyuga, Chandler, & Sweller, 1998; Leung, Low, & Sweller, 1997; Sweller et al., 1998; Tarmizi & Sweller, 1988).

A third and final dimension of cognitive load is germane cognitive load and is described as the "load imposed by cognitive processes directly relevant to learning" (van Merriënboer, Schuurman, de Croock, & Paas, 2002, p.12). The instructional designer can indirectly manipulate GCL. However, given that intrinsic + germane + extraneous cognitive load equals total cognitive load, the combination of ECL and ICL must leave sufficient resources available if GCL is to be addressed (Kirschner, 2002; van Merriënboer et al., 2002).

Currently, the study of cognitive load theory has provided hypotheses and conclusive findings concerning appropriate strategies for structuring instructional material as studied in many technical knowledge domains. The focus of this paper is to investigate the applicability of the cognitive load theory principles of redundancy and split attention to teaching Manual Physical Therapy Skills.

Literature Review

Working memory is loosely described as interconnected cognitive mechanisms that maintain newly acquired information and retrieve stored information to an active state for processing and manipulation. It is in working memory where complex cognitive tasks such as reasoning and problem solving occur (Baddeley, 1992; Becker & Morris, 1999). It is also in working memory where a potential bottleneck exists between the learning task at hand and long-term memory. Working memory while capable of managing an impressive array of cognitive tasks is surprisingly limited in both capacity and duration (Baddeley, 1992; Miller, 1956; Shiffrin & Nosofsky, 1994). In contrast, long-term memory effectively stores all of our knowledge (content, skills and strategies) on a permanent basis, with the ability to recall this information being somewhat more variable (Baddeley, 1992; Ericsson & Kintsch, 1995).

Element Complexity and Element Interactivity

In situations with low-element interactivity, such as with serial processing tasks, little or no overlap exists between elements but as the number of independent elements increases, the tasks may become difficult. In contrast, in situations with high-element interactivity where understanding requires that all elements be maintained in working memory and manipulated simultaneously, learning tasks can become exceptionally difficult. In such instances, the cognitive load imposed by trying to keep all elements in working memory may exceed the processing abilities of working memory (Sweller & Chandler, 1994).

Split Attention and Redundancy

Split attention and redundancy are closely linked concepts and in many cases are managed with similar design principles. For example, if two or more sources of information cannot be understood in isolation, then a split attention effect may occur and if they can be understood in isolation, a redundancy effect may occur (Kalyuga et al., 1998; Kalyuga, Chandler, & Sweller, 1999; Sweller, 1990, 1994, 1999; Sweller & Chandler, 1994; Sweller et al., 1998). Split attention and redundancy effects have been studied and can be practically categorized as (a) single format media studies, (b) dual format media studies and (c) multiple media studies employing the use of audio and visual materials. Last, important conditional factors such as learner experience have been identified across all categories.

First, the study of split attention and redundancy effects across several single format media studies have established consistent split attention and redundancy effects, as demonstrated by significantly superior learner performance, improved test scores, decreased error rates, quicker content processing times, reduced completion times and decreased levels of cognitive load. In contrast, given the situated nature of cognitive load research, specific levels of redundancy, split attention and/or levels of unintelligibility could not be expressed as formal prescriptive principles that are readily transferable to other learners and/or knowledge domains (Bobis et al., 1993; Chandler & Sweller, 1991, 1992; Purnell, Solman, & Sweller, 1991; Tarmizi & Sweller, 1988).

Second, similar split attention and redundancy effects have been studied in instructional situations involving two modes of instructional delivery, i.e., high complexity computer training with computer plus manual approaches vs. integrated manual or CBI only. Findings supported single media format studies and identified that instructional delivery strategies that utilize two pieces of instructional material may be detrimental to learning when more complex knowledge is being learned (Bobis et al., 1993; Cerpa, Chandler, & Sweller, 1996; Chandler & Sweller, 1992, 1996; Purnell et al., 1991).

Third, studies that incorporate both visual and auditory content have made a distinction between principles related to splitting the learner's attention between auditory and visual information (dual channel coding) and those related to split attention and redundancy effects in one channel (e.g., print) (Baddeley, 1992; Kalyuga et al., 1999; Reichle, Carpenter, & Just, 2000). In this context, both auditory and visual information may be used to expand working memory, while ameliorating audio-visual split attention effects (if any) and further benefit from prior strategies that limit split attention and redundancy effects (Kalyuga et al., 1999; Mayer, Heiser, & Lonn, 2001; Mayer & Moreno, 1998; Moreno & Mayer, 1999, 2002; Tindall-Ford, Chandler, & Sweller, 1997).

Last, in addition to the structure of human memory and distinct dimensions of cognitive load, learner experience and the ability of the instructional designer to correctly categorize how intrinsic, extraneous and germane load will influence a given learner or group has been shown to have bearing on the effectiveness of cognitive load theory driven design processes. That is, because a given instructional format is in part dependent on the experience of the learner, a format designed for a low level learner may not be suitable for a high level learner, with the opposite also holding true for a higher level learner. Such findings have provided support for

the need to design instruction and instructional processes to the level of experience of the learner and that instruction that fails to do so may present with deleterious effects (Kalyuga, Ayres, Chandler, & Sweller, 2003; Kalyuga et al., 1998; Pollock et al., 2002; Renkl & Atkinson, 2003; Yeung, 1999; Yeung, Jin, & Sweller, 1997).

Cumulatively, prior studies have provided powerful evidence indicating that material should typically be presented without redundant features, and that materials that cannot be understood in isolation should be physically integrated. Second, self-explanatory, integrated diagrams are presumed superior when redundant and incidental materials are removed. Third, split attention and redundancy effects are equally applicable to multimedia instructional modalities that incorporate dual channel strategies. Fourth, learning and transfer are both favored by strategies that eliminate split attention and redundancy in technical areas and last, conditional factors such as learner experience must be accounted for within a given knowledge domain.

Purpose of the study, Hypotheses and Research Questions

The purpose of this study was to test the effectiveness of realistic integrated instructional materials designed to control redundancy and split attention in the teaching of complex Orthopedic Physical Therapy skills. Integrated materials were compared to non-integrated materials and subjective ratings of cognitive load, post-instruction written test scores, post-instruction psychomotor performance, and time to complete specific tasks were assessed. The following hypotheses were tested:

1. Participants who receive integrated instructional formats will achieve higher written posttest scores as compared to control group participants who receive non-integrated instructional formats.
2. Participants who receive integrated instructional formats will report lower subjective ratings of cognitive load as compared to control group participants who receive non-integrated instructional formats for both post instruction and post psychomotor performance.
3. Participants who receive integrated instructional formats will achieve higher performance scores on the performance of manual physical therapy skills as compared to control group participants who receive non-integrated instructional formats.
4. Participants who receive integrated instructional formats will have lower task completion times (instructional unit and examination) as compared to control group participants who receive non-integrated instructional formats.

In an attempt to identify the applicability of cognitive load theory constructs to a previously unexamined knowledge domain (Physical Therapy) and from the perspective of both cognitive and psychomotor performance, research questions that were examined in this study were as follows:

1. Are redundancy and split attention principles derived from Cognitive Load Theory transferable to the knowledge domain of manual physical therapy?
2. Will instructional materials designed in accordance with cognitive load theory design principles positively influence learner attitudes towards instruction?
3. Will the management of redundancy and split attention affect psychomotor performance?
4. What aspects of the psychomotor skills are transferred immediately following instruction; accurately without practice and without feedback?

Method

Participants

Forty-one graduate program physical therapy students were recruited on a voluntary basis and scheduled from within the Department of Physical Therapy at a large Midwestern university (Integrated instruction N=9, Nonintegrated instruction N=8) and from within the Program in Physical Therapy at a second, but smaller Midwestern university (Integrated instruction N=12, Nonintegrated instruction N=12).

Materials

Two questionnaires, two instructional units of equivalent content, a psychomotor performance rubric, a date/time log, protocol instructions and participant instruction were developed and reviewed by four instructors and piloted on six advanced students. Both instructional units were based on an actual curricular unit of instruction and the content was directly applicable to clinical practice with the exception of only presenting a single technique in the stimulus materials.

Non-integrated instructional unit

The non-integrated instructional unit contained a brief introduction and two short knowledge sections. Section one provided a brief introduction to the principles of orthopedic provocation and alleviation (techniques used to increase or decrease patient symptoms based on patient movement, positions, or manual contact). Section two described the process for performing a specific provocation and alleviation test. Specifically, the procedure presented in the units of instruction required a series of appropriately sequenced steps that could be used to help clinically localize the primary anatomical region of dysfunction for an orthopedic patient complaining of generalized low back, pelvic and leg pain with weight shifting onto the painful extremity (leg).

Integrated instructional unit

Sections and content were equivalent, though message design attributes for the integrated instructional unit sought to eliminate all redundancy and split attention effects. Specifically, content was the same, though message design attributes for the integrated instructional unit subscribed to cognitive load theory design practices, i.e., content that was unintelligible in isolation was integrated and redundant information was completely eliminated.

Instruments

The post-instructional questionnaire was used to collect participant reported educational and biographical data (age, gender, GPA, and prior academic degrees), and a subjective rating of the difficulty of the instructional materials based on the prior literature (Kalyuga, Chandler, & Sweller, 2000; Paas, E. Tuovinen, Tabbers, & van Gerven, 2003). Finally, the questionnaire asked the participant to rate attitudes towards learning (quality, effectiveness, relevance and confidence). Additionally, the post-psychomotor task instructional performance questionnaire asked the participant to rate the difficulty of the psychomotor task performance using the same scale. The delayed written-post test consisted of 18 questions designed to assess specific content features of the instructional units and the posttest psychomotor rubric was used to evaluate the psychomotor performance of each participant.

Procedure

All participants were randomly assigned to one of two treatment groups. In all, 41 participants successfully completed the treatments across 11 data collection sessions across 11 data collection sessions (average number of participants per group $M=3.7$). After the written posttest, participants were escorted to a separate laboratory designated for the psychomotor assessment, which prohibited participants from overhearing other participants as they completed the psychomotor assessment.

Results

The four hypotheses were evaluated using a multivariate analysis of variance and the significance level was set at $\alpha = .05$. Additionally, no consequential violations of normality and homogeneity of variance were observed. Educational and biographical data were analyzed and no significant main effect was found; the data sets from the two institutions were pooled for the analyses. The MANOVA yielded an overall significant difference (Omnibus F) between the integrated and non-integrated groups, Pillai's Trace: $F(6, 34) = 6.213$, $p < .001$, $ES = .52$. Descriptive statistics for both groups are presented in Table 1.

A main effect was found for written posttest scores, $F(1,39) = 16.564$, $p < .001$, $MS_e = 2.12$, $ES = .30$. Participants who received the integrated instructional format achieved significantly higher written posttest scores ($M = 16.00$) as compared to control group participants who receive the non-integrated instructional format ($M = 14.15$) as predicted by the first hypothesis.

Table 1. *Descriptive statistics for both groups: primary hypotheses.*

| Dependent Variables | N | Instructional Format | |
|--|----|----------------------|------------|
| | | Non-Integrated | Integrated |
| Exam total score ¹ | M | 14.15 | 16.00 |
| | SD | 1.76 | 1.10 |
| Cognitive load rating one – instruction ² | M | 3.35 | 2.71 |
| | SD | 0.81 | 0.85 |
| Cognitive load rating two - technique ² | M | 3.50 | 2.62 |

| | | | |
|---|----|-------|-------|
| Psychomotor rubric total score ³ | SD | 0.95 | 1.07 |
| | M | 30.85 | 39.76 |
| Time to complete instructional unit ⁴ | SD | 6.05 | 4.44 |
| | M | 20.15 | 19.71 |
| Time to complete written examination ⁴ | SD | 6.13 | 6.55 |
| | M | 16.95 | 18.81 |
| | SD | 3.14 | 3.56 |

Notes

1. Possible range for exam score (0-18)
2. Possible range for cognitive load ratings one and two (1-7)
3. Possible range for psychomotor rubric score (0-44)
4. Possible range for instruction and written examination times (0-30 minutes)

Additional analysis was conducted to assess content structure scores as identified by low element interactivity and complexity or high-element interactivity and complexity in the following categories: (a) identical content (low element interactivity and complexity), (b) redundant content in the non-integrated unit of instruction (high-element interactivity and complexity) and (c) split attention content in the non-integrated unit of instruction (high element interactivity and complexity).

Univariate analyses of content structure scores revealed that the integrated instruction group ($M = 5.71$) scored significantly higher than the non-integrated instruction group ($M = 5.20$) on the written posttest when the content was not presented with redundant format, $F(1,39) = 6.82$, $p = .013$, $MS_e = .34$, $ES = .15$, and when the content did not have split attention features ($M = 4.81$), $F(1,39) = 9.73$, $p = .003$, $MS_e = .97$, $ES = .20$; as compared to the non-integrated instruction group ($M = 3.85$). No differences were noted with identical presentation formats between groups, observed power value = .33 (see descriptive statistics, Table 2).

Table 2. *Descriptive statistics for exam scores as a function of content structure.*

| Content Structure | | Instructional Format | |
|--------------------------------------|----|----------------------|------------|
| | | Non-Integrated | Integrated |
| | N | 20 | 21 |
| Identical content ¹ | M | 5.10 | 5.48 |
| | SD | 0.79 | 0.75 |
| Redundant content ² | M | 5.20 | 5.71 |
| | SD | 0.77 | 0.46 |
| Split attention content ³ | M | 3.85 | 4.81 |
| | SD | 1.18 | 0.75 |

Notes

Possible range for exam scores in each category (0-6)

1. Content was identical in both treatments (no redundant or split attention features)
2. Content contained redundant information in the non-integrated treatment
3. Content was unintelligible without mental integration in the non-integrated treatment

A main effect was found for subjective ratings of cognitive load measured after the completion of the instruction $F(1,39) = 6.02$, $p = .019$, $MS_e = .69$, $ES = .13$, and after the completion of the psychomotor performance task $F(1,39) = 7.76$, $p = .008$, $MS_e = 1.02$, $ES = .17$ supporting hypothesis two. Participants who received the integrated instruction format reported significantly lower subjective ratings of cognitive load measured after instruction ($M = 2.71$), as compared to control group participants who received the non-integrated instruction format ($M = 3.35$), as predicted. Additionally, participants who received the integrated instruction format reported significantly lower subjective ratings of cognitive load measured after psychomotor performance ($M = 2.62$), as compared to control group participants who received the non-integrated instruction format ($M = 3.50$).

A main effect was found for psychomotor performance scores $F(1,39) = 29.15$, $p < .001$, $MS_e = 27.90$, $ES = .43$. As predicted by hypothesis three, participants who received the integrated instruction format achieved significantly higher rubric scores on the performance of manual physical therapy skills ($M = 39.76$), as compared to control group participants who received the non-integrated instruction format ($M = 30.85$).

The psychomotor rubric was broken into three distinct sections: evaluation, application and comprehension. Univariate analyses of psychomotor performance scores revealed that the integrated instruction

group scored significantly higher on the evaluation section ($M = 7.10$): $F(1,39) = 20.23$, $p < .001$, $MS_e = 8.91$, $ES = .34$; and the application section ($M = 28.67$): $F(1,39) = 13.95$, $p < .001$, $MS_e = 13.37$, $ES = .26$; of the rubric as compared to control group participants who received the non-integrated instruction format ($M = 2.90$ and 24.40 respectively). No significant differences were noted on the comprehension section between groups (observed power value = .37). Descriptive statistics for evaluation, application and comprehension rubric scores are presented in Table 3.

Table 3. *Descriptive statistics for the psychomotor rubric: evaluation, application and comprehension.*

| Rubric Sections | N | Instructional Format | |
|----------------------------|----|----------------------|------------------|
| | | Non-Integrated 20 | Integrated 21 |
| Evaluation ¹ | M | 2.90 | 7.10 |
| | SD | 2.45 | 3.43 |
| Application ² | M | 24.40 | 28.67 |
| | SD | 4.88 | 1.85 |
| Comprehension ³ | M | 3.55 | 4.00 |
| | SD | 1.23 | 0.00 |

Notes

1. Possible range for scores (0-10)
2. Possible range for scores (0-30)
3. Possible range for scores (0-4)

Hypothesis four stated that “Participants who receive integrated instructional formats will have lower task completion times (instructional unit and examination) as compared to control group participants who received non-integrated instructional formats”. There were no significant differences between the groups on time spent to complete the instructional unit or the written examination. These two variables had observed power values of .06 and .41, respectively.

In an attempt to identify the applicability of cognitive load theory constructs to teaching manual physical therapy skills, four research questions were examined in this study. The first research question sought to determine if redundancy and split attention principles derived from cognitive load theory were transferable to the teaching of manual physical therapy skills. Statistically significant results in the expected direction for three of the four hypotheses provided support for the transferability of cognitive load theory design principles to the knowledge domain of manual physical therapy in this study. Specifically, the integrated instruction group achieved significantly higher written exam scores ($M = 16.00$): $F(1,39) = 16.564$, $p < .001$, $MS_e = 2.12$, $ES = .30$, as compared to the non-integrated instruction group ($M = 14.15$). Additionally, the integrated instruction group reported significantly lower subjective ratings of cognitive load after the completion of the instruction $F(1,39) = 6.02$, $p = .019$, $MS_e = .69$, $ES = .13$, ($M = 2.71$ and $M = 3.35$, respectively) and after the completion of the psychomotor performance task $F(1,39) = 7.76$, $p = .008$, $MS_e = 1.02$, $ES = .17$, ($M = 2.62$ and $M = 3.50$, respectively). Finally, the integrated instruction group ($M = 39.76$) achieved significantly higher psychomotor performance scores $F(1,39) = 29.15$, $p < .001$, $MS_e = 27.90$, $ES = .43$, as compared to control group participants who received the non-integrated instruction format ($M = 30.85$).

The second research question sought to discover if instructional materials designed in accordance with cognitive load theory design principles would positively influence learner attitudes towards instruction. The integrated instruction group reported lower subjective ratings of cognitive load for the written post test ($M = 2.71$): $F(1,39) = 6.02$, $p = .019$, $MS_e = .69$, $ES = .13$ and on psychomotor performance ($M = 2.62$), as compared to the non-integrated instruction group ($M = 3.35$ and 3.50 respectively). In contrast, there was no overall significant difference in general attitudes towards instructional format between the non-integrated group ($M = 1.64$) and integrated group ($M = 1.74$), with both groups reporting relatively high satisfaction with their respective instructional materials.

The third research question sought to determine if the management of redundancy and split attention will affect psychomotor performance. Relative to psychomotor performance, the integrated group scored significantly higher ($M = 39.76$) than the non-integrated group ($M = 30.85$) on the psychomotor task performance, $F(1,39) = 29.15$, $p < .001$, $MS_e = 27.90$, $ES = .43$.

The fourth research question asked what aspects of the psychomotor skills were transferred immediately following instruction. Overall, the integrated group scored significantly higher ($M = 39.76$) than the non-integrated group ($M = 30.85$) on the psychomotor task performance, $F(1,39) = 29.15$, $p < .001$, $MS_e =$

27.90, $ES = .43$. Specifically, psychomotor skills related to technique evaluation ($M = 7.10$): $F(1,39) = 20.23$, $p < .001$, $MS_e = 8.91$, $ES = .34$; and the application section ($M = 28.67$): $F(1,39) = 13.95$, $p < .001$, $MS_e = 13.37$, $ES = .26$ were transferred with greater efficiency, without practice and without feedback in the integrated instructional group, as compared to control group participants who received the non-integrated instruction format ($M = 2.90$ and 24.40 respectively). No significant differences were noted on the comprehension section between groups in this study.

Discussion and Conclusions

In this study, there was an overall significant difference (Omnibus F) between the integrated and non-integrated treatments and an overall moderate effect size of $.52$ was observed. Significant results were found in the expected direction for the hypotheses predicting higher achievement on the written examination scores, lower ratings of cognitive load following instruction and technique phases, and higher performance on the psychomotor task by the integrated treatment group, as compared to the non-integrated treatment group. There were no significant differences noted in terms of the time required to complete instruction or written examinations between groups.

Hypothesis one

Hypothesis one predicted that participants who received the integrated instructional format would achieve higher posttest scores as compared to control group participants. The primary variables under assessment were written posttest scores, which entailed the further analysis content structure scores. The results for cumulative scores and content structure scores indicated that there was a significant difference between the two instructional conditions in the expected direction with the integrated instruction group scoring significantly higher. These findings suggest that the instructional complexity, interactivity of elements, and novelty of the content were capable of placing an appreciable load on the learner's available cognitive resources. These results further suggest that the integrated treatment allowed for GCL by reducing ECL as a function of sound design practices. Conversely, these results also suggest that the traditional treatment (non-integrated format) sufficiently increased ECL and sufficiently limited GCL which prevented participants from developing the appropriate schema and understanding of the content. The reduction of total cognitive load via the management of ECL is perhaps the most prominent cognitive load management principle and is consistent with findings identified in prior research (Bobis et al., 1993; Chandler & Sweller, 1991, 1992; Marcus, Cooper, & Sweller, 1996; Purnell et al., 1991; Tarmizi & Sweller, 1988).

Content structure scores

Additional analysis was conducted to assess content structure scores between groups. In conditions where the instruction required mental integration (split attention effect) for understanding or in situations where instructional materials were presented with redundant features (redundancy effect) the integrated-instructional group scored significantly higher as compared to the control group on respective test questions. Because complex learning situations composed of several highly interrelated elements will create the heaviest load on working memory, the differences in content structure scores between groups provides further support for the preliminary findings. That is, the content containing redundant or split attention features represented a discernable difference between groups in terms of the number of discrete elements that participant's were required to maintain and manipulate simultaneously in working memory. Furthermore, the lower performance demonstrated by the non-integrated instruction group suggests that the number of elements exceeded the processing abilities of working memory and sufficiently limited germane cognitive load. Conversely, the higher performance demonstrated by the integrated instruction group suggests that the number of elements did not exceed the processing abilities of working memory as a function of sound instructional and message design practices. Finally, as would be expected, in situations where it was not necessary for the learner to integrate divergent sources of information or process redundant information, there was no difference between the integrated and non-integrated formats (Sweller & Chandler, 1994; Sweller et al., 1998).

Additional Considerations

As a function of study design, some meta-cognitive processes were under the direct control of the participants and subject to individual strategies that were in part a function of intrinsic cognitive load. To this end, learners may or may not have utilized advantageous metacognitive strategies. Furthermore, because the diagrams contained in both treatments reflected procedural sequences as a function of the clinical nature of

localization testing, both instructional formats would have offered the learner an isolated step by step illustration of task performance and an overall illustration of task performance. However, while each isolated step and the overall strategy driven process could have been derived from either instructional format, the redundant and divergent sources of information contained in the non-integrated group combined with increased extraneous load decreased GCL would have made it difficult for the non-integrated treatment group to form such understandings. Thus, it is plausible that participant access and execution of more and less productive metacognitive strategies would have varied between groups as a function of instructional format and available cognitive resources.

In the context of procedural nature of the treatment materials and in consideration of more recent contributions to cognitive load theory, the integrated group may have chosen to learn or memorize the individual steps in isolation (isolated elements approach or serial processing) before attempting to integrate the entire process (Pollock et al., 2002). While the claim that the integrated treatment group utilized such strategies is speculative, future studies might query the participants to determine what type of metacognitive strategies they used for the different tasks and/or choose a multi-stage approach in order to manipulate intrinsic load.

Hypothesis Two

Hypothesis two predicted that participants who received the integrated instructional format would report lower subjective ratings of cognitive load as compared to those receiving the non-integrated format. The primary variables under assessment were subjective ratings of cognitive load reported after completing both the instructional unit and psychomotor assessment. The integrated-treatment group reported significantly lower subjective ratings of cognitive load post-instruction and post-psychomotor assessment as predicted.

These significantly lower subjective ratings were well aligned with the significantly higher objective performance measures achieved by the integrated treatment group. Additionally, while the use of subjective ratings of cognitive load were not identified in prior research in the context of psychomotor assessment or the performance of manual physical therapy skills, the present findings suggest that such measures can be extended to the performance of psychomotor tasks. Specifically, significantly lower subjective ratings of cognitive load reported by the integrated treatment were correlated with significantly higher psychomotor assessment scores as discussed below.

Hypothesis Three

Hypothesis three predicted that participants who received the integrated instructional formats would achieve higher performance scores on manual physical therapy tasks. The primary variable under assessment was cumulative rubric score for performance of manual physical therapy skills. On this task, the integrated-treatment group scored significantly higher on total psychomotor performance in the expected direction.

As a function of the clinical nature of localization testing and its practical applicability to clinical practice, the psychomotor rubric consisted of three distinct sections: (a) comprehension, (b) application and (c) evaluation. When comparing psychomotor scores between groups, the integrated group scored significantly higher on the evaluation section and the application section of the rubric, with no significant differences noted on the comprehension section. These findings suggest that both groups understood the concepts presented in their respective instructional treatments, though only the integrated treatment group was able to demonstrate proficiency on psychomotor tasks performance. These specific findings could be attributed to both the content structure of the two treatments and the level of complexity of the content itself. Specifically, the presentation of evaluation and application content structure was very conducive to diagrammatic presentation and in fact, the patient positioning phases (application and evaluation) and the application phases (procedural steps) were both presented in diagrammatic formats. In the non-integrated treatment, the participants needed to integrate the information to understand the procedure, a constraint that was not present in the integrated treatment. Plausible explanations for superior performance demonstrated by the integrated treatment group on the application and evaluation sections were specifically discussed above.

In terms of superior performance demonstrated by the integrated treatment group on psychomotor tasks, Romiszowski (1993) identified that psychomotor learning typically involves the acquisition of both skills and knowledge in which he identifies knowledge as “information stored in the performer’s mind or available to the performer in some reference source” and skill as “actions (intellectual as well as physical) which the performer executes in a competent manner in order to achieve a goal” (p. 130-131). Romiszowski additionally discusses psychomotor performances across a continuum of types of knowledge content in which he notes the distinctions between “reproductive skills” that entail repetitive and automated actions and “productive skills”

that entail the use of adaptive strategies and reasoning skills. This study employed psychomotor tasks that are consistent with Romiszowski's definition of "productive skills" as the participants had little time to address repetition or automation and were required to problem solve and adapt strategies or make clinical decisions during the psychomotor assessment phase (Romiszowski, 1993).

This particular type of skill has also been studied by Anderson (1983) in his development of the Adaptive Control of Thought (ACT) model, which has been directed towards understanding procedural knowledge linked to cognitive skills relevant to decision making and problem solving or productive skills. ACT describes that "productions provide the connection between declarative knowledge and behavior" (Anderson, 1983). Relative to this study, Anderson's explanation of the link between declarative knowledge and behavior helps to offer further explanation for the significantly superior performance on task performance by the integrated instruction group as compared to the non-integrated instruction group. Specifically, given the significantly superior performance demonstrated by the integrated instruction group, the non-integrated instruction group would have likely experienced a waterfall failure effect in that they were unsuccessful in transferring the necessary declarative knowledge and problem solving schema to long term memory that were required for successful task performance.

Hypothesis Four

Hypothesis four predicted that participants who received the integrated instructional formats would have lower task completion times. The primary variables under assessment were task completion times for the instructional unit and the written examination. There were no significant differences between the groups on time spent to complete the instructional unit or the written examination. These two variables had observed power values of .055 and .408, respectively, which means that many more participants would have been needed to detect a significant difference, if it in fact existed. In contrast, Stem-and-Leaf Plots for the variable "Total Exam Time" in both the non-integrated and integrated instructional groups presented two data plots with extreme outliers relative to all other data, which contained no extreme outliers. Specifically: non-integrated format (1.00 extreme, ≥ 26.0) and integrated format (1.00 extreme, ≥ 30). When additional analysis was performed with these two extreme outliers removed, Total Exam Time was reported as $F(1, 37) = 5.11$, $p = .03$, $ES = .12$. One plausible explanation for these findings could be attributed to sample size, as a much larger sample size may have not been so readily influenced by extreme outliers, if present. Additionally, another plausible explanation is that the integrated instruction group had to give little mental effort, while the non-integrated group felt overwhelmed and did not give the additional effort needed to overcome the limitations of the materials needed to promote learning with understanding. Future studies might query participants to determine affective or motivational responses to varied instructional formats in order to better understand underlying cognitive reasoning.

Research Questions

The first research question asked if redundancy and split attention principles derived from Cognitive Load Theory were transferable to the knowledge domain of manual physical therapy. In this study, the statistically significant results in the expected direction for three of four hypotheses provide support for the transferability of cognitive load theory design principles to the teaching of manual physical therapy.

The second research question asked if instructional materials designed in accordance with cognitive load theory design principles would positively influence learner attitudes towards instruction. In this study, statistically significant results in the expected direction indicated that attitudes as a function of subjective ratings of cognitive load reported by the integrated instruction group were positively influenced as compared to the non-integrated instruction group. However, general attitudes towards instructional formats did not identify an overall significant difference between the integrated and non-integrated groups. In this context, both groups perceived both units of instruction rather favorably which for the non-integrated treatment group was in contrast to both objective measures and subjective ratings of cognitive load. In this study, the short instructional time might have also influenced the subjective ratings while longer instructional periods noted in a traditional classroom setting might have provided different findings.

The third research question asked if the management of redundancy and split attention would affect psychomotor performance. Statistically significant results in the expected direction indicated that cognitive load theory design principles were successfully extended to the performance of manual physical therapy skills. Additionally, no differences were found in conditions involving low element complexity and interactivity, such as with conditions that would not be expected to tax working memory resources.

The fourth research question asked what aspects of the psychomotor skills are transferred immediately following instruction; accurately without practice and without feedback. Study findings suggest that superior performance on both cognitive and psychomotor performance can be obtained as a function of instructional message design principles that eliminate split attention and redundancy effects.

Applications to Physical Therapy

Relative to practical and clinical significance is the observation that the integrated treatment group achieved an 89% on the examination and 90% on the psychomotor assessment (practical examination), while the non-integrated treatment group achieved a 79% and 70% respectively, the latter grades would be considered failing by program standards. Additionally, practical examinations (formal psychomotor assessments) are often limited to a single “re-take” opportunity prior to course and/or program dismissal. To this end, the differences in scores from a curricular perspective as a function of instructional format, as well as the direct applicability of the treatment materials to real world clinical practice are salient features of this study.

Relative to cognitive load theory, distinctions between the reduction of ECL and the “freeing up” of GCL via message design strategies and the external facilitation of GCL via schema driven strategies could be better delineated via multiple experiment designs. Second, the applicability of isolated and interacting elements approaches to cognitive and psychomotor tasks should be entertained. Last, future research should attempt to determine to what extent (if any) metacognitive strategy selection is influenced by manipulating various facets of cognitive load and the effects that isolated and interacting elements approaches for both cognitive and psychomotor tasks.

Conclusions

This study used ecologically valid materials in a realistic classroom setting. As predicted, the participants receiving the integrated-instructional materials scored significantly higher on the written posttest. This result suggests that designers can increase the germane cognitive load by reducing the extraneous cognitive load through good instructional and message design practices. This study extended the prior research by examining the effect of lowered extraneous cognitive load on the performance of a psychomotor task. The significant increase in performance by the integrated-materials treatment participants suggests that psychomotor performance is also enhanced by an increase in germane cognitive load capacity.

These findings suggest that instructional designers should reduce designs that create split-attention and redundancy. In addition, graphics should be created using an integrated approach suggested by Sweller (1999) that further reduces extraneous cognitive load. With complex information, it is apparent that instructional designers must manage extraneous cognitive load to afford learners the opportunity to develop appropriate schemata. The findings from this study combined with the robust nature of cognitive load theory in general, warrants further investigation of cognitive load principles in the design of Physical Therapy instructional materials and the application of cognitive load principles to psychomotor performance.

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K-12 Technology Coordinators: Expectations and Realities

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Abstract

This paper reports the findings of an exploratory study that investigates what Technology Coordinators (TC) are expected to do and what they actually do. Schools have invested large sums of money on technology and they have high expectations for the educational outcomes associated with the use of such technology. A question then arises regarding the expectations of the TC whose job it is to coordinate or manage the school's technology. What are the expectations for the TC? Do the expectations match what the TC actually does? Our exploratory study examines the expectations and realities in detail. The results of this exploratory study indicate that there is a disconnect between the expectations and the reality of the TC's job. We present three main findings. First for a TC to succeed, they must have a clear, yet dynamic, job description that is widely disseminated within the educational community. Second, job descriptions should vary depending on the needs of the TC's educational community. Third, the TC needs time built into their schedule to afford them the opportunity to work on professional development (PD) projects.

Background

According to the National Center for Educational Statistics, the average public school has 124 instructional computers (NCES, 2003), and 99% of all public schools have access to the Internet (NCES, 2002). The teacher with an interest in computers is ordinarily responsible for integrating the instructional computers into the curriculum. These teachers typically find themselves playing the role of the school or district TC.¹ We examine the roles of TCs to determine if the expectations match the reality of what the TCs are able to accomplish.

The literature on the TC's job responsibilities exemplifies the diverse views of the TC's responsibilities. The main area of agreement, across the literature, as to the TC's role is that of PD and technician (Strudler, 1999; Marcovitz, 1998; Reilly, 1999; Lai, Trevern & Pratt, 2002). The other combined roles of the TC include: Classroom Assistant, Curriculum Consultant, Curriculum Designer, Policy Maker, Strategic Planning, Manager and Envisioner (Strudler, 1999; Marcovitz, 1998; Reilly, 1999; Lai, Trevern & Pratt, 2002). This suggests that the expectations for TCs vary. The question is then: why so much variance?

Before we address the question of the variance in job responsibilities, it is important that we discuss effective PD for technology utilization in educational environments. PD was one area that the literature agreed was one of the TC's job responsibilities. We believe that PD is an evolutionary process and should be based on the technology needs of the community. Over time the method for professional development will change as the technological skills and needs of the educational community change. In other words, technology-related PD is a process that changes as teachers and students become more versed in technology (Sherry, Billig, Tavaline, & Gibson, 2000). There may be so much variance in the literature regarding the role of the TC because the needs for PD change over time.

This study seeks to determine what Technology Coordinators do and what others in their environment expect of them. We seek to determine if there is a disconnect between expectations and reality within educational environments and across environments. We believe there are two possible reasons for a disconnect. The first explanation is that the *technology needs* of the educational communities are diverse which accounts for the diversity in roles documented in the literature. If the first explanation is correct then the expectations within an individual TC's environment should match the reality of the job. The second explanation, for the wide variance in the roles of TCs reported in the literature, is that there are simply *too many expectations* for technology coordinators due to the varied ways in which technology is employed in the educational setting. If this second explanation is true, then expectations will not match the reality of the TC's jobs within and across educational communities.

We believe that everyone within a given educational community needs to have a clear understanding

of what the TC is expected to do to avoid inefficient and ineffective use of the technology. If there is a disconnect, then educational communities will need to determine ways to alleviate the disconnect and work towards a unified vision of reasonable expectations. A unified vision will allow schools to design the TC's role so that the TCs will fulfill the educational community's needs while avoiding inefficient and ineffective use of technology.

It is important to note that we use the title "Technology Coordinators" to refer to the individual who is responsible for coordinating and/or managing technology efforts within an educational environment. Depending on the school system, this person can be school-based or system-based. Some common titles for such positions are Computer Coordinator, Technology Facilitator, and Technology Coordinator. We refer to these positions in general and we realize that there are fundamental differences in school-based, district-based and system-based positions. This is an exploratory investigation that is looking at general expectations for those who coordinate technology efforts within educational environments.

Methodology

A descriptive, exploratory case study was conducted. To triangulate the results, a variety of data collection techniques were used and information was gathered from a variety of sources. What follows is a discussion of the participants and the collection methods.

Participants

Primary Participants Two district TCs and one middle school TC participated. TCs were selected based upon their willingness to participate and their proximity to the primary investigator's office.

Secondary Participants In addition to the TCs, four people (including a supervising administrator and a media coordinator who is at the same level as the TC) from each TC's school/school district participated in interviews.

The secondary participants are as follows:

Middle School TC: the Middle School Principal, the Middle School Media Coordinator and two teachers from the middle school.

District TC #1: the High School Principal, the District Wide Media Coordinator, the High School TC and a High School Teacher.

District TC #2: the Assistant Superintendent of the District, the District Wide Media Coordinator and two elementary school media coordinators.

By interviewing people who play different roles in relation to the TC we are able to get a greater perspective to enhance our understanding of the TC's activities.

Interviews

Primary Participants Prior to the interview, each TC received a copy of the interview questions. The goal of the interview was to get acquainted with the TC and gain an understanding of their role. The initial interview was approximately one-hour in length. Several days after the initial interview a half-day observation and a follow-up interview were conducted. The purpose was to clarify any ambiguities from the initial interview and to allow each TC an opportunity to expand upon their initial responses. A second, half-day observation was scheduled after the follow-up interview.

Subsequent to the second half-day observation a summary of the interview notes were sent to each participant for validation.

Secondary Participants Interviews took place after the initial interview with the TC. Each secondary participant received the interview questions prior to the interview. The purpose of these half-hour interviews was to learn how the TC interacts with their colleagues and their perceptions of the TC's role in the educational environment. The teachers and the media coordinators/specialists were asked the same questions while the administrators were asked two additional questions regarding the TC's responsibilities.

The information gathered from the interviews was recorded, synthesized, interpreted and sent to the corresponding study participant for validation purposes.

Observations

After the initial interview, each TC was shadowed for two half-day sessions. After each half-day

shadowing, observation notes were synthesized and sent to the TC for comment.

Documents

During the initial interview, each TC was asked for a copy of their official job description and any other material that would provide insight into their responsibilities (such as promotional materials for the school). Only the two district TCs had official job descriptions. Both of these descriptions listed a variety of activities and responsibilities. The brief descriptors were combined into a list of 20 descriptors (see table A). Each of the TCs and administrators were asked to determine which of the tasks the TC is responsible for and to rank the top five.

Analysis

The investigator's write-ups of the teacher interviews were sent to each respective teacher for comment. All but two teachers returned the investigator's write-ups. The corrections the investigator received were confined to the spelling of names and clarification of titles.

Once the majority of the respondents' comments on the write-ups were received, data from each of the sources and data gathering methods were coded. The Constant Comparison Method was used to code the data. The coded data was then analyzed for trends, relationships, and linkages between the codes. The trends were then synthesized and an expert in the field commented on the synthesis. A copy of the final write-up was sent for comment to each TC.

Results

Document Analysis

Table A lists the combined job descriptors for the two job descriptions provided by the participants. The columns next to the descriptors are the respondents' rankings for each descriptor with the TC listed first and the TC's supervisor immediately following. The numerical rankings are as follows. The most important descriptor is assigned a value of 1, the second a 2, and so on up to 5. An X indicates that the job descriptor is considered a part of the TC's job but was not considered one of the top 5 descriptors. A blank indicates that the respondent did not consider the job descriptor as part of the TC's job.

Table A: *Perceived Job Descriptors Document*

| Descriptor | School | | District | | | |
|---|--------|----|----------|----|---|----|
| | 1 | 1a | 2 | 2a | 3 | 3a |
| Supervises and maintains operation of voice, data, video, and other technology systems. | 2 | 1 | X | X | 1 | X |
| Advocates technology utilization, awareness, and assists building technology committees. | 5 | X | 2 | 2 | 2 | 5 |
| Services and maintains related technologies and the wired infrastructure of the schools. | X | X | | X | X | |
| Maintains the school's on-line bulletin board services. | X | | | X | | X |
| Formulates and monitors, with the technology committee, a vision and a plan for technology implementation. | X | 3 | X | 1 | 4 | X |
| Coordinates distance learning activities. | | | | | X | X |
| Coordinates, evaluates, and recommends software purchases and replacement. | X | 5 | X | X | 3 | X |
| Maintains an inventory of technology for school computers. | X | X | X | X | X | |
| Plans and supervises technology maintenance. | X | X | X | | X | 3 |
| Plans and provides staff development and training opportunities a.) Assists teachers with hardware and software problems. b.) Trouble shooter and repair technician when appropriate. c.) Assist the teachers in optimizing the integration of technology and instruction. | 3 | 2 | 4 | 4 | 5 | 1 |
| Develops and monitors specifications for technology purchases. | X | X | 5 | 3 | X | X |
| Trouble shooter and repair technician when appropriate. | 1 | X | X | | X | X |
| Management of vendor relationships, including maintenance, hardware and software upgrades and ongoing development work with the system users. | X | X | 1 | 5 | X | X |
| Other duties as assigned by the superintendent or his designee. | X | X | X | | X | |
| Plan offerings for xxx schools adult education concerning technology. | | | X | | X | |

| | | | | | | |
|--|-----|---|-----|---|-----|---|
| Assist in development of building office automation plans. | X | | X | | | |
| Disseminate info. about new tech., software, meetings, and classroom apps. of comps. to appropriate personnel. | 4 | 4 | X | X | 2 | X |
| Realize latest technologies and their educational applications by attending conferences, workshops and meetings. | X | X | 3 | X | X | 2 |
| Participate in state and national professional associations and encourage participation of other district personnel. | X | X | X | X | X | 4 |
| Disseminate info. about technology usage in xxx schools to parents, community members, students and faculty. | X | | X | | X | X |
| Agreement within school or district | 83% | | 58% | | 73% | |
| Agreement across district | 50% | | | | | |

Interview Results

The following are the summaries of *all* of the interviews that were conducted.

Professional Development and Communication Skills The TC needs to freely provide information/instruction to others and not withhold information. The comfort level of the community improves as they receive more information and instruction. As one participant stated “the TC needs to be able to share (their) knowledge and empower others to become competent technology users.” Additionally, the TC needs to communicate and interact with people on a variety of levels and they need to be approachable and friendly so that everyone is comfortable seeking their assistance and training.

Well Versed in Technology and Education The majority of the interviewees stated that the TC needed to be well versed in how the school’s technological systems operate, as well as how people within the systems operate. With a solid understanding of these systems, the TC will be able to succeed in maintaining and operating the technology.

One administrator noted that “while school corporations might want to move the Technology Coordinator’s responsibilities away from working on technical aspects and more towards curriculum integration, it is a difficult task because many Technology Coordinator’s salaries come out of the capital project funds, which requires that they work on maintaining the school corporation’s hardware/software.” Another person noted, “while the district wide Technology Coordinator excels in integrating technology into the curriculum, she still spends a large portion of her time working on the upkeep and trouble-shooting of the technology.” This is mainly due to the way the technology support system is set up. It forces people in the school system to call upon the district-wide TC for technical maintenance.

Stressful job Many of the interviewees indicated that the TC’s job could be very stressful due to the wide variety of technologies and wide range of people with whom they interact. They need to be flexible in order to “switch gears” due to the nature of the job and the wide-variety of responsibilities. For instance, one person stated “the TC is the person that the teachers and staff go to for assistance with technology, ranging from resources to equipment requests, or training.”

To deal with the stress of the job some interviewees emphasized the ability of the TC to prioritize their responsibilities so that the most immediate needs are served first. One interviewee stated “they are being asked a question on a different topic every ten minutes.” Another stated the TC “needs to be on call to assist teachers when there are problems.” Many of the interviewees stated that it is important for the TC to refer questions and/or requests to others. Not all of the technology problems need to be solved by the TC personally. The belief is that if the TC is flexible and delegates tasks then their workload will become manageable.

Office locale Many interviewees stated that it was important to have access to the TC at all times to solve problems as they arise. Some felt that a key element to properly integrating the technology into the classroom is to have the person responsible for the integration of the technology become an active participant in that environment. Thus, it is important to locate the coordinator’s office in the same building if possible. Additionally having the TC in the same building opens the lines of communication. Having the TC's office within close proximity allows the school to capitalize on their skills to a greater degree than a school that does not have easy access to the coordinator.

Visionary There were a few interviewees who stated that the district wide TC is a "visionary" who plans for future technologies within the educational environment. These plans include technology investments as well as plans for adapting the technology to keep it current.

Observation Results

Observations See Appendix A for illustrative transcripts of two observations. The number of transcripts presented in the appendix has been limited to conserve space. Pseudonyms are used to maintain anonymity.

Technology The TCs are responsible for a wide range of technologies. They included video retrieval, voice systems and computer systems (hardware and software, instructional and administrative). The software included: attendance, communication, productivity and instructional software.

Discussion

The following summarizes one of the themes that grew out of our study.

"We weren't trained to work on technology, we were trained to educate. We need to get back to that-- spending the majority of our time to work with education rather than the majority of the time working on the equipment." District Technology Coordinator

It was apparent from the results of the job description analysis and the interviews that all of those involved in the study believed that the primary responsibilities were to assist teachers with integrating technology into the curriculum and be responsible for the maintenance of the school environment's hardware and software.

Job descriptions As discussed in the results section, the TCs and administrators could agree on only one out of the 20 constructs that could be considered to be one of the TC's top five responsibilities. This construct is: "Plans and provides staff development and training opportunities a) assists teachers with hardware and software problems, b) trouble shooter and repair technician when appropriate, and c) assist the teachers in optimizing the integration of technology and instruction." This description incorporates both technology integration and responsibility for repairing and trouble-shooting technical problems.

A second construct that all but one of the TCs and administrators rated among the top five priorities was, "advocates technology utilization, awareness, and assists building technology committees."

It was clear from the job descriptions that the primary responsibilities of the TCs within and across communities are ensuring that the hardware and software is operational and PD. This was also consistently evident during the interviews and observations.

However, when it came to agreement within the educational community regarding the overall responsibilities, there did not appear to be much agreement between the TC and the supervisor (83%, 58%, and 73% agreement respectively). Furthermore there was only 50% agreement across the two school districts. This indicates that while there is agreement in regards to the primary responsibilities, the expectations for secondary responsibilities are not clear within or across educational environments.

Perceptions Everyone interviewed stated that the TC needs to be able to solve technical problems but they also need to be able to teach others how to use the technology in an educational setting. PD was perceived to be a very important part of the TC's job. This perception is consistent with the findings of the job descriptions. However, there seemed to be a disconnect between these responsibilities and how coordinators spent their time.

During the interview portion of the study only one TC agreed with their administrator on what their job description was. This TC didn't have an official job description. The unwritten yet commonly understood description was that the TC "...would be responsible for anything that has a bell, button or buzzer on it." However, when asked to rank the job descriptors this TC and supervisor achieved 83% agreement. The other two TCs had wide variance between the perceptions of the administrator and the TCs with regards to their responsibilities. Without a clear definition of what the TC is expected to do, there is a greater likelihood for coordinators to focus on only the most glaring problems first and then tend to other responsibilities when time allows. This was rather apparent during the observations.

Another cause of conflict is a question of the funds for which the TC's salary is paid. In two of the

schools the TC's salary was paid out of the capital projects fund, which is the fund for the maintenance and upkeep of the school building, furniture and equipment--including technology. In these instances it was necessary that the TC spend the majority of their time on the maintenance and upkeep of the technology. A problem arises when the TC is expected to assist with the integration of the technology into the curriculum. Every participant in the study indicated that integration was expected of the TC.

Wide Variance in Clients Abilities and Needs Throughout the observations and the interviews it was apparent that the TC had to work with a wide range of people. They assisted teachers who varied with regards to their technical skills, students, administrators, secretarial staff, parents and other members of the community.

Problems Associated with Being "On Call" The TCs stated that they needed to be able to quickly solve problems when a technical "emergency" arises. This idea was also stressed in the interviews with the TC's colleagues. There was an emphasis on the idea that the technology needed to be operational in order for it to be used--if it does not work no one can use it. As one interviewee stated, if the technology is unstable the staff will not use it because it will cause them to lose their "faith in the technology." It is unlikely that anyone would argue against the idea that the technology needs to be stable and operational. The concern is when the TC has to determine when maintenance takes priority over PD or another curriculum related responsibility.

Observations indicated that the TCs day was fragmented. People were constantly stopping by the office or stopping the TC in the hall to ask questions. Some of these questions did not need to be answered immediately but because the TC was "accessible," individuals asked questions regardless of what the TC was engaged in at the time. Additionally, it is important to note that the TCs thrived on being able to solve problems as they arise. Each appeared to be very good at what they do and appeared to have an excellent rapport with those with which they worked. These were important characteristics that were noted in the interviews. While the TC's day was fragmented due to issues associated with being "on call," one TC was observed preparing for a PD activity and another conducted a training session for members of the Chamber of Commerce.

In addition, each of the TCs developed coping mechanisms for their fragmented day, such as requiring individuals to send their questions or requests via e-mail. Or, establishing a "response tree," where a teacher with advanced technology skills is the first point of contact, then the TC. While these techniques are effective to a degree, there are those who would prefer to work directly with the TC. The interviews made it clear that the expectation was that the TC needed to be "on call" in order to answer questions and solve problems. Also based on the observations there were enough interruptions in the TC's day to make it difficult to spend a reasonable amount of time on technology integration projects.

Office locale The physical location of the TC's office seems to have an impact on how many interruptions or requests they have during the day. One TC's office was in a large room in the back corner with their assistants' desk directly off the entrance to the main room. The assistant served as a gatekeeper for the coordinator. She took care of the computer lab scheduling, answered some of the walk-in traffic questions, answered phone requests and during her spare time she evaluated educational software. The TC was still interrupted however the interruptions were minimal as compared to the other two TCs, who did not have gatekeepers. The other two TCs' offices were in high traffic areas and they did not have a person who served as a filter for technology questions. Each of these coordinators indicated that their offices were going to be moved soon to a locale that has lower walk-in traffic. Each was looking forward to their move because they felt that it would afford them more time to work on educational activities.

Responsibility for Technology The simple fact is that the more technology that the TC oversees the greater likelihood that they will spend their time maintaining, repairing or upgrading. As noted in the results section, each of the TCs had a large variety of software and equipment for which they were responsible. A large quantity and variety of technology can influence the amount of time that the TC has to spend on maintaining the technology rather than on curriculum integration.

Conclusion and Recommendations

The purpose of this research is to determine if there is a disconnect between what TCs are expected to do and what they actually do. This is one inquiry in the greater pursuit of efficient and effective utilization of technology in educational environments. The results of this exploratory case study indicate that the primary responsibilities for TCs are to integrate technology into the curriculum and to be responsible for the maintenance and upkeep of the school/district's hardware and software. There wasn't much agreement amongst

the participants within or across educational communities, regarding other responsibilities and the expectations for attaining these primary responsibilities. Additionally, the reality of the job appears to indicate that the majority of the TC's time is spent on the maintenance and upkeep of the school/district's hardware and software, leaving a small portion of their time for technology integration projects.

Clear job descriptions need to be developed to match the needs of the educational environment. These job descriptions need to be dynamic to meet the ever-changing needs and technical skills of the TC's educational community. Additionally, this job description needs to match the TC's end-of-year evaluation criteria, which should be dynamic as well. Both the job description and the end of year evaluation should be reevaluated every year or two and revised as necessary to meet current needs.

There are several things that need to be taken into consideration before these job descriptions can be identified. There needs to be a clear vision within the school of what it means to integrate technology into the curriculum. Additionally, it needs to be clear whom the TC primarily supports (ie, teachers, students, administrators, etc.) and their skill level.

The job description of the TC needs to take into account the amount and variety of technology that the coordinator is responsible for and the skill levels of the teachers and students. As technology is added to the school system the job description needs to be modified to account for the change. Finally, the source of TC's salary needs to be clear as it may determine the nature of the tasks that the TC can perform.

The TC's job description should be based on the unique needs of the educational community in which they serve. This means that there are going to be different job descriptions for different TCs. Thus, there should be variance in expectations across education communities in regards to the responsibilities of TCs.

In order to assist the TC with meeting the expectations of their job it is important to schedule time into the daily routine of the TC when they do not work on anything but curricular tasks. The TC needs time when they are not "on call" so that they can be guaranteed uninterrupted time for work with curriculum integration. This time needs to be equivalent to "planning periods" for teachers and it needs to be "advertised" amongst the school community.

The job description of the TC should be widely disseminated within the educational community, as well as, the time periods that are set aside for the TC to work on specific responsibilities. Clear, dynamic job descriptions and dedicated time for TCs for working on PD will aide in effective and efficient use of the technology.

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Appendix A: Observation Results

Excerpt from one District TCs. We are in the computer lab and the server just crashed.

1:47. Machine that is copying the CD to the network stopped running. Message on the screen read "general failure reading drive." Kathy makes a phone call "this is (Kathy) could you tell (the media coordinator) to reboot the lab server? (Listening) ok." She hangs up the phone. Kathy turns off the remainder of the machines. Stating "this is so aggravating. I'll do this another day. They're locked up totally."

Technician (T): I tell you what--once they get the server restarted we could try again.

Kathy (K): I've got a meeting, I can't.

T: Well, just get it started and I'll check on it later.

K: OK... Well let's just wait the server's been crashing a lot lately. The service person's coming out to work on the problem. We've at least got the 256 colors working.

T: You've got my beeper number. Technician leaves.

1:50. Phone rings. Kathy picks up the phone. "This is [Kathy] (listening) you are kidding! (Listening) ok! (Listening) we're doing the Internet with the chamber of commerce tomorrow morning. (Listening) Ok, I'll be right there." Kathy looks at me and says, "the server won't come back up" Kathy grabbed her box and we left the computer lab.

1:57. We stopped in office to drop off the box. Someone in the office asks Kathy if she could get a Word Processing manual from her. She responds and then asks for envelopes to put the materials in the box in.

2:00. We leave the office and head towards the media center to check on the server. She gives me a newsletter that she has written up and explains that she has a lot of friends in the district and they are now starting to ask her to come to their home and assist them with their equipment. She worked on three machines last week. She brought this up to the administration and they said that she should start charging them, which she did. She flipped through some of the mail that she picked up at the office. As we turn the corner towards the media center, the technician is waiting in the hallway for us.

Technician: The server can't find its name and the hard drive is making galloping sounds. It's not finding the system.

Kathy: This is serious isn't it?

Technician: yep.

The technician then reboots the machine and asks Kathy to listen closely to the hard drive.

Kathy: I'm gonna call AmeriData. What's it say? "system not mounted." I'm gonna tell him this is serious big time serious.

We walk over to her office that is the next hall over. She goes behind her desk and picks up the phone. She looks at me and says "and, this is just one building. This building is a full-time job in itself. It really is!" She then calls AmeriData--gets an answering machine and leaves a message, "this is Kathy from xxx that server has really crashed. I'll be in a meeting at guidance now you could call there and talk to me. From 3:45-5 I'll be at xxx you could call me there the number is xxxxx or you could call me at home this evening the number is xxxxx. The server can't find its name and it's unable to mount the system. I need to know if this could be fixed because I might have to reschedule a meeting for tomorrow morning." She made a phone call to another place there was no answer. Then she called someone else and left a message stating the problems with the server. And, called yet another person who teaches adult education classes in the evening using the computer lab and left a message with him.

Excerpt of School Technology Coordinator walking into his office

9:55 As soon as we walked in to Rich's work area his assistant said that we had to go back to the principal's office. He just called. So, we turned around and we headed back to the main offices.

9:56 On our way out a woman stopped Rich asking for help. She lost her E-mail. He told her he would stop by after he helped someone else.

9:57 Then as we got a little farther two other people meet up with Rich in the hallway, stating that he was exactly the person they wanted to see. He deferred their questions to his assistant.

Exploring the Presentation and Format of Help in a Computer-Based Electrical Engineering Learning Environment

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Abstract

This study investigated whether it was more beneficial to provide the learners in computer-based learning environments access to on-demand (self-regulated) help after they committed an error in problem solving or for the learning environment to externally regulate the presentation of instructional help. Furthermore, two different presentational formats—textual and pictorial—of instructional prompts were examined. This study was conducted with a computer-based learning environment that introduced high school students without any prior content-specific knowledge to the principles of parallel and series electrical circuit analysis. We found that textual prompts facilitated problem solving statistically significantly better than pictorial prompts. Moreover, the learners provided with externally regulated prompts reported statistically significantly more positive attitudes toward the prompts than learners in the self-regulated conditions. Finally, the continuing motivation was statistically significantly stronger in learners who viewed textual prompts than in their counterparts in the pictorial prompt groups.

Introduction and Related Work

The computer-based instruction of electrical circuit analysis techniques has received a significant amount of interest over the last fifteen years, (see for instance Coulon, Forte & Rivera, 1993; Hanrahan & Caetano, 1989; Yoshikawa, Shintani & Ohba, 1992). A wide variety of computer-based instruction and tutoring systems with the aim to teach circuit analysis techniques and to provide opportunities for practicing circuit analysis have been developed and evaluated. Many of the developed systems interact with the learner to aid in imparting the knowledge of the circuit analysis techniques and to provide feedback on learner input to practice problems. In the case of incorrect solutions the feedback is oftentimes accompanied by instructional prompts (help). These learner-program interactions are in the form of text and/or graphics and are controlled (presented) by the learner or the system. The impact of both the format and the control (presentation) of the instructional prompts in circuit analysis tutoring systems have not been previously examined in detail. This study extends the existing literature on computer-based instruction of electrical circuit analysis in that it examines the impact of the presentation and the format of the instructional prompts in electrical circuit tutoring systems.

Schnackenberg, Sullivan, Leader, and Jones, (1998) provide an extensive overview of different studies on the control approaches up to their time of writing. More recently, Brown (2001) found that leaving the navigation of computer-based training to the learner tends to interfere with the instructional integrity of the learning environment, which is counterproductive. Schnackenberg et al. (1998) found that with learner control, the learners tend to skip practice examples, which tends to negatively affect learning. In the context of the highly structured content domain of the present study, namely electrical circuit analysis techniques, it appears that program controlled instructional design and navigation would be beneficial (Lawless & Kulikowich, 1998). Furthermore, program control might be especially advantageous for learners with low levels of prior knowledge in the domain area (Shin, Schallert & Savenye, 1994). Against this background, it is reasonable to assume that both subject-matter novices as well as technology neophytes should benefit from a program-control design.

Overall, the issue of learner vs. external control has so far been primarily investigated in the context of navigating the instructional and/or practice material. We are not aware of a study on the impact of learner vs. external control of the *provisioning of instructional prompts* within a given practice problem, which is the focus of this study.

How should the highly structured content on circuit analysis techniques be presented to learners in order to foster their initial knowledge acquisition and to introduce them to structured, algorithmic problem solving associated with electrical circuits? One theoretical approach that offers some guidance in this area is cognitive load theory, which provides the general guideline that the limited capacity of the working memory has

to be taken into account when designing an instructional module. One empirically validated instructional approach that is particularly well-suited to accommodate the limited capacity of learners is the use of worked-out examples. Specifically, research suggests that worked examples, consisting of problem formulation, individual solution steps, and final solution, foster initial learning of highly structured subjects such as algebra in Sweller and Cooper (1985) or statistics in Atkinson, Renkl and Merrill (2003).

Two important factors found to influence the degree of learning associated with worked examples are their structure in Atkinson, Derry, Renkl and Wortham (2000) and the presence of self-explanation activities during example processing as in Chi (2000). One way to classify the structure of the worked examples in interactive learning environments is by the relationship to accompanying practice problems. For instance, presenting a fully solved example followed by a practice problem that requires the learner to independently solve all problem subgoals (steps) is called *example-problem* design. In contrast, in a *problem-example* design, the learner first encounters a practice problem and is subsequently presented with a fully worked example. In the fading approach, the learner is initially presented with a fully worked example and in the next example all but one of the problem subgoals are worked out and the learner is required to independently solve (anticipate) the solution of the missing problem subgoal. In the subsequent example all but two problem subgoals are worked out and the learner is required to anticipate the solutions to the two missing problem subgoals, and so on, until the learner is required to anticipate the solutions for all problem subgoals (independent problem solving). This fading design comes in two types: *forward-fading*, where the solution steps are omitted starting with the first problem subgoal, and *backward-fading*, where the last solution step is omitted first, then the last two, and so on. Recent studies found indications that fading, especially *backward-fading* has a positive effect on learning (Renkl, Atkinson & Grosse, 2004). Backward fading is therefore employed throughout this study.

In summary, we note that the usage of the pictorial and textual presentation formats of the instructional content and the implications for the cognitive load have been evaluated by several research groups. The influence of pictorial or textual *instructional prompts* in interactive learning environments with fading, however, has not yet been studied in detail. It is interesting and important to understand the impact of pictorial vs. textual prompts on the learner's performance as well as the impact on the learner's motivation. At the same time it is worthwhile to study these effects in conjunction with learner vs. external control (presentation) of the prompts.

Study Methodology

The present study manipulates two independent variables, namely the *presentation* (external vs. self regulated) and *format* (pictorial vs. textual) of instructional prompts. The study addresses the following research questions:

- What is the effect of the different presentation and format of instructional prompts on the learner's performance?
- What are the attitudes of the learners toward the different types of presentation and format of the instructional prompts?

Participants and Design

The participants in this study were 51 students from a small charter high school in the Southwest. The participants were recruited from a regularly scheduled computer class. The experimental sample consisted of 26 females and 25 males. The grade level of the participants ranged from eight to twelve (2 eighth-graders, 8 ninth-graders, 15 tenth-graders, 18 eleventh-graders, and 8 twelfth-graders). The participants had a mean grade point average of 3.02 ($SD = .84$) and had not been exposed to formal instruction on electrical circuit analysis techniques before participating in this study.

Participants were randomly assigned to one of the four experimental conditions as defined by a 2 x 2 factorial design with presentation (external vs. self regulated) and format (pictorial vs. textual) of instructional prompts as factors. The resulting conditions were: (1) self-regulated textual prompts, where participants could exercise control over the use of text-based instructional prompts (textual descriptions), (2) externally regulated textual prompts, where the computer program automatically provided textual prompts, (3) self-regulated pictorial prompts, where participants could exercise control over the use of prompts (diagrams), and (4) externally regulated pictorial prompts, where the computer program automatically presented pictorial prompts.

Pencil-Paper Materials

The participants were administered a set of pencil-paper materials consisting of a demographic questionnaire, a pretest, an overview of parallel and series electrical circuits, a posttest, and an attitude survey.

Demographic Questionnaire

The questionnaire collected basic demographic data (grade level, gender, ethnicity), as well as the participants' GPA and standardized test scores (Arizona Instrument to Measure Standards (AIMS) or Stanford 9 math and reading scores). The questionnaire also asked the participants whether they had ever learned about electrical circuit analysis before.

Pretest

The pretest was designed to assess the participants' prior knowledge in the area of electrical circuit analysis. It was composed of six multiple-choice questions relating to the basic physical meaning of electrical current, voltage, and resistance and elementary properties of electrical circuits. The participants could select from four response choices for each question.

Introductory Overview

The four-page overview of parallel and series electrical circuits introduced the participants to (i) the physical meaning and units of electrical current and voltage, (ii) electrical circuit elements and their graphical representations, such as light bulbs and batteries, and the way circuit elements are connected with wires in the two main forms of electrical circuits, namely parallel and series circuits, (iii) the physical meaning and units of resistance as well as Ohm's Law, (iv) the calculation of the resistance of a parallel circuit, and (v) the calculation of the resistance in a series circuit. These last two sections on calculating the resistance of series and parallel circuits were not focused on deriving the formulas for calculating the total resistance of the circuit from the resistance values of the individual circuit elements (i.e., $R_{tot} = R_1 + R_2 + \dots$ for series circuit and $1/R_{tot} = 1/R_1 + 1/R_2 + \dots$ for parallel circuit).

The instructional goal was not to teach the participants to use these formulas. Instead the participants were taught to calculate the total resistance from basic principles, namely Ohm's Law and the properties of current and voltage in the electrical circuits. In particular, for the series circuit, the participants were presented with the resistance values of the individual resistors in the circuit and with the value of the current emitted by the battery into the circuit. The participants were then instructed to proceed in the following three steps in the calculation of the total resistance of the series circuit. First, the participants studied that the current flowing through each of the circuit elements is equal to the current emitted by the battery and the calculation of the voltage over each individual resistor is done using Ohm's Law. Second, the participants were shown examples where the calculation of the total voltage over the series arrangement of resistors is carried out by summing up the voltages of the individual resistors. Third, the examples presented the calculation of the total resistance of the series circuit by applying Ohm's Law to the entire circuit, i.e., the calculation of the total resistance of the series circuit as the sum of the voltages determined in step 2 divided by the current emitted by the battery. For the parallel circuit, an analogous solution strategy was presented.

Posttest

The posttest contained eight complex problems, more specifically, four problems (two for each type of the electrical circuits, parallel and series) to measure the performance on near transfer and four problems (two for each type of the electrical circuits, parallel and series) to assess the far-transfer learning.

The near-transfer problems had the same underlying structure but different surface characteristics from the practice problems encountered during the learning (computer) phase. They required the participants to perform the same tasks (e.g., calculating the individual voltage or current respectively, determining the total voltage or current respectively, and finally computing the total resistance) as they learned in the computer-based module. Despite having the same structure and requiring the same solution steps as the practice problems from the learning phase, the near-transfer problems appeared different since they had different cover stories and current, voltage, and resistance values.

The far-transfer problems had different underlying structure and surface features as compared to the computer-based practice problems. In particular, in the far-transfer series circuit problems the participants were given the individual resistance values and the voltage over one of the resistors. The far-transfer series circuit

problem asked the participants to calculate the battery voltage. To solve this problem, the participants had first to use Ohm's Law to calculate the current in the series circuit from the resistance value of the one resistor for which the voltage was given. The participants then had to notice that the current is the same in all resistors and had to calculate the voltages over the other resistors in the circuit from the current determined in the first step and the values of the individual resistors using again Ohm's Law. In the third and final solution step, the participants had to sum up the voltages over the individual resistors to obtain the total voltage (battery voltage) over the circuit. The far-transfer parallel circuit problems were structured analogously.

Attitude Survey

A 14-item attitude survey was used to collect data on participant attitudes and motivation. The survey pertained to the overall effectiveness of the computer-based program, the format of the instructional prompts, and participant continuing motivation. The individual items were five-choice Likert-type questions. The response choices were assigned ratings of strongly agree, agree, neither agree nor disagree, disagree, and strongly disagree. The attitude items were grouped into three categories, namely instructional effectiveness (7 items), role of instructional prompts (4 items), and continuing motivation (3 items).

Computer-Based Learning Environment

The module was developed using Director MX (by Macromedia, Inc. (2002)) software, which is an authoring tool for creating rich multimedia programs. The module was programmed to operate in one of four modes that corresponded to the four experimental conditions of the current study.

The goal of the computer-based learning environment was to deliver instruction on the principles of calculating resistance in parallel and series electrical circuits. The aim of the program was to present worked (solved) examples to the participants and to scaffold their learning by progressively reducing the number of worked solution steps and increasing the amount of independent problem solving by the participants. The environment presented two sets (parallel and series) with four problems each, constituting a total of eight problems. The following is the cover story from one of the instructional examples that were shown to the participants on the computer screens during the learning phase:

To operate an aquarium you wire the pump with a resistance of $R_p = 20 \text{ W}$ and the aquarium light with a resistance of $R_l = 40 \text{ W}$ in parallel. You connect this parallel circuit to a battery with a voltage of $V_b = 5 \text{ V}$. What is the total resistance R_{tot} of this parallel circuit?

Each problem had exactly three solution steps. Each step was clearly labeled and visually distinguished from the other steps. The computer module revealed one step at a time after the participants clicked the "Next" button, thus allowing the participants to control the pace of their learning. The participants proceeded through the module by clicking on the "Next Problem" buttons after inspecting all three steps in each problem. The navigation was linear and the participants could not return to previous steps and problems once they finalized their answers.

The first problem in each of the sets of four problems was fully solved (worked), whereas in the subsequent problems the worked steps were backward faded and the participants had to anticipate the correct solution to the missing steps. Specifically, the participants had to independently solve one step (the last one) in the second problem of each set, two steps (the last two) in the third problem of each set, and were responsible for independently solving all three steps in the last problem of each set.

In the case of incorrect anticipation, the computer-based learning environment offered an instructional prompt that was either externally regulated or requested by the participant, depending on the treatment condition. Participants in the externally regulated groups were always presented with the instructional prompt if they made a mistake while solving the individual steps. On the other hand, the decision to view the instructional prompts was solely at the discretion of the participants in the self-regulated conditions. They were offered the option to receive the instructional prompt but could refuse the help.

The instructional prompts were presented in two different formats, depending on the treatment condition. In the textual-based prompt groups, the prompts were verbal reminders of Ohm's Law and the properties of currents and voltages in series and parallel circuits. These reminders were tailored to the individual problem steps. The pictorial-based prompts were presented as drawings illustrating the current flow and voltages in series and parallel circuits, as well as Ohm's Law tailored to the individual problem step.

Once the request for the instructional prompt was entered, the prompt appeared on the screen next to the solution step that needed to be solved. The participants were given two attempts at solving each missing

step. The correct solution was then displayed on the screen. The solved steps remained visible on the screen after the final answer was presented, allowing the participants to study the entire solution (worked example).

Procedure

Groups of 8 to 15 participants attended one of the five scheduled experimental sessions. The average duration of each session was approximately 60 minutes. The participants took part in the study in a computer lab in their high school. Each participant was seated in front of a Windows-based desktop computer. The experimenter instructed the participants to work independently of their peers. The participants first filled in the demographic questionnaire. Next, they answered the pretest. The participants proceeded to study the introductory overview on electrical circuits. After studying the introductory instructional text the participants worked through the problems in the computer-based learning environment. During this phase the experimental variation took place. Immediately after completing the computer-based instructional program the participants were administered the posttest. Finally, they indicated their responses on the attitude survey. Each participant completed this entire procedure in one session.

Scoring

The participants' performance on the pretest, practice problem solving during the computer-based instruction, and the posttest (near- and far-transfer problems) as well as their responses to the attitude survey were scored. The computer-based learning module automatically recorded the en route practice (accuracy of solving the missing steps) and time on the computer. The maximum pretest score was 6, one point for each correctly answered multiple-choice question. There were a total of 12 unsolved steps in the computer-based learning environment. The participants were given two attempts at solving each of the 12 unsolved steps. For each correctly solved step, one point was awarded, thus producing a maximum score of 12 for each of the solving attempts, i.e., the first and second anticipations. (A score of zero was assigned for the second anticipation if the first anticipation was correct.) The individual scores for each of the anticipations were summed and divided by 12 in order to obtain the proportion of problem steps that were correctly solved on the first/second anticipation. The values for the first and second anticipations ranged from 0 to 1. The eight posttest problems had three distinctive solution steps each, thus resulting in a maximum score of three points for each problem, equaling to a maximum total score of 24 (12 points each were associated with the performance on the near- and far-transfer problems, respectively). On the attitude survey, a rating of strongly agree received a score of 5, agree a score of 4, a rating of neither agree or disagree equaled to 3, disagree was scored as 2, and a rating of strongly disagree received a score of 1.

Data Analysis

There was no significant difference in the pretest scores between the participants randomly assigned to the textual and pictorial prompts groups $F(1,47) = 1.70, p = .20$. Similarly there was no significant difference in the pretest scores between the participants randomly assigned to the self-regulated and externally regulated prompts groups $F = .01, p = .94$. The near transfer and far transfer posttest scores were analyzed using 2 (Prompt Format: Textual and Pictorial format) x 2 (Prompt Presentation: Self-regulated or Externally regulated) x 2 (Posttest Problem Type: Near-transfer and Far-transfer posttest scores) analysis of variance (ANOVA). Prompt format and prompt presentation were between-subjects variables in the analysis and posttest problem type was within-subjects variable. En route data on performance on practice problems in the computer-based learning environment was also collected and analyzed. Attitude data were analyzed using 2 (textual or pictorial format of prompts) x 2 (self or external presentation of prompts) x κ (number of attitude items for each of the three item categories: overall effectiveness of instruction ($\kappa=7$), effectiveness of prompts ($\kappa=4$), and continuing motivation $\kappa=3$) multivariate analyses of variance (MANOVA).

Results

Achievement

The unadjusted mean scores and standard deviations for each treatment group on the near- and far-transfer posttest problems are shown in Table 1.

Table 1: *Posttest scores by format and presentation of prompts.*

| Measure | Format of Prompts | | | | Presentation of Prompts | | | |
|---------------|-----------------------------|-----------|-------------------------------|-----------|--------------------------|-----------|------------------------------|-----------|
| | Textual (<i>N</i> = 24) | | Pictorial (<i>N</i> = 27) | | Self (<i>N</i> = 24) | | External (<i>N</i> = 27) | |
| | <i>M</i> | <i>SD</i> | <i>M</i> | <i>SD</i> | <i>M</i> | <i>SD</i> | <i>M</i> | <i>SD</i> |
| Near Transfer | 9.08* | 2.29 | 6.89 | 3.70 | 8.54 | 3.24 | 7.37 | 3.26 |
| Far Transfer | 1.04 | 1.40 | 1.00 | 1.18 | 1.29 | 1.43 | .78 | 1.09 |

* *p* = .01

An ANOVA revealed that there was no significant difference between the two levels of the presentation factor (self vs. external regulation) on the overall posttest total, *F* ratio $F(1,47) = 3.43$, mean square error *MSE* = 11.20, significance level *p* = .07. There was a statistically significant difference when comparing the two different formats of prompts (pictorial vs. textual). Specifically, on the near-transfer posttest, participants presented with text-based instructional prompts scored significantly higher, achieving a mean score of 9.08 (76%), than their counterparts provided with pictorial-based prompts, who achieved a mean score of 6.89 (57%). This difference on the near transfer posttest scores was statistically significant $F(1,47) = 6.50$, *MSE* = 9.69, *p* = .01. Cohen's *f* statistic for these data yields an effect size estimate of .37 for the near-transfer posttest problems, which approaches a large effect. This advantage did not, however, extend to the performance on the far-transfer items. Finally, there was no significant interaction between the two factors.

Practice

The performance on en route practice problems was analyzed using 2 (textual or pictorial format of prompts) x 2 (self or external presentation of prompts) analysis of variance (ANOVA). The proportions (accuracy) of correctly solving the unsolved practice problem steps at the first and second attempt are presented in Table 2.

Table 2: *Accuracy of practice problem solving by format and presentation on prompts*

| Measure | Format of Prompts | | | | Presentation of Prompts | | | |
|---------------------|-----------------------------|-----------|-------------------------------|-----------|--------------------------|-----------|------------------------------|-----------|
| | Textual (<i>N</i> = 24) | | Pictorial (<i>N</i> = 27) | | Self (<i>N</i> = 24) | | External (<i>N</i> = 27) | |
| | <i>M</i> | <i>SD</i> | <i>M</i> | <i>SD</i> | <i>M</i> | <i>SD</i> | <i>M</i> | <i>SD</i> |
| First Anticipation | .93* | .08 | .82 | .13 | .86 | .14 | .88 | .11 |
| Second Anticipation | .05 | .07 | .13* | .09 | .09 | .09 | .09 | .08 |

* *p* < .01

The participants in the textual prompts groups solved on average 93% of the unsolved problems steps, i.e., 11.16 out of the 12 unsolved steps, at the first attempt, whereas the participants in the pictorial prompts group solved 82% of the unsolved steps at the first attempt. The ANOVA revealed that this difference corresponds to a significant main effect on first anticipation for format of prompts, $F(1,47) = 12.00$, *MSE* = .01, *p* < .01. The differences on accuracy of anticipations on the first anticipation between the self and external approach to presentation of prompts were non-significant as was the interaction between presentation and format of instructional prompts. There was a significant main effect for format of prompts on the second trial of solving practice problems. In particular, the participants who received pictorial-based prompts had a significantly higher probability of accurately solving the practice problems on the second trial as compared to participants who were assigned to the text-based prompts groups, $F(1,47) = 12.77$, *MSE* = .01, *p* < .01.

Table 3: *Participant attitude scores by format and presentation of prompts*

| | Format of Prompts | | | Presentation of Prompts | | |
|--|-----------------------------|-------------------------------|----------|--------------------------|------------------------------|----------|
| | Textual (<i>N</i> = 24) | Pictorial (<i>N</i> = 27) | <i>F</i> | Self (<i>N</i> = 24) | External (<i>N</i> = 27) | <i>F</i> |
| | <i>M</i> | <i>M</i> | | <i>M</i> | <i>M</i> | |

| <u>Attitude Category</u> | | | | | | |
|--|------|------|---------|------|------|-------|
| Instructional Effectiveness | 4.05 | 3.78 | 3.18 | 3.91 | 3.92 | .01 |
| Role of Instructional Prompts | 4.01 | 3.93 | .19 | 3.73 | 4.18 | 5.40* |
| Continuing Motivation | 3.83 | 3.36 | 6.36* | 3.68 | 3.50 | 1.06 |
| <u>Role of Instr. Prompts Items</u> | | | | | | |
| The instructional explanations (hints) helped me to learn | 4.04 | 4.11 | .07 | 3.75 | 4.37 | 6.18* |
| Text-based instructional explanations (hints) were/would be helpful | 3.83 | 3.37 | 2.40 | 3.29 | 3.85 | 3.60 |
| Pictorial-based instructional explanations (hints) were/would be helpful | 4.21 | 4.19 | .01 | 4.13 | 4.26 | .35 |
| Having control over the instructional explanations (hints) was/would be beneficial for my learning | 4.21 | 4.04 | .52 | 4.00 | 4.22 | .89 |
| <u>Continuing Motivation Items</u> | | | | | | |
| I would like to learn more about electrical circuits | 3.79 | 2.93 | 12.34** | 3.54 | 3.15 | 2.13 |
| After completing the instructional unit, I find science more interesting | 3.63 | 3.30 | 1.91 | 3.54 | 3.37 | .50 |
| I would recommend this instructional unit to others | 4.08 | 3.85 | .81 | 3.96 | 3.96 | .00 |

* $p < .05$, ** $p < .01$

Instructional Time

In order to test if the amount of time participants spent on acquiring initial knowledge during the paper-based training and learning in the computer-based learning environment influenced their performance on the posttest, an analysis of variance (ANOVA) was conducted on these times. No statistically significant differences between the different treatment groups were found.

Attitudes

The attitude items were scored on a five-point scale, ranging from 5 indicating strong agreement with the positive statements to 1 corresponding to strong disagreement. The overall mean score across all the 14 attitude items on the survey for all participants was 3.86 ($SD = .49$).

The attitude items were grouped into three categories, namely instructional effectiveness (7 items), role of instructional prompts (4 items), and continuing motivation (3 items). The mean attitude scores by format and presentation of prompts for participant responses on the three main categories of attitude items on the five-point attitude survey are presented in Table 3. Multivariate analyses of variance (MANOVA) of the attitude items related to the role of instructional prompts revealed that there was a significant overall main effect across the four items relating to the presentation of prompts, ($M = 4.18$ for externally regulated prompts and $M = 3.73$ for self-regulated prompts), $F(1,47) = 5.40$, $MSE = .45$, $p = .03$. Cohen's f statistic for these data yields an effect size of .34, which corresponds to medium to large effect. In addition, a significant overall main effect was discovered across the items relating to continuing motivation for the format of prompts ($M = 3.83$ for text-based prompts and 3.36 for pictorial-based prompts), $F(1,47) = 6.36$, $MSE = .45$, $p = .02$. Cohen's f for these data yields an effect size of .37, which corresponds to medium to large effect. The differences for the format and presentation of prompts on the attitude survey items relating to the instructional effectiveness were non-significant.

Univariate analysis of variance on the four items relating to the effectiveness of the instructional prompts by presentation of the prompts revealed significantly higher scores on the item "The instructional explanations (hints) helped me to learn" for the externally regulated prompts ($M = 4.37$ for externally regulated prompts and 3.75 for self-regulated prompts), $F(1,49) = 6.18$, $MSE = .79$, $p = .02$.

Univariate analysis of variance on the three items relating to the continuing motivation by format of the prompts revealed significantly higher scores on the item "I would like to learn more about electrical circuits" for the textual prompts ($M = 3.79$ for text-based prompts and 2.93 for pictorial prompts), $F(1,49) =$

12.34, $MSE = .77$, $p < .01$).

Discussion

The two main research questions addressed in the present study focused on the impact of the format (textual or pictorial) and presentation (self or externally regulated) of instructional prompts on the learners' performance and attitudes. Significant differences were revealed for the accuracy of anticipations on practice problems during the learning phase in the computer-based environment. In particular, the learners assigned to the textual-based prompt groups were significantly more successful in correctly solving the individual solution steps at the first problem-solving attempt than their counterparts in the pictorial-based prompt groups. This finding corresponds to a large effect and is therefore of practical significance. The learners who were assigned to the treatment conditions with pictorial prompts, on the other hand, had a significantly higher success rate at the second anticipation compared to learners in the text-based prompt conditions. One way to account for the higher success rate of the learners with the pictorial prompts in the second attempt is that these learners had a significantly higher probability of advancing to the prompt and second trial because of their higher error rates at the first anticipation. In particular, for 18% of the solution steps the learners in the pictorial-based prompt group advanced to the prompt and second trial, compared to 7% for the learners in the text-based prompt group.

We also found that the textual prompt format leads to significantly higher near-transfer posttest performance compared to the pictorial prompt format. The advantage of textual prompts over pictorial prompts on the near-transfer learning yielded a large effect, which indicates this is also of practical relevance. The analysis indicates that the advantage of the textual format of instructional prompts cannot be attributed to the amount of instructional time. The significantly better performance with the textual prompts indicates that the textual representation of the electrical analysis techniques is more suitable for learners without prior exposure to electrical circuit analysis. The results suggest that all the learners, regardless of the treatment condition, encountered difficulties when attempting to solve the far-transfer problems. Essentially, we encountered a floor effect on this measure.

The results from the attitude survey indicate that the learners in the text-based group expressed significantly more positive attitudes towards the statements relating to continuing motivation. In particular the learners that had experienced text-based prompts had a significantly more positive attitude toward the survey item relating directly to future study of electrical circuit analysis. This more positive attitude is consistent with the higher posttest scores of the learners in the text-based prompt group. Indeed, the higher posttest scores suggest that these learners had acquired a better mastery of the instructional material, which may have made them more confident about their newly acquired skills, and had resulted in higher motivation for further study in the content area of electrical circuits. This difference in attitudes towards learning more about electrical circuits corresponds to a large effect, indicating that this difference has practical relevance.

The results for the learner attitudes toward the statements relating to the role of the instructional prompts indicate that the external regulation of the prompts is perceived as significantly more appealing than the self-regulation of the prompts. This is an interesting result considering that there were no significant differences for external vs. self regulation of the prompts in terms of the performance on the posttest and the instructional time. The learners with the low level of prior knowledge may have preferred that the prompts were automatically presented by the system instead of being forced to decide for themselves whether or not they should view them. Overall, the results of the attitude survey suggest that employing text-based prompts and having the prompts under the control of the instructional module are preferred by students in a module on electrical circuit analysis for high school students with little knowledge in this domain.

There are several interesting avenues to pursue in future research on computer-based interactive learning modules with instructional prompts. One avenue is to investigate the impact of text vs. pictorial prompts on learners with a higher level of prior knowledge of general engineering analysis techniques, such as college freshmen or sophomore engineering students. Another avenue is to study the impact of more complex and elaborate pictorial prompts that are designed to foster the acquisition of the more expert-like graphical representation common in electrical circuit analysis.

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Validating Instructional Design and Development Models

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Abstract

Many recognize that instructional design and development (ID) models should be substantiated by systematic validation rather than relying primarily on user testimonials as evidence of their effectiveness (Gustafson & Branch, 2002). Model validation projects, however, seldom become a priority. The paucity of such efforts may be more a reflection of time constraints and ill-defined model validation procedures, rather than a lack of appreciation of the fundamental need for validation. This paper describes the general nature of ID models and ID model validation, and then explores five alternative approaches to the validation process.

The Nature of ID Models

Models, by definition, are simplified representations, and they are often idealized. Nonetheless, models provide structure and order to complex real life events that on the surface can seem chaotic. ID models are no different. In most cases, the use of an ID model calls for considerable interpretation and amplification to provide the detail required for specific applications.

Most ID models are visual diagrams and are procedural in nature. Notable examples are the generic flowchart models of Dick, Carey and Carey (2001) and Smith and Ragan (1998). Other visual formats are also used, such as the embedded circle design of the Morrison, Ross and Kemp (2003) Model. The majority of these procedural models pertain to comprehensive design projects. Gustafson and Branch (2002) have described these models as beginning with various forms of analysis, and progressing through the design of a set of specifications for the learning environment and the development of learning materials. Evaluation activities permeate the entire process, even through the management of the ongoing implementation of the products. There are many variations of this general ID process often represented by more specific models intended to relate to the idiosyncrasies of specific groups of learners, learning environments, types of delivery systems, or even specific design philosophies.

Conceptual design models have less consistent formats than procedural models, but there is one large segment of conceptual models that use the taxonomy format. Seels (1997) has explored a range of taxonomic models in our field. These models began with Dale's (1946) Cone of Experience, an early media selection model that classified media on a concrete-to-abstract continuum. Other conceptual models in the literature are more varied in format. Some path diagrams can also be viewed as conceptual ID models. These are graphical displays of the patterns of direct and indirect relationships between variables. One such example is Richey's (1992) model of factors predicting employee training outcomes. Another type of conceptual model is Hannafin and Rieber's (1989) ROPES+ meta-model for designing computer-based instruction.

The General Nature of ID Model Validation

Practically speaking, most designers seem to view models as "valid" if they address the needs and constraints of their workplaces, are easily used, and if their use tends to result in products and programs that are well received by one's clients. One's own experiences or the recollections of others serve as the supporting data. Theorists and model developers, on the other hand, are likely to assume the validity of a model if it is a logical, coherent entity with literature support. They are also influenced by the practical results of its use and user satisfaction. Certainly the prominent models in the ID literature have been used successfully for many years. However, even with these models, the data supporting validity tends to be rare or non-existent.

Here, I am viewing ID model validation as a carefully planned process of collecting and analyzing empirical data to demonstrate the effectiveness of a model's use in the workplace or to provide support for the various components of the model itself. Akin to the use of the term validation in relation to measurement and research design, this is a process that concerns the extent to which inferences are appropriate and meaningful.

Internal and External Validation of ID Models

ID model validation is viewed here in two ways – as either internal validation, that is a validation of the components and processes of an ID model, or external validation, that is a validation of the impact of the products of model use. The findings of all model validation studies form critically needed parts of the

instructional design knowledge base.

The Character of Internal Model Validation. Internal validation focuses upon the integrity of the model and its use. Such studies are typically conducted during model construction or in its early stages of use. They provide data to support each component of the model, as well as the relationship between the components and the processes involved. In many respects, internal validation studies can be seen as a type of formative evaluation of the model. These investigations answer questions such as the following:

Model Components

1. Are all steps included in the model necessary? Are there any steps missing in the model? Are there any that need to be clarified?
2. Is the sequence of steps appropriate? Are the steps manageable in the prescribed sequence?
3. To what extent does the model address those factors in the instructional, pre-instructional, and work environments that contribute to learning?
4. To what extent does the model address those factors in the instructional, pre-instructional, and work environments that contribute to transfer or performance improvement?

Model Use

5. To what extent is the model usable for a wide range of design projects? Does it easily accommodate many types of content, instructional products, delivery systems, and instructional strategies?
6. To what extent is the model usable in a wide range of work environments given varying organizational cultures and learner populations, as well as varying resources and constraints?
7. Can the steps be reasonably implemented by both novice and expert designers? Can the model be used without assistance by a trained designer?
8. Can the steps be completed efficiently under most working conditions?
9. Is the level of client involvement in the design and development process appropriate for most work settings? To what extent are the clients satisfied with the design and development process?
10. Is the use of this model cost effective?

It would be unlikely that a particular validation study would address each of these concerns, or give equal emphasis to each factor. Nor is this list presumed to be complete; other issues may be pertinent to particular models or particular users.

The Character of External Validation. External model validation addresses the effects of using the model – the instructional products themselves, and impact of these products on learners, clients and organizations. In many respects, these studies can be seen as summative or confirmative evaluations of the model. They address questions such as the following:

Product Characteristics

1. To what extent does the resulting instruction meet learner needs, client needs, and client requirements?
2. To what extent is the resulting instruction motivating and interesting to the target audience? Were the learners engaged in the instructional activities?
3. To what extent do learners accept the resulting instruction, its delivery system, and its navigation techniques (if applicable)?

Impact of Instruction

4. To what extent do changes occur in learners' knowledge, attitudes, and/or behaviors after instruction?
5. To what extent are these changes retained over time?
6. To what extent does the instruction result in efficient learning?
7. To what extent do resulting behavior changes impact the organization's performance?
8. To what extent are the clients satisfied with the instruction and its impact?

External validations can be complex research undertakings due to the large number of extraneous factors that can influence the findings. Such findings may be impacted by factors such as instructor characteristics, learner distractions, past history and organizational priorities to name just a few. Nonetheless, external validations address those factors that many consider to be the central focus of design efforts.

Key Factors Impacting ID Model Validation

ID model use, and its subsequent validation, is affected by a large number of factors. Some of these factors tend to lead to variations in the model's use and, at times, they even lead to variations in the models

themselves. An important part of any validation effort is to identify those factors that may be influencing the use of an ID model in the target environment. It is one function of the validation research design to control for these variables. In a typical work setting this is not always easy. Nonetheless, there are two factors which are especially critical to address – the context in which the model is used and the expertise of the designer.

Design Context Effects. There is an implicit (if not an explicit) assumption that most of the widely published and taught models can be used in all design contexts, and there is a long history of many ID models being successfully used in a variety of settings – corporate, educational, health care, and military, for example. Most assume the universal applicability of instructional systems design (ISD) procedures, and traditionally this has been viewed as a major advantage of the methodology.

Edmonds, Branch and Mukherjee (1994) posit that the success of an ID model is dependent upon the extent to which a match between the application context and the context for which the model was originally intended. The contextual elements they stress are not only setting, but also differences in type of content and the type of product being produced. The complexities that are suggested by the questions I have posed for both internal and external validation studies can also lead one to consider the possibility that ID models may be valid for one design setting and not for another.

Design contexts vary not only in terms of available resources and facilities, but also in terms of the climate and emphases imposed by factors such as the organization's mission and leadership style. They also vary in terms of the characteristics of the learning and performance environments in which the subsequent instruction is implemented. The many aspects of context that impact the design process have been identified and discussed in Tessmer and Richey (1997). Some of the updated ID models (e.g. Dick, Carey & Carey, 2001) specifically recognize these factors and include procedures for dealing with them. More often than not, however, designers modify the generic models to accommodate their unique work environments. For example, they may eliminate or curtail the analysis phase and use previously collected data or the input of supervisors. Thus, detailed design procedures can vary depending upon context even when the same model is being used ostensibly.

Designer Expertise Effects. Design models are also typically interpreted differently by expert designers and novice designers. This has been well established by researchers such as Rowland (1993), Perez and Emery (1995), Saroyan (1993) and others. While the key tasks are still completed by experts, they tend to treat all problems as ill-defined. They consider a wide variety of situational factors in combination, as well as both instructional and non-instructional solutions, but delay making design decisions as long as possible. Perez and Emery noted that experts "*interpreted* the design problem – novices *identified* the problem" (1995, p. 92).

Some approaches to design demand more experienced designers than others. This is true, for example, of rapid prototyping procedures (Jones & Richey, 2000). Expert designers basically use a general ISD model, but the design process tends to be more iterative, and the sequencing of design steps varies to meet the demands of an individual design project. Design tasks are performed concurrently. This procedure is common in larger organizations where projects are typically completed by design teams, with members each having expertise in a unique area required by the project at hand.

Edmonds, Branch and Mukherjee (1994) see that ID models themselves are often oriented toward either expert or novice designers. Experts use intuitive judgment stemming from their past experiences to provide design guidance. The design experience of experts, they further contend, is necessary to use the Layers of Necessity approach to design (Tessmer & Wedman, 1990) as well as the rapid prototyping model proposed by Tripp and Bichelmeyer (1990). Another explanation of expert design behavior is that they modify standard models to meet the demands of a given situation. In either case, designer expertise and design context interact to shape the design task, and these interactions have important implications for the systematic validation of an ID model.

ID Model Validation Procedures

There are various ways of conducting both internal and external validations. In this section five different validation procedures are discussed. These alternative approaches can be viewed as types of instructional design and development research (see Richey, Klein & Nelson, 2004). These validation processes are *not* mutually exclusive; the various approaches can be combined to reinforce the data base and, in turn, to strengthen the conclusions. Table 1 compares each of these validation processes in terms of the typical types of ID models addressed, the focus, the research techniques employed and when the validations are typically undertaken.

Table 1 A Comparison of Five Approaches to ID Model Validation

| Validation Process | Types of ID Models Addressed | Typical Focus | Research Techniques Employed | Time of Completion |
|--|------------------------------|--|---|---|
| Internal Validation: Expert Review | Conceptual Procedural | Model Components; Model Use | Survey Delphi | During model development |
| Usability Documentation | Procedural | Model Use | Case Study | During model try-out or use |
| Component Investigation | Conceptual Procedural | Model Components | Survey Experimental or Quasi-Exp. Path Analysis LISREL Analysis | Prior to model development; During model use |
| External Validation: Field Evaluation | Procedural | Product Characteristics; Instructional Impact | Case Study Evaluation Survey | During model try-out or use |
| Controlled Testing | Procedural | Instructional Impact | Experimental or Quasi-Experimental | During model use |

Internal Validation Procedures

Expert Review. One of the most commonly used approaches to internal validation is expert review. Expert review is a process whereby ID experts critique a given model in terms of its components, overall structure and future use. It is the most expeditious of the internal validation methods. Essentially, this is a cyclical process of model review and critiquing based upon pre-specified criteria, and subsequent model revision based upon the data. Often Delphi techniques are employed as a framework for achieving consensus among the participants. Participants need not physically meet; instead, data are typically collected via mail, e-mail, telephone or web-based instruments. The process continues until there is a consensus among the panel of experts as to the completeness and the utility of the model. Some of the best examples of expert review validations are in doctoral dissertations. For example, Sleezer (1991) developed and validated a Performance Analysis for Training (PAT) Model using expert review methods. She used experts in training needs assessment to evaluate the content and face validity of the PAT model.

In this approach, the soundness of the validation is dependent to a great extent upon the number of reviewers and the authority of the reviewers. This validation relies upon the experiences and knowledge of the reviewers. Often, reviewers represent both design practitioners and design theorists, but persons are also selected so that a variety of theoretical orientations and work settings are represented. It is increasingly important to include experts with geographical diversity, taking special care to reflect design practice in countries other than the United States.

One can typically expect expert reviews to be most credible with respect to verifying model components. Unless the participating experts have used the target model themselves or have extensive work experience in a given environment, their predictions of model use may be open to question. More robust data on model use is usually gathered from documentation of the actual design and development process as it occurs.

Usability Documentation. The second approach to internal validation involves the systematic documentation of designers using a particular model. This involves keeping records of actual implementation procedures, time taken, resources used, problems and difficulties encountered using the model and resolutions of these problems. It involves systematically describing the background and abilities of those involved and of the work environment. While in the past this process has typically been an added task for designers, such documentation is more common today as organizations strive to establish quality standards and gain recognition of their standards through avenues such as ISO certification.

The integrity of usability documentation data is dependent upon its authenticity and objectivity. Care

must be taken to insure objectivity through consistent, systematic data collection techniques and the collection of corroborating data. Often structured logs and diaries completed by several project participants according to a regularly established schedule create a structure that facilitates the generation of reliable data. Recall data should be avoided when possible.

It is possible that usability documentation research is being done within large corporations to examine their own model use. If so, it is unlikely that these studies would be published and available to the larger ID community. The examples of usability documentation vary considerably. For example, Forsyth's (1998) usability data describes the specific steps completed when following her model for designing community-based train-the-trainer programs, the time allocated to each phase of the model and the lessons learned throughout. The researcher and the designer in this case were one in the same. Data were obtained from logs and designer reflection.

Both expert review and user documentation validation schemes depend primarily upon reaction data. A key difference between them is that the latter demands actual use of the model, while expert review data requires reflection and analysis. Component investigation, on the other hand, typically involves research with a fairly rigorous statistical verification of the factors addressed in a given design model.

Component Investigation. ID models have many parts. In general, procedural models consist of separate steps, and conceptual models consist of factors critical to the instructional design process. Each of these elements can be initially identified or confirmed through research. This is the essence of component investigation.

The research directed toward procedural model validation seeks to provide evidence of the effectiveness of the various steps in the process. For example, very early in the use of ISD procedures, Kibler, Cegala, Barker and Miles (1974) sought to establish an empirical base for the use of behavioral objectives. The research directed toward conceptual model validation, on the other hand, typically seeks to identify variables that predict key outcomes of instruction – either knowledge acquisition, attitude change or performance change. These predictive variables then become factors that should be addressed in the design of instruction. For example, various studies have validated the ARCS Model of Motivation Design by studying the impact of the various model components (i.e. attention, relevance, confidence and satisfaction) on achievement (Brolin, Milheim & Viechnicki, 1993-94; Means, 1997; Small & Gluck, 1994).

Other studies have tested an array of variables that are hypothesized to predict successful learning. For example, Quinones, Sego, Ford and Smith (1995/1996) in their investigation of transfer of training used LISREL analysis techniques to support a model of factors that predict the opportunity to perform in a work environment after training. Noe and Schmitt (1986) used path analysis techniques to develop models of training effectiveness. The strength of these findings as validation tools is naturally dependent upon the integrity of the foundational research.

These first three approaches to ID model validation are internal, speaking only to the worth of the model itself without examining the results of using the model on learners or on the organizations in which they are used. Approaches that address these latter issues are external in nature.

External Validation Procedures

Field Evaluation. Field evaluation is the most commonly used external validation process. As with usability documentation, it involves actually using the model to produce instruction. However, here the instructional product is also implemented in the setting for which it was designed. Data is collected to facilitate a study of the nature of the resulting product and the impact of the instruction on learners and organizations. The impact of the entire process on clients is also documented in some situations.

Sullivan, Ice and Niedermeyer (2000) systematically field tested a comprehensive K-12 energy education curriculum that tested a long-term instructional development and implementation project. The project has been on-going for 20 years. Conclusions were drawn that could be generalized to other long-term projects. McKenney (2002) validated her design and development model through an extensive field evaluation. She studied the development of a computer program to support curriculum materials development in the context of secondary science and mathematics education in southern Africa. Superior field evaluations draw upon the methodologies of any product or program evaluation effort. However, when used for ID model validation the results need to be examined in terms of their implications for confirming or altering the basic design model that guided the project.

Controlled Testing. Design models can also be validated by establishing experiments that isolate the effects of the given ID model as compared to the use of another model or approach. This is the object of controlled testing validation. This type of research provides data that supports the validity of a given procedural

model under controlled conditions.

There are examples of controlled model testing available. Tracey (2002) is one example. She compared the use of the Dick and Carey model with an ISD model enhanced with a consideration of multiple intelligences. The experiment was controlled in terms of task, time, and designer expertise. In the Tracey study there were two design teams, each with two novice designers. Each team worked with a different model. Both groups designed a two-hour instructor-led workshop. The resulting programs were actually implemented and evaluated. The verification of model effectiveness was based upon measures of learning and participant reactions to the instruction. Research, such as this, is more likely to be undertaken by academics than practitioners, but when it can take place in natural work environments the results are apt to be seen as more trustworthy among practicing designers.

Comprehensive Model Validation

Given the contextual nature of ID model use, there is the question whether model validation findings can be generalized to other settings. This concern speaks to the need for comprehensive validation efforts. All of the examples discussed have been situation-specific. This reflects the nature of the vast majority of validation efforts. Comprehensive validations, on the other hand, would examine ID model use under a variety of conditions. To meet these goals, the validation research requires systematic replication. Systematic replication of ID model validation research would allow the field to determine the impact of factors such as:

- alternative settings;
- alternative types of learners;
- designer expertise;
- alternative content areas; and
- a variety of delivery strategies

It seems to make the most sense for comprehensive research to be conducted during model use (e.g., usability documentation studies, field evaluations, and controlled testing) rather than model development.

When a large number of validation studies appear in the ID literature it will be possible to employ meta-analytic or other integrative research procedures using these findings to summarize the findings pertaining to the effectiveness of a particular ID model that has been employed in a variety of situations. Replication of model effectiveness under a variety of conditions and integration of the various findings would not only increase the credibility of that particular model, but would provide data to support the assumption that ISD processes are generic.

Conclusions

The underlying theme of this paper is that as a field we should be validating our many ID models as well as developing them, and that validation should become a natural part of the model development process. This message stems from a belief that instructional design itself is a science, but one that is practiced by blending creative and rule-bound activities. By viewing design itself as a science rather than an extension of science, it follows that its overarching theories and models should be grounded not only in research on instruction, but in research on instructional design and development.

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Engendering Technology Use in the Classroom

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Abstract

The purpose of this study was twofold: a) to test the hypothesis that participation in a course providing theory and practice in the classroom use of technology engenders such use and results in gained competence in the use of this technology; and b) to test the hypothesis that functional relations exist among the availability of technology in the classroom, the use of such classroom technology, and competence in its use. Fifty-five graduate students participated in a course in the use of technology in the classroom. Statistically significant differences emerged between pre-tests and post-tests on a) use of e-mail, b) Web site use, c) automated library resources, d) computer software, e) Internet virtual field trips, f) video cameras, g) PowerPoint, and h) Blackboard $\frac{3}{4}$ pointing to the effectiveness of the course for the purpose. Further, as hypothesized, competence in the use of technology in the classroom proved to be a direct function of the degree of use of this technology.

Introduction

Teachers are expected to use technology in their classrooms. However, teachers who have been in the field for more than 10 years often do not have the necessary expertise to use technology in the classroom. Their education coursework may not have included technology training, and these teachers may not have obtained the necessary technology skills on their own. Further, many schools have been lax in offering their faculty members technology training with appropriate follow-up and support.

Teachers who have had "training" often report that it consisted of a single in-service session with no follow-up or support. Teachers who are in school to earn master's degrees are sometimes required to take a course to help them integrate technology into their own classrooms. The course includes theory as well as opportunities to practice newly learned skills to achieve competence with technology. Both the course instructor and class members provide ongoing support for novice technology users. Questions arise whether these courses really enable teachers to gain competence in the use of technology so that they can integrate their newly learned technology expertise into their classrooms.

Literature Review

There is wide variance in the nature of the training to enable teachers to use technology tools in their classrooms. Researchers report that teacher-training programs generally fail to provide future teachers with the experiences necessary to prepare them to effectively use technology in their classrooms (Baylor & Ritchie, 2002; Clouse & Alexander, 1998; Ertmer, Conklin, & Lewandowski, 2001; Russell, Bebell, O'Dwyer, & O'Connor, 2003; Wiencke, 2002). Although newer teachers are usually comfortable working with technology, they have not been exposed to applications of classroom technology. These newer teachers have more recently completed teacher education programs, many of which focus on how to use technology rather than on how to teach with technology and integrate it into everyday teaching. Models of teaching based on their own experiences as students do not include the integration of technology into instruction. Russell, Bebell, O'Dwyer, and O'Connor further posit that although teachers use technology outside the classroom, especially for preparation and professional communication via e-mail, they infrequently use technology in the classroom. Ertmer, Conklin, and Lewandowski (2001) comment that knowing how to use word-processing, e-mail, and the Internet does not mean facilitation of these skills will occur in classroom instruction. Once teachers are in the classroom, opportunities for learning to use technology are rare since most in-service training programs lack a model for integration (Clouse, & Alexander, 1998) and many schools have not yet incorporated technology into regular instruction (Russell, Bebell, O'Dwyer, & O'Connor, 2003). Gooler, Kautzer, and Knuth, (2000) explain that the teacher plays a key role in determining not only how but how well technologies are used in classrooms, and thus the extent to which technologies improve student performance. Khamis (1987) reports that merely placing a computer into a classroom of untrained teachers is ineffective since untrained teachers are likely to use computers for daily trivial things. These inconsistencies point to the need for developing teachers' classroom technology competence.

Teachers need both the time and the opportunity to gain competence in instructional technology (Harris, 2000). Some researchers report that teachers progress through stages as they develop technology integration competence. At each stage teachers need particular support and professional development (Gooler, Kautzer, & Knuth, 2000; Harris, 2000). A compilation of research suggests that effective professional development in learning to use technology to teach should have relevance for the teacher and include modeling, hands-on practice, continuing support, collaboration, and easy access to the technology.

Modeling. As mentioned earlier, many teachers do not have good models for integrating technology into their teaching. Baylor and Ritchie (2002) note that teachers tend to teach the way they were taught. Providing appropriate models so that teachers can observe and then practice themselves is useful for many teaching applications (Dunne & Harvard, 1992). Clouse and Alexander (1998) claim that the best training is through observation and collaboration with full time teachers who use technology effectively in their classrooms.

Mager (1992) suggests that modeling by peers is a good training strategy to help self-efficacy (a personal judgment about one's ability to carry out a particular course of action or do a specific thing.) Although the present study focuses on competence, it should be noted that self-efficacy/confidence is an important consideration for teachers in their decision to use technology in their classrooms.

Hands-on practice. Before teachers can infuse technology into the curriculum, they need to have appropriate skills, knowledge and attitude (Baylor & Ritchie, 2002; Gooler, Kautzer, & Knuth, 2000). Clouse and Alexander (1998) suggest that the most effective training programs must provide practical hands-on experiences and meaningful activities that are appropriate for an individual's level of expertise. Teachers need time to reflect on new learning and integrate this new knowledge into practice through experimentation and then reflect on these outcomes further so that appropriate adjustments can be made (Gooler, Kautzer, & Knuth, 2000). Khamis (1987) agrees that teachers need time to practice to improve their competence and further suggests a team strategy of requiring teachers to participate in student activities led by a more experienced team member.

Continuing support. Continuing support is an important ingredient if teachers are to use technology in the classroom (Gooler, Kautzer, & Knuth, 2000). Introductory teacher training is unlikely to guarantee continued use of technologies. Support is needed to help teachers infuse technology into the curriculum as well as to provide technical expertise to insure that the equipment is functioning properly.

Collaboration. Well designed training programs provide opportunities for participants to interact and collaborate so that they can learn together and from each other (Gooler, Kautzer, & Knuth, 2000). A collegial and collaborative culture in which colleagues can exchange knowledge and ideas and provide constructive feedback and encouragement to their peers fosters the growth of (and is cultivated in) a learning community. Teachers should be in a supportive environment when trying something new (Harris, 2000).

Ease of access. Teachers, administrators, and students who have easy access to technology are more likely to take the time to practice with it to improve their skills (Khamis, 1987). Harris (2000) reports on exemplary uses of technology in several school projects in southeastern states. In one program participating teachers received laptops; in another project there were two computers in each classroom, and in yet another project there was a two to one ratio of students to computers. Harris reasons that easy and regular access to computers is necessary if teachers are to plan lessons requiring children to use the Internet or to prepare reports using presentation software.

Purpose

The purpose of this study was twofold: a) to test the hypothesis that participation in a course providing theory and practice in the classroom use of technology engenders such use and results in gained competence in the use of this technology; and b) to test the hypothesis that functional relations exist among the availability of technology in the classroom, the use of such classroom technology, and competence in its use.

The model in Figure 1 was used to guide the research effort. In this model, we hypothesized that Availability of Technology (AT) would engender the Use of Technology (UT), that UT would engender the Use of Internet Web sites (UW), and that these conditions would engender Competence in the Use of technology (CU).

Method

The study was conducted during the Fall 2002 and Spring 2003 semesters in three graduate educational technology classes. One instructor taught all the classes.

Sample

Fifty-five graduate students (master's students in education) participated in the study. Most of these graduate students were employed as teachers in an urban school district. Participant technology expertise ranged from almost no technology background to those who were facilitating students' classroom use of technology. The availability of technological resources for teachers in their schools ranged from no technology resources to several computers in their classrooms.

Procedure

A variety of activities were designed to give participants hands-on experiences with the technology, as recommended in the research. Participants found information on Web sites and navigated electronic library resources. They learned to send file attachments and became proficient with e-mail. They researched a topic and used PowerPoint to develop a presentation. Participants prepared and shared virtual field trip lessons using topics suitable for their own students.

Collaboration was encouraged, recognizing a preference to work with a partner when learning something new (Rosenfeld, 1992). PowerPoint assignments were completed in small groups and presented to the class. It was anticipated that being a part of a group would be less threatening than developing and making a solo presentation, particularly since the PowerPoint program was new to many participants. The virtual field trip (VFT) lessons were presented individually, but participants could opt to collaborate on the development of the plans. The VFT lessons were presented to small groups so that this would be a less threatening environment for those who had newly learned about this technology-driven activity. The presentations gave participants the opportunity to try out the technology with an audience (practice), and also provided participants with several models to emulate, as recommended in the research.

The use of Blackboard (a distance learning management program) allowed for continued discussion outside class on the discussion board or through small group discussion forums. Weekly announcements were publicized to relay information about the class prior to meeting. Grades and course documents (e.g., syllabus and class handouts) were posted. Blackboard gave participants another opportunity to build their technology competence, allowing the classroom community to meet asynchronously.

Instrumentation

The Survey of Technology Use Questionnaire (STUQ) was administered at the beginning of each semester (STUQ 1), and again at the end of each semester (STUQ 2). Participants were queried regarding their perceived competence in the use of e-mail, Web site use, automated library resources, computer software, Internet virtual field trips (VFTs), video cameras, PowerPoint, and Blackboard/WebCT. These activities were grouped into two categories, Technology Use (automated library resources, computer software, video cameras, PowerPoint) and Internet and Web Site Use (Blackboard, e-mail, VFTs). The information gleaned with STUQ 1 and STUQ 2 was deemed as indicative of the participants' use of and perceived competence with the various technologies before and after participation in the study.

Additional data was collected through a course feedback survey. Questions asked about participants' classroom use of technology at the end of the course, for example, whether they had tried a virtual field trip (VFT) prior to the class and whether they had tried a VFT since it had been discussed in class.

Method of Data Analysis

To test the first hypothesis posed for investigation, 1-tailed paired comparison *t*-tests were performed to ascertain gains in the use of technology in the classroom and competence in the use of this technology. To address the second hypothesis, path analysis was performed to test the model as shown in Figure 1.

Results

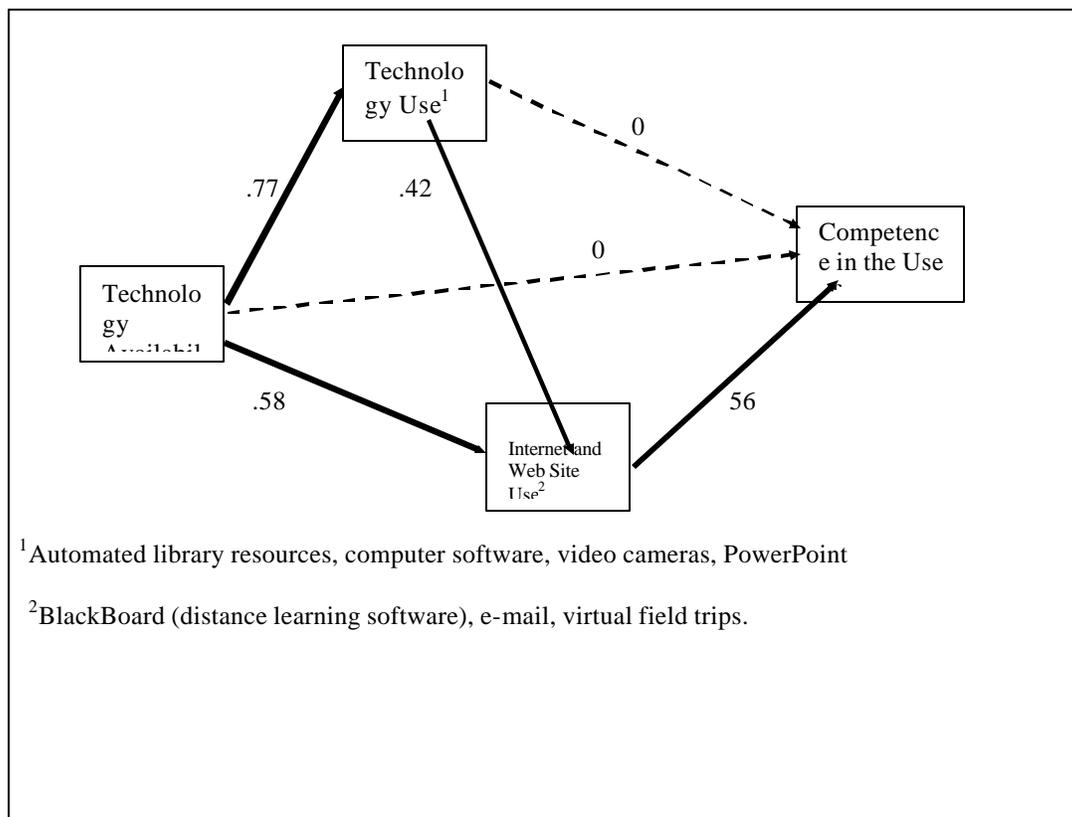
The *t*-test outcomes appear in Table 1. As shown in this table, a statistically significant gain emerged for competence in the use of technology from pre- to post-test. (CU) from STUQ 1 ($M = 11.85$, $SD = 5.34$) to STUQ 2 ($M = 19.10$, $SD = 3.34$): $t = -11.06$, $df = 47$, $p = .00$ —suggesting that the interventions were successful in raising the participants' competence in using technology in the classroom.

Table 1. t-Test Outcomes

| | <i>M</i> | <i>SD</i> | <i>t</i> | <i>p</i> |
|-----------|----------|-----------|----------|----------|
| Pre-Test | 11.85 | 5.34 | -11.06 | .00 |
| Post-Test | 19.10 | 3.34 | | |

Figure 1 shows the path analysis outcomes. As hypothesized, competence in the use of technology in the classroom proved to be a direct function of the degree of use of this technology, most directly on the use of Internet Web sites ($b = .56, p < .05$); the degree to which teachers use the Internet proved to be dependent on both the availability of computer technology in the schools ($b = .58, p < .05$), and the general use of this technology ($b = .42, p < .05$); and the use of this technology proved to be a function of the degree to which it is available to teachers in the schools ($b = .77, p < .05$).

Figure 1. Hypothetical Model and Path Analysis Outcomes. The coefficients for the heavy-lined linkages, in the form of standardized regression weights, are statistically significant beyond the .05 level.



Additional information from the course feedback survey indicates that by the end of the course some participants were infusing technology into their own classrooms while other participants expressed an interest in doing so, but could not because of a variety of problems barring classroom technology use.

Discussion

The interventions used in this study took into account suggestions from past research. Professional development should be relevant to the teachers and incorporate modeling, hands-on practice, continuing support, collaboration, and easy access to the technology. In most instances, participants chose topics for their projects and assignments resulting in a course that had relevance for the participants. For example, the VFT

lesson plans were developed for use in participant teachers' own classrooms. One participant commented, "You tried to make this class useful for our professional lives. You did not have us working in hypotheticals which I really appreciated" (Participant's response to the course feedback survey, Spring, 2003). Another observed, "We were exposed to many useful and interesting activities that would all be wonderful to use with kids" (Participant's response to the course feedback survey, Spring, 2003). A third participant wrote,

We were involved doing projects where we could see practical use in the classroom. In the other education classes I have taken, they gave us a lot of theory about instruction and management, but these were things that we could use right away. I guess you applied the theories with us that we are being told to use. We are being taught to deliver the instruction in a way that makes it relevant to the students. This was very relevant to our situations. You also made sure that the course did not just get wrapped up in the technology. There were always connections to the educational reasons for using the technology (Participant's response to the course feedback survey, Spring, 2003).

Modeling and hands-on practice were provided through in-class presentations – participants had hands-on experiences developing PowerPoint presentations and they modeled technology use for each other. A participant remarked, "I liked both the PowerPoint and the VFT. Both presentations were educative and informative. In addition, these assignments enabled us to learn from each other" (Participant's response to the course feedback survey, Spring, 2003). Another echoed that she "loved the opportunities that we had as a class to learn from each other" (Participant's response to the course feedback survey, Spring, 2003).

During the semester there was continuing support from the instructor as well as from classmates. A collaborative environment was encouraged with many opportunities for participants to work together in class and asynchronously through Blackboard. A participant wrote, "I enjoyed all the group activities. I love exchanging thoughts and ideas with others" (Participant's response to the course feedback survey, Fall, 2002). Another wrote, "I have truly enjoyed working together with the other students. With their different background and knowledge I have gained great knowledge for myself and my students. Every time I had a chance to work with them, I felt like I came out of that experience even stronger and better" (Participant's response to the course feedback survey, Fall, 2002).

The class met in a computer lab, providing easy access to the technology, but outside of the class participants worked in varied environments. All participants reported having a computer at home and all had Internet access either at home or at school. Of the 53 respondents to the end of semester Survey of Technology Use Questionnaire (STUQ 2), eight reported that they had no computer access at school; three additional respondents had no Internet access at school. This means that over 20% of the participants in this study could not facilitate on-line activities in their classes.

It should be noted that available technology is not always in good working order. One participant reported that of four computers in his classroom only one worked. Teachers often recount that the school does not provide quick technical support to fix computers when they malfunction. This may cause teachers to avoid the use of technology altogether. When teachers report on the number of computers that are in their classrooms, they also should report on the status of these computers – are they in working condition? How old are they? Do they have the memory and speed to support graphical and audio downloads? Technology that does not match users' needs will not be used.

Responses on the course feedback survey indicate that 11 participants tried a VFT with their students since that topic was discussed in class, 18 planned to do so in the future, 9 reported that the VFT was not available or accessible, and 11 responded that they would like to but could not. There were 8 affirmative responses to the question on using PowerPoint with students since the topic was discussed in class, 12 said that they plan to use PowerPoint in the future, and 10 reported that they would like to use PowerPoint but could not. Twelve respondents said that they had tried other technology activities with students, including videotaping and showing videotapes, using software, spreadsheets, a digital camera, Web sites and other Internet resources.

Information from the course feedback survey indicates that by the end of the course some participants were infusing technology into their own classrooms while other participants expressed an interest in doing so, but could not because of a variety of problems barring classroom technology use. In addition to inaccessibility, lack of Internet access, and malfunctioning computers, some participants reported that they were working on city-wide testing, were not currently teaching, had scheduling problems, lacked software, or had very young students.

There may be other factors that prevent teachers from using technology in the classroom. For example, even when teachers are competent in technology use, if they do not have self-efficacy or confidence, they may not opt to try to use technology tools in the classroom. Several participants mentioned in the course feedback that they felt more confident and/or comfortable with technology use: "I have not been in school for 13 years so

I was a little intimidated about having to go back but you made me feel very comfortable and confident” and “I learned a lot of new things for myself and to incorporate in my classroom. It has made me more comfortable with technology” (Fall 2002). Another participant commented, “This course helped me be a confident user of the computer” (Spring 2003). The present study only looked at perceived competence with technology. A future study might also examine self-efficacy/confidence and comfort issues.

Conclusion

The statistical data support the first hypothesis, that participation in a course providing theory and practice in the classroom use of technology engenders such use and results in gained competence in the use of this technology. The data also support the second hypothesis, that functional relations exist among the availability of technology in the classroom, the use of such classroom technology, and competence in its use. The results of this study strongly suggest that when an educational technology course is relevant to students’ needs and provides students with modeling, hands-on practice, and continuing support in a collaborative environment, it can lead to competence and future classroom technology use. This study also points to the need for states to mandate that a similar course, in-service, or training be required of all teachers who are expected to use technology tools in the classroom. Further, principals and other administrators should support their teachers’ efforts to infuse technology in their classrooms, thus helping their students to better prepare for the future.

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Linkage between Instructor Moderation and Student Engagement in Synchronous Computer Conferences

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Problem Statement

Current theories of learning have emphasized the value of dialogue for student engagement and achievement (Cazden, 2001; Bruffee, 1992). Research has also shown that the nature of classroom discourse depends greatly on the teacher (Anderson, Rourke, Garrison, & Archer, W., 2001). These issues are relatively well understood in face-to-face classrooms. However, the advent of online learning has raised more questions about student interaction and the role of teachers in such contexts. We need to develop a better understanding of how teachers can provide effective online mentoring and scaffolding to facilitate student engagement with each other and with their subject matter (Bonk, 2003).

Perceptions of online teachers' roles in distance education remain quite varied and controversial (Lobel, Neubauer, & Swedburg, 2002). Although online instruction literature increasingly emphasizes the importance of moderation and leadership (Anderson, et al., 2001; Feenberg, 1989), it remains unclear how online moderating are related to student engagement and interaction. The purpose of this research is to develop a better understanding of the relationship between moderator behavior and student engagement in synchronous computer conferencing learning environments.

Theoretical Perspectives

Current interest in collaborative learning—both in face-to-face and computer-mediated classrooms—is grounded in socio-cultural and socio-constructive theories (Duffy & Cunningham, 1996; Vygotsky, 1934, 1978). Learning is seen as a process of negotiating community membership through various social interactions (Wenger, 1998) with peers, experts, and teachers (Kaye, 1992). Proponents of computer conferencing have often argued that such social-constructivist perspectives may be particularly amenable to this new medium (Bonk & King, 1998; Bruce & Levin, 1997). They argue that computer conferencing may help students maximize both their own and peers' learning through the use of collaborative activities and discussions.

The teacher plays an important role in online discussions. While individual learning can occur through independent or self-directed study, it is only through active intervention of a teacher or moderator that collaborative computer conferencing becomes a useful instructional and learning resource (Garrison, Anderson, & Archer, 2001). Though the literature recommends (e.g. Garrison & Anderson, 2003; Salmon, 2000) extensive online moderating and guidelines, few experimental studies evaluate, much less certify, moderating processes or validate the optimal level or scope of online moderating.

Research Questions

As we have argued above, the relationship between moderating level and student engagement is complicated. Thus the major task of this study is to investigate the relationship between teacher moderating levels and student engagement. Taking a mixed research method approach, both quantitative and qualitative questions are asked:

1. Quantitatively, how are teacher moderating levels associated with each of the three student engagement variables? Is the effect of moderating levels on one student engagement variable higher than on another student engagement variable?
2. Qualitatively, what does the process of the collaborative meaning construction look

like? What is the transactional nature of the relationship between teacher moderating levels and student engagement?

As the first step of a large scale study, our answers to the research questions are based on a preliminary analysis of a small portion of the large data set. Additional analyses are underway and will be presented.

Research Design

The current research applies a mixed method approach—a combination of qualitative and quantitative approaches. Its quantitative character is evident in the process of converting communication content into discrete units and calculating the frequency of occurrence of each unit. It is quantitative also in that it extends the descriptive results of content analysis to inferential hypothesis testing (Borg & Gall, 1989; Rourke, Anderson, Garrison, Archer, 2001) which intends to certify the relationship between the predictor variable of moderating levels and outcome variables of student engagement.

Data Collection

The prime data source for this study will be the automatically archived conference transcripts from an online three-credit course offered at a Canadian University. This course on interpersonal communication is delivered through a real-time, interactive text, image, and animation messaging system and it is one of the first synchronous technologies that offer a visual representation of participant interaction. This course is unique also in the respect that all activities and interactions happen in real-time, i.e. in synchronous mode (Lobel, et al., 2002).

Though the transcripts form the main data for the study we plan to collect other data to triangulate the results (Patton, 2002). These additional data sources include course syllabus; course readings; classroom activity agenda developed by the teaching team and delivered to each teaching staff two days before class once a week; class preparation—one hour online meeting of the teaching staff immediately before class, and course assignments. These data will help better understand the context of each conference.

Data Analysis

The predictor variable of the study is moderating level. By adapting and combining Xin's (2002) rubric for measuring online moderating with Anderson et al.'s (2001) teaching presence model, this researcher has created a five-level rubric to measure the moderating level. In this model, the minimal level of moderating (level 1) includes when the moderator: opens discussion, establishes the computer conferencing agenda, and observes conference norms. At the high end of moderating (Level 5), the moderator strongly weaves and summarizes participants' ideas in addition to performing the previous moderating levels or functions. Though termed as "levels," the scale embraces both the quality and quantity nature of moderating.

The outcome variables of the study are student engagement and its sub-constructs. Student engagement is measured through three indicators (sub-constructs): behavioral engagement, social-emotional engagement, and intellectual engagement. While computer log data provides behavioral engagement information, emotional engagement is assessed through emotional expression and group cohesion attributed to closeness, warmth, affiliation, attraction, and openness (Rourke et al, 1999). Interactivity and higher-order thinking are considered key indicators of intellectual engagement in this inquiry. In terms of computer conference interactivity, declarative, reactive, and interactive messages are coded (Hara et al., 2000; Henri, 1992; Rafaeli & Sudweek, 1996; Sarlin et al., 2003). In terms of higher-order thinking, messages of problem initiation, problem exploration, and idea integration are coded.

Given that the synchronous conferencing messages are relatively short, content analyses focus on individual message units as the unit of analysis. A message unit is considered a posted message that is automatically numbered by the system. Inter-rater reliability (Krippendorff, 1980) is determined using Cohen's kappa.

Preliminary Findings and Discussion

With the purpose of revealing relationships between teacher moderating behaviors and student engagement which may later lead to the articulation of a model or framework for online teacher moderation, we have conducted preliminary analyses of the data here. To date, we have looked at the relationship between number of teacher postings and student attending and participating, two indicators of student behavioral

engagement. Second, we compared the outcome variable (student engagement) of two different groups—one with an overall high moderating level (Level 5) and the other with a somewhat lower moderating level (Level 2).

To look at the relationship between predictor variable teacher posting and outcome variables attending and participation, a correlation analysis was performed. The Pearson correlation between teacher posting and student attending as well as student participation were significant, respectively. The comparison of a portion of the outcome variable (student engagement) of two different groups—one with an overall high moderating level (Level 5) and the other with a somewhat lower moderating level (Level 2) provided interesting findings. Findings show that in these two groups behavioral engagement and intellectual engagement are about the same, whereas emotional engagement is at least two to three times higher in the group with low moderating level. Further analysis of one indicator of intellectual engagement—higher order thinking—shows that there are minimal differences in the frequency of problem initiation. However, the level of exploration is higher in the group with a high moderating level compared to the group with a low moderating level. In contrast, the level of idea integration is higher in the group with low moderating level compared to the group with high moderating level.

One interesting finding that emerged was the striking difference in the number of creative ideas offered by students in these two groups. The group with a high moderating level only produced three main ideas for their project, whereas the other group with a low moderating level produced up to seven different ideas for their project. Even though idea generation was not considered intellectual engagement in prior research, we think these differences are worth exploring in the other online classes. We are interested in the number of unique ideas or solutions produced by group members since it is a sign of creativity and divergent thinking.

Our preliminary analysis of a small sample of the data indicates some interesting trends. As we forecasted, there appear to be a difference in student engagement levels when group discussions are moderated at different levels. However, higher levels of moderation might not be associated with higher levels of student engagement. Consequently, we believe that there is a need to discover how to effectively moderate student behavioral, emotional, and intellectual engagement. Higher moderating levels might be more conducive for more student exploration, but may interfere with idea integration, emotional expression, and creative ideas.

Significance of the Study

This study explores student engagement in relation to online moderating in synchronous computer conferencing. Eventually, research in this area can extend to online training programs and curricula. The results of the study could allow researchers and practitioners develop better protocols for moderating online discussions. Such knowledge is essential if online learning (particularly synchronous conferencing) is to achieve its full potential.

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The Impact of Spoken Instructions on Learner Behavior Following Multimedia Tutorial Instruction

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Abstract

The choice of what to include in educational software is an issue with which instructional designers are regularly concerned. Multimedia capacity, standard on today's desktop computers, gives designers the opportunity to provide learners a more exciting learning experience than simply looking, clicking, and then looking some more. One feature that can make multimedia software different than such conventional media as books is the technological capacity to include sound. This capacity is already available to educational software developers regardless of whether they are producing instruction in fixed media or networked form. Recent interest in the use of sound to enhance learning (Bishop and Cates, 2001a) suggests, however, that although there is reason to believe that sound can enhance learning, that sound is used infrequently.

One reason given for the scarcity of software that incorporates sound is a lack of experimental evidence indicating a significant learning improvement when sound is present. While some experimental evidence supports combining sound with other media (Lai, 2000; Moreno & Mayer, 2000; Nocente, 1996), few experiments have directly compared textual and spoken presentations while maintaining content and visual information. For instructional designers seeking to accommodate different learning preferences by offering products that facilitate multiple learning modalities, or for those seeking to accommodate learners with reading or visual impairment, it makes sense to examine whether learning by listening can match or surpass learning by reading.

This paper presents a different point of view. Instead of looking for significant learning improvements in the presence of sound, it looks instead at differences in the ways learners behave when sound is introduced. With this kind of information, it becomes possible to plan to take advantage of the strengths of sound for accomplishing different parts of the instructional mission.

Another reason that sound is not often included in educational software is that it simply costs more in terms of time, money, and computer resources to include it than to leave it out. Sound is an investment that can only weakly point to learning improvement, and then usually only in combination with other interventions. So, unless it can be shown that sound can lead to some kind of improvement in learning, there is little reason to include it.

This paper investigates the effect of sound as a presentation modality on the way students review procedures learned at the moment the procedures are first being applied. It reports on a series of three experiments conducted at various times in the one and a half years before October of 2004. The findings of each experiment generated the questions investigated in subsequent experiments, with the result that the experiments form a series. The outcome of the series is that there appears to be an effect on student reviewing habits that is influenced by the modality in which the review material is presented. This takes the form of a preference for listening to the presentation when the desire to complete the task makes it important to know how it is done and when learning on the first time through was incomplete.

Introduction

As educators, we'd like to make learning more likely to occur for our students. We introduce educational software in the hope that it will be instrumental in bringing about the changes that we identify with learning having taken place. The changes frequently take the form of increases in the ability to provide answers to questions about some aspect or aspects of the subject matter of the instruction. In other cases, the changes we seek to bring about are new or improved proficiencies in the performances of various tasks. When the learning we desire falls into this latter category, it makes little sense to measure it as if it were the ability to answer questions. If we wish to measure the ability to perform procedures, we need to measure how well or frequently the procedures are performed after the learning experience.

When we teach people to perform tasks in the context of using computer programs, their learning is rightly measured by setting up the conditions in which the tasks are performed and turning the learners loose to do what they've been taught. A suggestion that learning hasn't taken place because the learners are unable to answer some questions is irrelevant to the purpose for which the instruction was undertaken in the first place.

A perennial discussion in Educational Technology classes is about whether media choices impact learning. Richard Clark's (1981) claim that the media that delivers content has no influence on the learning of that content is substantiated by a meta-analysis that is based on a shortage of consistent valid studies that, in some way, show that any one delivery medium outperforms any other delivery medium at delivering the same content. A set of studies I conducted comparing a spoken with a textually presented lesson is subject to the same criticism. But by shifting attention away from learning and focusing on behaviors, they provide a small amount of evidence that media influences how students act in the light of learning without showing that they learn more from one medium than the other.

There exists with any procedural learning a brief instant in which the learning of the procedure is completed and the application of the procedure is not yet tried. This is a moment in which we hope that the learning we have been anticipating has, indeed, been produced. If, for instance, a learner is instructed in the business of tying knots and is then handed a rope, the time interval between when the rope is introduced and the first knot is tied is a moment of hopefulness. What the learner does at this moment is an indication of the effectiveness of what we have put forward as a learning experience. The studies I conducted all share an examination of this moment after the textual or auditory learning experience has taken place. They do so in the belief that a difference in what the learner does at this point is as surely a difference in learning as a difference in outcome examination scores.

Experiment 1

In the first study, each of 29 educational technology undergraduate students completed one of three versions of an interactive software tutorial before attempting to apply the learned procedure. The three treatments differed by presenting the instructions for the procedure only with text, only with spoken audio, or with an available choice between text and audio. At the end of the lesson about recording sentences and arranging them so that clicking a hidden button activated them, many students concluded the lesson with a sense of having forgotten the earlier parts of the procedure while learning the later parts. It was clear that being able to go back into the material to review it was a feature that many students expected. The option of reviewing was not yet included in the design of the software at the time. Because the students were intent on succeeding with the procedure, they followed a path to review the material by reopening the tutorial program. They were completely unaware that a timer was running in the original tutorial program to monitor their performance over time. When they re-opened the program, they reset the timer. The experiment, for all practical purposes, was useless. But I didn't know this until I talked with the students a week later.

In the intervening week, analysis of the data pointed in the direction of concluding that the reading-only treatment resulted in a higher number of procedure completions than the listening-only treatment. When I approached the students with this result, students in the listening-only version suggested two plausible explanations. The first was that as college students, they were in a group for whom reading was a well-executed strategy for learning. They felt that there is a natural progression from listening to reading modality built into the structure of academic institutions. In other words, college admissions and retention naturally select strong reading skill as a trait.

The other explanation was that the reading version students appeared to have more time. This was not a part of the design of the experiment, and clearly invalidated any conclusions that could be reached about how the treatments affected performance. But it appeared that many more of the students randomly assigned to learn by reading made efforts to review when compared with those randomly assigned to learn by listening. 21 students were in these two groups. The other 8 were in the switchable version of the software. Of 11 students who were assigned to learn by listening, only 2 initiated procedures to review the program. On the other hand, 7 of the 10 assigned to learn by reading initiated procedures to review. The distribution of students to groups and their tendency to reset the timer is shown in table 1. Chi-Square analysis of data related to this phenomenon, and shown in table 1, indicates that the likelihood that chance could account for this difference is less than .05. (Chi-Square = 5.47, Asymp. Sig. = .019)

Table 1: *Students who reset the timer by unanticipated reviewing*

| Version | N | Students resetting timer | Anticipated # resetting timer |
|------------|----|--------------------------|-------------------------------|
| Reading | 10 | 7 | 4.5 |
| Spoken | 11 | 2 | 4.5 |
| Switchable | 8 | NA | |

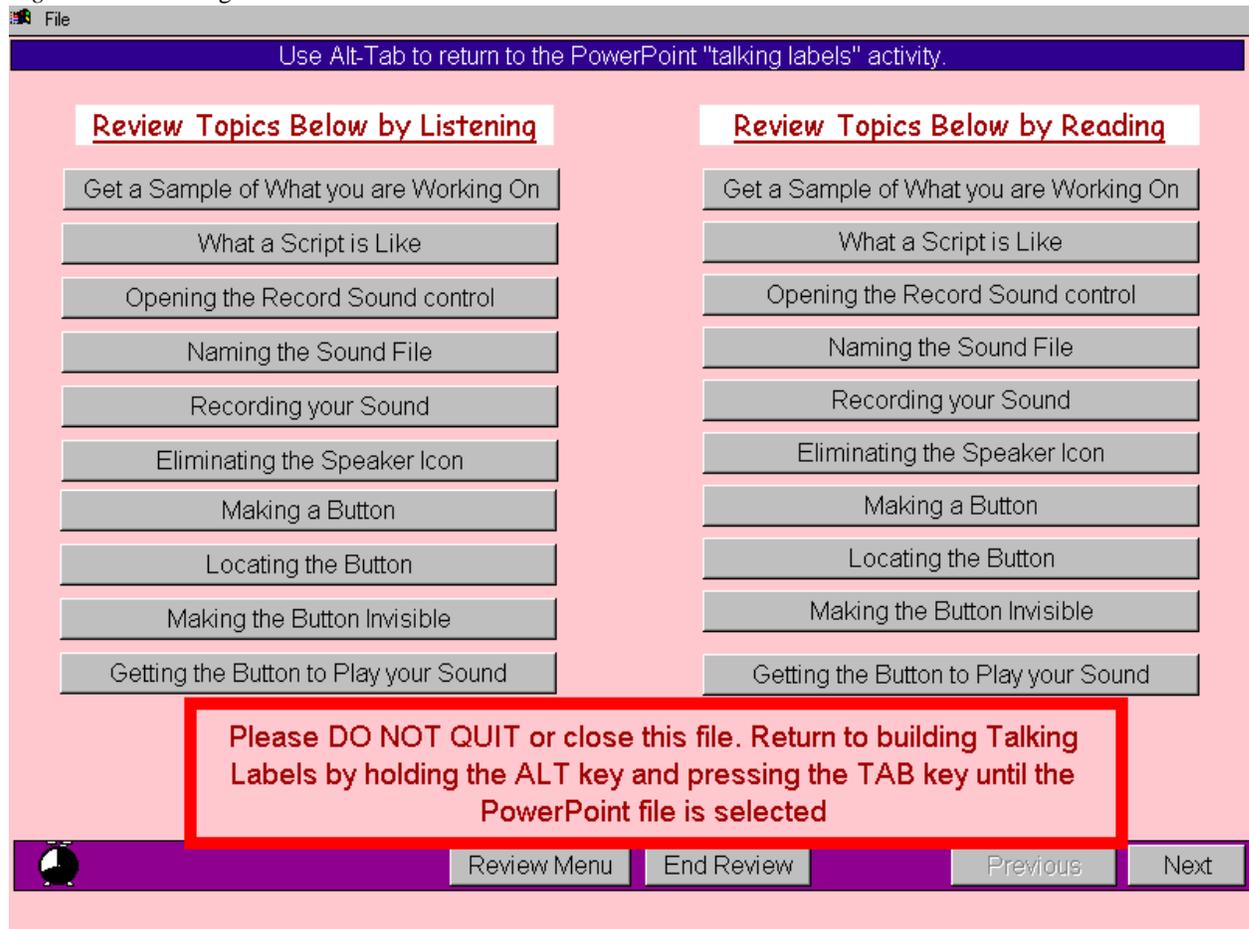
There was no reason not to notice that while students in either treatment group had equal opportunity to reset the program timer by attempting to review, nearly all students who did so had experienced the reading modality treatment. The ability to review by going back to the presented text is a natural affordance of reading - something we expect to be able to do. Although we have the technological means to do so, when we hear a speaker talk, we do not expect to be able to recapture what we heard in other instances. This is a major difference between a temporal medium like speech and a non-temporal medium like printed text. The use of a non-temporal medium leads to a stronger expectation that reviewing is supposed to be allowed.

Experiment 2

The second experiment arose from the first explanation that college students were a selected group of strong readers who would naturally favor learning by reading. It sought to investigate the effect reading level had on learning from different modalities. Studies conducted by the US Department of Education in the 1970s (Taylor, 1972) established the general guideline that children favor listening over reading as a learning modality through the 6th grade. Beyond this age, high levels of practice with the encoding and decoding of text make text a more efficient learning modality, and one that most learners prefer because they can learn more quickly by reading rather than by listening. Because 7th graders were thought to be near the transition point where text becomes the dominant modality, I felt that they were likely to still regard learning by listening in a favorable light. This experiment set out to compare modality effects in two populations, one of college undergraduate students and the other of 7th graders. The expected learning superiority of undergraduates showed up and was significant. But what was being measured was the relative advantage of the listening modality between groups. Although the 7th graders measured showed a higher mean benefit from the listening modality than did the undergraduates, this difference failed to reach a significant level.

The software used for this experiment had been modified from the previous version to keep track of reviewing habits. At the conclusion of the tutorial, the user was informed that there was access to a way to review while engaged in the task. This way to review exposed both the listening and reading modality material to the learner. The reviewing choices offered to students are shown in figure 1.

Figure 2: Reviewing choices offered to learners at the conclusion of the tutorial lesson



Learners who had learned by reading could choose, if they wished, to review in the listening mode. Similarly, learners in the listening modality treatment group could, if they desired, choose to review by reading their previous instruction as text on a screen. Because of the exposure to the alternative presentation modality in the reviewing mode, the rate at which the task was performed after the tutorial could not be attributed to the mode in which it was presented. However, the entire group of students who used the reviewing feature at all, regardless of whether they were part of the 7th grade or the undergraduate population, chose to review the majority of the time in the listening modality. Data related to this phenomenon is shown in table 2. The choice to do most of the reviewing as a listening experience was significant at the pre-determined alpha = .1 level.

Table 2: *Reviewing choices made by reading level*

| Reading Level | N | LM Chosen | RM Chosen | Chi-square | Asymp. Sig. |
|---------------|----|-----------|-----------|------------|-------------|
| Below Median | 14 | 10 | 4 | 2.571 | .109 |
| Above Median | 18 | 11 | 7 | .889 | .346 |
| Total | 32 | 21 | 11 | 3.125 | .077* |

* Significant at $\forall < .10$

Experiment 3

Because of a low confidence in the previous finding, I replicated the previous study. 25 undergraduate students enrolled in an introductory educational technology course completed a tutorial designed to teach them the same linear label-making procedure. As before, at the completion of the tutorial, they were given a scenario in which they were asked to complete the task multiple times. As they began the task, they were also instructed

that they could review by looking at the original program. The reviewing menu (Figure 1) consisted of two lists of all the available steps in the procedure, one of which was in a column indicating that they could re-read the step, the other of which was in a column indicating that they could listen to the step. So a choice of reviewing presentation mode was always offered to students at the time they needed to retrieve procedure information. Of the 25 students who completed the project, 17 reviewed while engaged in the task. 14 of the 17 conducted the majority of their reviewing of the procedure's steps in the listening modality (Chi-Square = 7.118, Asymp. Sig. = .008). This result is shown in table 3.

Table 3: *Favored (majority) reviewing modality used by student*

| | N | Reading | Listening |
|---|----|---------|-----------|
| Completed Presentation in Switchable Modality | 25 | | |
| Favored for Reviewing | 17 | 3 | 14 |
| Initially Chosen for Reviewing | 17 | 1 | 16 |

Because the learners could freely choose between listening and reading mode presentations while they reviewed, their initial choice of reviewing modality may not have coincided with their majority choice. The initial choice to review in the listening modality occurred 16 of the 17 times that reviewing occurred (Chi-Square = 13.235, Asymp. Sig. = .000). Regardless of the path they chose for going through the tutorial, at the point where they first sought help before beginning to apply their knowledge, their choice was consistently to have somebody tell them how something is done rather than read how something is done.

Discussion

Does the media have an impact on the learning experience? Robert Kozma (1991), in responding to Clark claimed that media are an integral part of the design process. He elaborated that the whole instructional package is designed to include specific media because the designers anticipate the user acting and reacting with that media. Reviewing at the beginning of the task is a critical point where the interaction of the user and the media takes place. Hannifin and Land (1997) advocated using technology to give students choices in their learning process. The choice of how reviewing material is to be presented is a choice that can be included and uses the capacity of multimedia to facilitate review.

At the end of a tutorial about a computer procedure, the best guarantee that the student has learned the procedure is to observe the procedure being put into action without further guidance. Unfortunately, students do not always end the tutorial with sufficient confidence to expect to complete the procedure successfully. Reminders at the point where the procedure is being applied can be helpful. Such reminders can take many different forms. Job aids, for instance, exist for the sake of reminding performers what they already know but may not immediately remember.

When a computerized tutorial is immediately followed by a computerized task, the learner is being asked to demonstrate the learning in the exact environment where the learning took place. This is why computerized multimedia learning is an ideal teaching tool for teaching computer-related procedures. Except for possible savings of computer memory – which by now is a non-issue – there is little reason to close the tutorial. Keeping it open makes it convenient as a support to the performance just learned. In effect, the learning material switches its function to that of an electronic performance support tool. And at the point where this switch occurs, learners consistently choose to have the instruction presented to them in auditory form.

Students in the classes concerned, when asked for their opinions about why these results were obtained, offered very few potential answers. Among the suggested explanations was a greater sense of security with a speaking voice. We ought not to forget that language is a spoken representation of the phenomena observed in reality, and printed text is an abbreviated form of language. Text gains its non-temporal advantages at a cost of leaving out inflection and accent. It appears, from the results obtained, that when students want critical small bits of the information about a procedure they just learned, they want it in a way that delivers as much of the meaning as possible.

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The Development and Evaluation of Multi-Level Assessment Framework for Analyzing Online Interaction

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Abstract

Interaction is one of the key variables involved in successful online learning. Previous studies analyzing online interaction are limited in their ability to reveal dynamic aspects of interaction in online learning environments. The aim of this study is to develop and test the multi-level assessment framework for analyzing multi-facets of online interaction. To achieve this purpose, a multi-level assessment framework including micro-assessment and macro-assessment was proposed. The multi-level assessment framework, then was tested with the data collected from an online course. This study suggests that multi-level assessment framework provides us with different kinds of information that helps us to understanding interaction in online environments.

Introduction

The rapid development, in recent years, of Internet technology has changed the nature of interaction in online environments. As a result, there is raised concern over how to assess the interaction of online environments. Previous studies analyzing online interaction have focused mainly on either micro-level analysis or macro-level analysis. The micro-interaction analysis is to examine the content of the information acquired in the process of interaction (Henri, 1991; Offir & Lev, 2000; Oliver & Mcloughlin, 1996). The macro-interaction analysis, on the other hand, is to examine the flow or patterns of interaction (Henri, 1991; Levin, Kim, & Riel, 1990).

Although these methods provide us with a tool for identifying the nature of the interaction occurring in online environments, they are limited in their ability to reveal dynamic aspects of interaction in such environments. Each analysis method has a limitation in which it does not completely cover the dynamics of online interaction. The multi-facets of interaction in online environments require us to build a more comprehensive assessment framework that will encompass various assessment methods proposed in previous studies. Analyzing interaction at both micro and macro levels is expected to provide us with different kinds of information that helps us to understand interaction in online environments.

Therefore, the purpose of this article is to propose and test a multi-level assessment framework for analyzing interaction in online environments. To achieve this purpose, we first propose the multi-level assessment framework for analyzing online interaction. Next, we evaluate the multi-level assessment framework with the data collected from an online course.

Multi-Level Assessment Framework for Analyzing Online Interaction

An initial study proposed a systemic assessment framework to analyze online interaction. Song (2003) proposed a multi-level assessment framework to analyze various aspects of interaction in online environments. According to his framework, the unit of analysis at the micro level is the individual message. The content analysis of individual messages uncovers the nature of shared information. As a result of this microanalysis, each individual message can be divided basically into two main dimensions: cognitive and social. The dimensions can again be divided into more specific sub-dimensions according to the nature of the interaction between participants. At the macro level, the unit of analysis is multiple messages. Since individual messages are related to other messages, they form a multiple message combining those individual messages. Therefore, macro-analysis gives a good initial approach to sketching out the big picture of an interaction and can serve as a way of identifying messages to be analyzed more deeply. It also gives a context to the individual messages as they are analyzed at the micro level.

However, this framework had a limitation in that it did not provide specific guidelines in its application. Therefore, one of the goals of this current study was to investigate whether the framework would be useful to analyze online interaction. While testing the framework, we identified critical categories and assessment criteria for each category. Table 1 shows multi-level assessment framework that includes assessment levels, assessment units, assessment categories, and assessment criteria for analyzing online environments.

Table. 1 *Assessment Levels, Assessment Units, Assessment Categories, and Assessment Criteria*

| Level | Analysis Unit | Analysis Category | Analysis Criteria |
|-------|--------------------|---|---|
| Micro | Individual message | <ul style="list-style-type: none"> • Cognitive dimension | <ul style="list-style-type: none"> • One way communication • Process (procedure, expository, explanatory) • Cognitive trust |
| | | <ul style="list-style-type: none"> • Social dimension | <ul style="list-style-type: none"> • Two way communication • Process (development of identity, development of social climate, and managing the affective factors) • Social trust |
| Macro | Multiple messages | <ul style="list-style-type: none"> • Patterns of Interaction | <ul style="list-style-type: none"> • Work patterns (dropouts, crammers, regular periods) • Type of participation (lurker, persistent) |
| | | <ul style="list-style-type: none"> • Depth of interaction | <ul style="list-style-type: none"> • Number of threads • Numbers of participants per thread • Length of posting |
| | | <ul style="list-style-type: none"> • Purpose of interaction | <ul style="list-style-type: none"> • Introduction • Clarify, question, elaborate • Conclude |

Analyzing interaction at the micro-level, there are two clearly identified dimensions in the literature: cognitive and social. We define the cognitive dimension as the processing and organization of information in order to create knowledge while the social dimension as social presence including affective elements to create a community of learning. In addition to these two broader dimensions, we have identified three categories of sub-dimensions that can be used for both cognitive and social interaction research: type of communication, processes, and trust. First, in comparing cognitive and social interaction, there is a difference in the way that on-line participants communicate. Another subdimension that can be studied in assessing cognitive and social dimensions of on-line interaction is the processes used to create knowledge and a community of learning. The most commonly used categories for the cognitive dimension are Gunawardena, Lowe, & Anderson's procedural, expository, and explanatory. While Gunawardena, Lowe, & Anderson framework is often used to categorize cognitive processes, there is no corresponding framework accepted by experts. In fact, Gunawardena, Lowe, & Anderson model does include a category of "social processes" in addition to procedural, expository, and explanatory. However, we have identified corresponding categories that are the elements in creating learning communities: development of identities, developing social climate, and managing the affective factors. The last subdimension we have identified is cognitive and social trust. Kanawattanachai and Yoo (2002) identify the factors that establish cognitive trust as reduction of complexity, reliability of functions and information exchange, and delivery of promised action and information. Social trust is those factors such as empathy, emotional support, and free expression, that are the basis for social interaction and relationship building.

The macro analysis looks at long term participation and interaction to identify patterns and trends in on-line learning. Based on the literature and our own analysis, we developed three main areas for macroanalysis: patterns of interaction, depth of interaction, and purpose of interaction (DeLaat, 2001; Garrison & Anderson, 2003; Gunawardena, Lowe, and Anderson, 1997; Henri, 1991; Hwang & Wang, 2004; Mazur, 2004). While each area of the macro analysis has its own characteristics, it is important to look at how each affects the overall pattern of interaction. It is the combination of factors that researchers need to look at when determining what is happening at the macro level (Howell-Richardson & Mellar, 1996).

The Contexts for Evaluation of Multi-Level Assessment Framework

Participants

Multi-level-assessment framework for analyzing interaction in online environments was evaluated with the data collected from an online course. The participants in this study were twenty graduate students who taking an online course in Educational Technology program at a major university located in the northeastern United States.

Data Collection and Analysis Procedures

All participants took part in an online group discussion. The online group discussion was conducted as an extra-credit activity for the course and was facilitated via a web-based bulletin board, "Web City". The discussion took place over a one week discussion period. Participants were randomly assigned to two different types of group discussions: an instructor-moderated discussion or a student-moderated discussion. The discussion case involved Internet security issues: "Why privacy and security of personal information on the Internet became an increasingly important issue? Who is responsible to protect children's privacy and security? What can we do in order to protect children's privacy and security in classroom? ". Students in a student-moderated discussion group discussed and created roles related to the problem case, chose their roles, discussed the problem case with their group members, and completed a discussion. On the other hand, the students in the instructor-moderated discussion group followed the same procedure, except that they did not create and select a role. Data were analyzed using the categories of the multi-level assessment framework developed in this study.

Results

Micro-Level Analysis

Cognitive Dimension

Communication Type. For the most part, communication in the cognitive dimension is a one-way transmittal between the sender and receiver (Chen, Wong, Hsu, 2003). Interaction between teacher and student, for example, often falls into the cognitive dimension. As the example below illustrates, the instructor does not expect any feedback from the student on the content of the information unless the student has questions. This is teacher initiated with the expectation that further interaction will need to come from the instructor. For example, in the on-line discussions, the instructor wrote:

The main task in today (Monday) and tomorrow (Tuesday) is to read the problem case and create three important roles that we will play. To create the roles, I hope you find answers to the following questions:... [Posts four questions]...Please post a note(s) in which you show a role that you feel most important to solve this problem before Tuesday.

It is clear that this is one-way communication with the instructor initiating the discussion and the student expected simply to respond. Chen, Wong, and Hsu (2003) associated this dimension with strictly teacher-student interaction. However, student-student interaction can also have this cognitive dimension. In the following example, the student, like the instructor above, initiates the interaction and does not expect any feedback from the other group members. Any further communication about the information provided will need to be initiated by the student that posted the paper.

The problem is how can we provide for children's privacy on the Internet that is effective, cost effective, and reliable? The answer is very complex and I am attaching a paper about this.

Process of Interaction. First, the procedural interaction can take the form of orienting, subdividing the problem, and designing (Gay & Lentini, 1995), task description, scheduling, or identifying tools and techniques to be used (McFadzean & McKenzie), goal and objective creation (Owen, Pollard, Kilpatrick, and Rumley, 1998) or teacher designed framework within which students are expected to work (Moaliem, 2003, Thorpe, 2002). In our research, the instructor gave students a general framework on tasks that needed to be accomplished and a schedule of due dates. Throughout the course, at key points when tasks needed to be accomplished, he would give further directions on how to accomplish a certain task. Students also set their own schedules and procedures within the course such as:

I have posted a response to (Student Name)'s essay that bridges from the material that I posted yesterday. I think that you will find my opinions and views there, as well as in the framing remarks that I made before posing some of the illustrations from the AOL model...If you have ideas as to how to compile our team report, I am open to them. One way to compile a team report might be to thread them with one another here. Or perhaps we open another thread to do this. This is new ground that

we are exploring so I think that we will have to figure out what we are doing together with this as we are doing it.

Another component to processes is expository interaction. Expository interaction can include organization of information, concepts put into different contexts, or representation of knowledge (Cunningham-Atkins, Powell, Moore, Hobbs, Sharpe, 2004), evaluation/application, problem identification, definition, exploration (Newman, Webb, & Cochrane, 1992), moving from concrete to abstract ideas (McMahen, 1995), or summarizing concepts (McFadzean & McKenzie, 2001). An example of this is an instructor posing questions in order to illicit student ideas or information such as the sample above when the instructor posed 4 questions for the students to answer. Another example of this is a student posting answers to a question. The interaction in this component focuses on the content and usually is a result of well-structured instructional design (Moallen, 2003; Thorpe, 2002).

Finally, the explanatory interaction, often (although not always) is a response to questions raised during expository interaction. Often it is the instructor that will provide explanation, although other students can fill this role, especially in smaller group activities. Explanation may require negotiating understanding (Gay & Lentini, 1995), integration or general clarification, in-depth clarification, inference, judgment (Newman, Webb, & Cochrane, 1992) or determining the information gap and what is needed to close it (Kayworth & Leidner, 2001/2002). In the case of our research, the instructor used explanatory interaction to clarify tasks and goals in accomplishing tasks. However, he also summarized key points at the end of the tasks, which acted to explain the issues and concepts presented in the course. While this is an obvious example of explanatory interaction, student explanations also help in the developing understanding. For example,

I need to offer a disclaimer. The material that I posted to get things going yesterday were elements of AOL's way of responding to these issues. AOL has certainly been very successful as a business in general and as one which must be attentive to these privacy and security issues.

In this case, the student was offering further insight into readings he had posted on the previous day. He felt that the student he was writing to may not have understood the basis of the information, based on her response to his original posting.

Cognitive Trust. Cognitive interaction needs information and processes that are reliable, productive, and relevant to the task. In the following case, the student is questioning the reliability of the information on which she needs to base a paper. She also has identified a flaw in the process, an indication of lack of cognitive trust.

I am not sure if I can write the final paper because I feel there is information missing from all groups. I know that there is information missing from the parents group because at least one of {student name}'s and one of my postings wasn't in the summary.

Social Dimension

Communication Type. In developing a learning community, the interaction tends to be two-way (Chen, Wong, Hsu, 2003). The receiver is expected to contribute equally to the communication process as the sender, initiating feedback even when it is not elicited. The level of communication is deeper and more complex, as defined by Henri (1991). Communication initiated by the student to the instructor can be an example of the social dimension. The following example demonstrates an equality in the initiation of ideas:

After posting the responses to a questionnaire: To tell the truth, while I didn't quite follow your schedules, I still think that your initial moderation strategy is pretty impressive and interesting. Personally, I think that if this task was not scheduled almost toward the end of this semester, we should have been able to proceed this discussion with more fun. Unfortunately, at this point of time, we have many homework or projects due, which distracts us from discussion more or less. Isn't it?

One limitation to using the direction of communication is that it excludes content and purpose of the interaction. In fact, some two-way communication can be cognitive and some one-way communication can indicate social interaction. As a result, assessment of this subdimension alone does not indicate one type of dimension, but rather it helps identify the nature of the interaction.

Process of Interaction. The first subdimension, developing identities, focuses on creating a group identity. In creating a group identity, members explicitly or implicitly determine the norms of group behavior, interaction conventions, shared language, and identification with the community (Kling & Courtright, 2003;

McFadzean & McKenzie, 2001; Owen, Pollard, Kilpatrick, & Rumley, 1998). This is achieved through group involvement, creating feelings of contentment and belonging, and creating new symbolic convention and communication codes (Oren, Mioduser, Nachmias, 2002). In the data we analyzed, group members began their e-mails by greeting others with their group name, e.g. "hi government group". This clearly identified the group members with the "government" group, establishing membership through the team name. Another example of establishing identity was the student that referred to "we" in stating the group's position. By using "we" and "us" she is identifying two groups that have different membership requirements. Not everyone can be "us", only those in the business group. Part of the business group, she wrote:

Would you expect us to comply with those regulations or even contribute to this community's growth once we are out of business?

The second aspect of social processes, developing social climate, focuses on creating the behavioral norms, shared language, and interaction conventions of the group (Kling & Courtright, 2003; Owen, Pollard, Kilpatrick, and Rumley, 1998). As a community is created, members need reassurance, trust (Gay & Lentini, 1995), feedback, advice, and support (McFadzean & McKenzie, 2001). This is often achieved through socializing and the exchange of personal information (Moaliem, 2003; Rovai, 2002; Vissar, Plomp, Amirault, Kuiper, 2002). This socializing helps to develop group norms and values that are the basis for the on-line community. The social climate can be negative or positive. It is obvious that student to student interaction makes up a large part of this aspect of social process. For example, one student summarizing another's ideas ends with, "hopefully I'm representing you correctly! If not, just add at will." Social climate may need to be moderated by the instructor. In fact, instructor interaction may set the tone for the social climate. For example, by beginning instructions for student tasks with "I am so happy to work with you", the instructor is setting the tone for social interaction expectations. In other words, all group members should be open to working with others in their group. The instructor is also implying that work is a collaborative effort, not a transfer of knowledge from instructor to student. He clearly states that he is working *with* the students, not that the students are doing work *for* the instructor.

The last aspect of creating a community is recognizing and managing the affective factors that students, the group, and even the instructor have. This may include participant emotions and feelings (Vissar, Plomp, Amirault, & Kuiper, 2002), motivation, conflict and conflict resolution, student control and efficacy (Moaliem, 2003), tolerance of ambiguity, and comfort with technology. This is the hardest subdimension to identify, since affect is not always expressed explicitly. In face-to-face interactions, participants can see non-verbal social cues such as body language, eye contact, and changes in the voice. On-line interaction does have non-explicit social cues, however. For example, the student in the following posting:

Many of the teacher concerns are similar to the parental concerns, because the teacher can give online consent for the parent in a school setting.

Social Trust. Social trust is based on empathy, free expression and emotional bonds (Kanawattanachai & Yoo, 2002). These are the affective attributes that are the basis for community and the creation of identity within the community. Social trust can affect group processes (Hiltz, 1998), group loyalty, motivation, and shared knowledge creation. One major cause for lack of social trust is a lack of social presence by both instructor and/or students. The following is an example of how social trust is established:

I leave for Kansas City at 6:25 a.m. Thursday, arrive back in Philly at 11:45 p.m., then take my dad to Hopkins for an appointment in Baltimore at 8:30 a.m. Friday...I will not be able to respond to everyone's posts tomorrow, in other words. I will check in and post on Friday evening.

In this case, the student is explaining his lack of social presence for the next few days. As a result, he is creating expectations, which establishes social trust. He also gives some personal information which can create feelings of empathy and an emotion bond with the group members.

Macro-Level Analysis

Patterns of Interaction

Looking at the posting patterns, who posted when, we could get an idea of student work patterns. As shown in the Table 2, we found that one group did not post during last three days. Although more than one week's worth of data would be necessary to determine trends, looking at postings throughout the entire course, we could determine if this was their regular work pattern. According to Hwang & Wang (2004), there are three different types of student work patterns: dropouts, crammers, and regular periodic reading learners. Dropouts

tend to have bursts of activity at the beginning of an on-line activity, then stop contributing and/or drop out of the course. Crammers have bursts of posting activity around due dates or at the end of an activity, not contributing until they have to. Regular periodic reading learners may post regularly or may have multiple bursts of activity. However, they develop a sense of presence throughout the activity. By identifying student work patterns, researchers can test various instructional designs for effectiveness, identify factors that enhance or impede participation, and determine system usage rates. As shown in the Table below, students in group A seems to be more dropouts where as those in group B seems to be more regular periodic learners.

Table 2. *Patterns of interaction*

| Person | Date | | | | | | | | | | | | | Total |
|---------|------|------|------|------|------|------|------|------|-----|-----|-----|-----|-----|-------|
| | 3/24 | 3/25 | 3/26 | 3/27 | 3/28 | 3/29 | 3/30 | 3/31 | 4/1 | 4/2 | 4/3 | 4/4 | 4/5 | |
| Group A | | | | | | | | | | | | | | |
| 1 | 6 | | 2 | 8 | | 3 | 4 | | | | | | | 23 |
| 2 | | | 1 | | | | 1 | | | | | | | 2 |
| 3 | | 1 | 1 | 2 | 1 | | 2 | | | | | | | 7 |
| 4 | | 1 | | | 1 | | | 2 | | | | | | 4 |
| 5 | | 1 | 1 | | 1 | | 1 | | 1 | | | | | 5 |
| 6 | | | 1 | | | | | 2 | | | | | | 3 |
| 7 | | | 2 | 2 | 1 | 1 | | 1 | 1 | | | | 1 | 9 |
| 8 | | | 2 | | | | | | | | | | | 2 |
| 9 | | | 2 | 1 | | | | | 1 | | | | | 4 |
| Total | 6 | 3 | 12 | 13 | 4 | 4 | 8 | 5 | 3 | | | | 1 | 59 |
| Group B | | | | | | | | | | | | | | |
| 1 | 5 | 4 | 4 | 3 | | 7 | 1 | | | 2 | | | | 26 |
| 10 | | 2 | 1 | 1 | | | | | 1 | 1 | | | | 6 |
| 12 | | | | | | | | | 2 | | | | | 2 |
| 13 | 1 | | 3 | 1 | 1 | | | | | | | | | 6 |
| 14 | | 3 | | 1 | 1 | | | | | | | | | 5 |
| 15 | | 2 | 1 | 1 | 2 | | | | | | 1 | | | 7 |
| 16 | | 1 | 2 | 8 | 3 | | | | 3 | | | | | 17 |
| 17 | | | 1 | | 2 | | | | | | | | | 3 |
| 18 | | | | 1 | | 1 | | | | | | | | 2 |
| Total | 6 | 12 | 12 | 16 | 9 | 8 | 1 | | 6 | 3 | 1 | | | 74 |

Related to the patterns of interaction is the type of participant in the interaction process. In the macro-level analysis, we are concerned with how a participant affects the interaction process, not the prescribed role he/she or the group assigns the participants. Mazur (2004) identifies two of these roles as the Lurker and the Persistent. The Lurkers may not make their presence known except at key points in the course (such as assignment due dates). However, their postings indicate that they are keeping up with the group interaction. The Persistent contributes despite negative or no feedback. In table 1, Student # 9 was a Lurker. There was no posting from March 27 to April 1. However, in reviewing the April 1 posting, many of the group's postings were incorporated into the student's final comment. This indicates that the student, while not actively posting, did review other group members' contributions.

Depth of Interaction

The example in Figure 1 demonstrates how multiple threads can be related. Message 617 resulted in 5 direct postings. However, two additional threads were indirectly related to this initial message. One was a group discussion without instructor direction generated as a result of message 617; the other was a summary of discussion (appointment of group roles) as a result of message 617. The breadth of discussion in this case was much more than an index of threads would indicate. The complexity of the interaction and the non-linear sequencing are more accurately illustrated in the conversation map. Looking at the lengths of the postings and the time between postings help indicate the level of urgency in the interaction and the amount of thought that

may have gone on in posting. For example, in message 639 the student indicates that she is confused about the assignment. The message is short (less than 10 lines) indicating urgency. Three additional messages are exchanged in a direct thread within the next 24 hours. Each of these are medium or short messages. Comparing this with the related thread starting with message 660, these messages are longer and posted with more time between each one. The depth of the interaction appears to be deeper with message 660 than 639, even though both have the same number of postings. On the other hand, message 639 appears to be more urgent, with a need for a definite conclusion.

Purpose of Interaction

In order to understand what is going on in a sequence, each posting should be characterized as to what it is doing in the interaction. Mazur (2004) identifies three different characterizations of a posting: initiation, repair, and close. She further defines repair as including clarification and elaboration. We would add to this questioning. In initiation, the topic thread is introduced. Message 617, for example, begins the discussion by giving instructions on what the assignment is and how students are expected to proceed in the discussion. In response to this, some students elaborate by posting their answers to the assignment (messages 658, 620, and 626). By posting the assignment, each of the students also finishes the conversation/topic. However, message 655 elaborates by postponing the assignment. As a result, the topic is picked up later under another thread starting with message 660. Clarification is usually in response to a question or problem. In message 639, for example, the student is unsure of the assignment (resulting in a question). The instructor clarifies the assignment. The student elaborates on the assignment, indicating why there was confusion. The instructor then clarifies the source of the confusion and finishes the topic. In reviewing the purpose of the interaction, the end of the threads should have a concluding statement. However, when a conclusion is missing, this is an indication that either the topic is being continued somewhere else (as with message 655) or it has not been thoroughly discussed. By analyzing the sequencing of the conversations, researchers can determine how best to facilitate on-line interaction, interaction motivation, barriers to interaction, and timing of assignments and modules. This type of analysis also allows for the identification of related threads and ideas between threads (Henri, 1991; Howell-Richardson & Mellar, H., 1996).

Conclusion

The purpose of this paper was to develop and test the multi-assessment framework for analyzing the multi-facets of online interaction. The macro analysis helps researchers to identify trends and generate questions that can only be answered in a microanalysis. On the other hand, the microanalysis needs a context outside of the message that only a macro analysis can provide.

The application of this framework has provided several areas for further studies. First, in applying the microanalysis to an actual on-line discussion, we discovered that it was difficult in some group interactions to separate the cognitive and social interaction. Henri (1991), in fact, developed four categories, social, cognitive, metacognitive, and interaction. Since we are looking at all interaction, the last category could be renamed socio-cognitive interaction. Future research should look at those aspects of interaction, especially within group processes, where there is both social and cognitive interaction at the same time. Second, The macro analysis of on-line interaction must include various factors as: technology used, the interaction environment (synchronous vs. asynchronous), stated goals of the interaction (topic, field of study, task), and events or unplanned interruptions that took place during the interaction (Garrison & Anderson, 2003; Mazur, 2004). This description will explain any constraints or limitations in the macro-level analysis. Finally, this framework needs to be tested in various contexts and needs to establish interrater reliability.

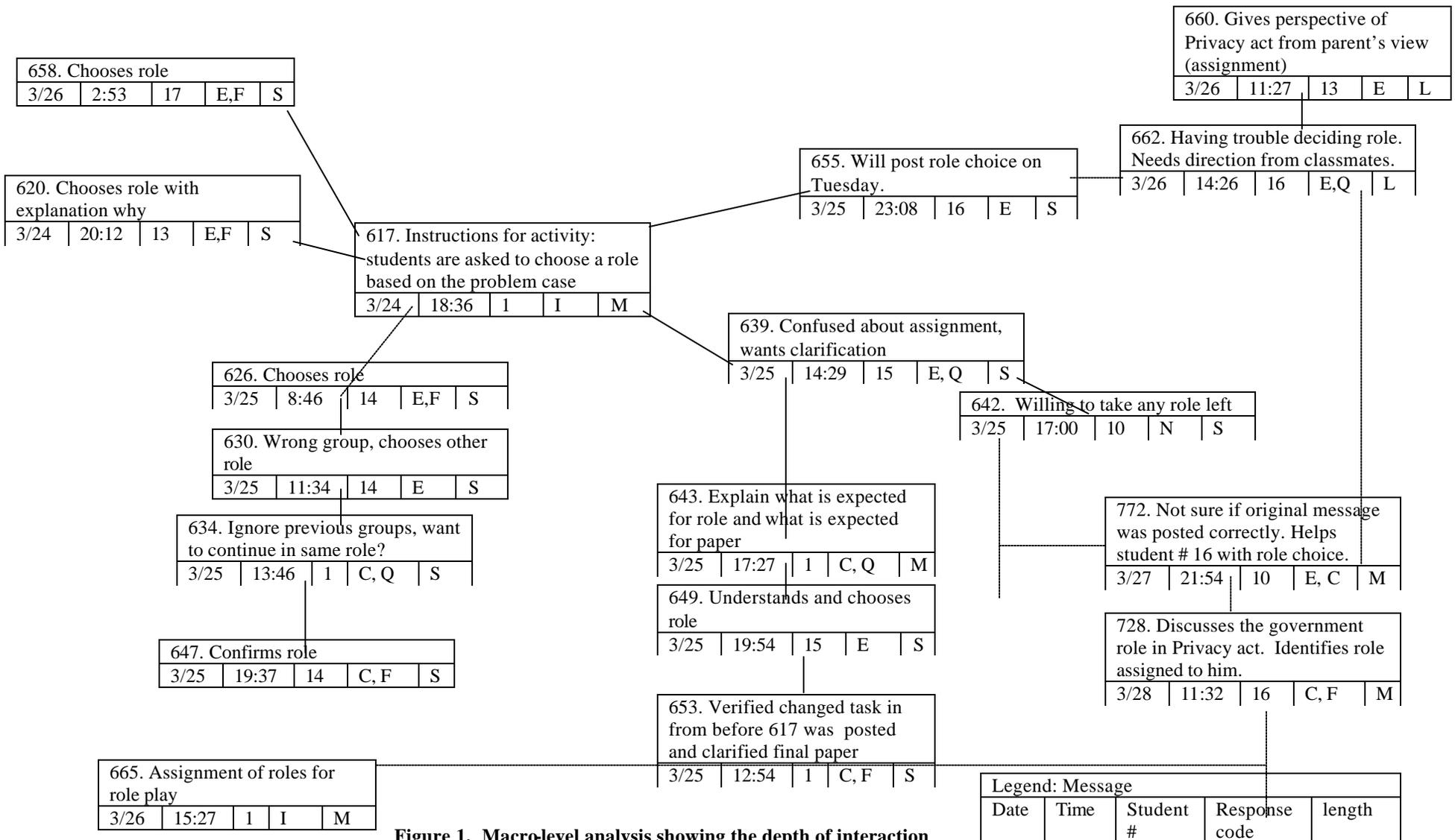


Figure 1. Macro-level analysis showing the depth of interaction

Note 1. Response Code: I=Initiate E=Elaborate Q=Question C=Clarify F=Finish N=Not related. Note 2. Length Code: S<10 lines M: 10-20 lines L>20 lines

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Public School Teacher Use of Instructional Technology from an Organizational Culture Perspective: An Explanatory Case Study of Two Middle Schools

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Abstract

The purpose of this qualitative case study is to study the organizational culture and context of two school sites in which instructional technology (IT) use by teachers is evident; to study what and who influences individual teacher preferences toward IT use; and to describe the relationship of Mary Douglas' (1982, 1989, 1992) grid and group typology in the decision process to implement IT use in curricula.

Statement of the Problem

Public schools have increased the amount of technology available to teachers, assisted in increasing teachers' familiarity with technology through training, and supported and encouraged the use of technology through administrative directives. In spite of these efforts to increase the use of instructional technology, public school teachers are not using instructional technology to create the anywhere, anytime classroom that was anticipated.

While schools tend to make instructional technology resources available to all who seek them, many teachers refuse instructional technology for a variety of reasons. Rogers (2000) indicates that barriers to instructional technology adoption and integration are found in both internal and external sources:

Internal barriers may be summarized as "teacher attitude" and "perceptions" about a technology, in addition to a person's actual competency level with any technology. External sources include the availability and accessibility of necessary hardware and software, the presence of technical personnel and institutional support, and a program for staff development and skill building. Barriers that cross internal and external sources are lack of time and funding and the unique culture of the institution. (p. 459)

Rogers (2000) and Chiero (1997) summarize several studies of teacher barriers to instructional technology adoption and point out that different studies discover similar barriers. Internal barriers (barriers imposed by the teacher) include lack of time (both personal and release) to learn to use instructional technology and integrate instructional technology, lack of role models (others in the school site using instructional technology), lack of other models for using instructional technology, and teachers' attitudes about instructional technology. Rogers (2000) and Chiero (1997) also summarize external barriers (barriers teachers view as imposed upon them) as lack of availability and quality of hardware and software, lack of time, low levels of funding, low institutional support, minimal staff development, uncertainty that instructional technology affects student learning, and lack of technology support.

In addition to the question of adoption and integration, instructional technology represents a change in the way teachers and school officials operate. Change is always difficult and change in schools often seems even more difficult than in other areas. Gruenert (2000) determined that the culture of the school itself is one major factor in promoting change within schools:

If things do not change it is because the existing culture did not allow it. Understanding what culture is and what it does allows leaders to orchestrate real change. Shaping school culture is not for the timid (Peterson & Deal, 1998) and it takes a long time, five to seven years. (p. 17)

The adoption and integration of instructional technology is a fundamental change in school culture and the education community. Cohen (1987) comments upon change, technology, and schools:

Americans have celebrated technology as a powerful force for change nearly everywhere in social life. . . . Computers are only the latest in a long line of mythologized machines, endowed with near-miraculous powers. . . . Americans are fond of picturing technology as a liberating force Nearly all of the new technologies pressed on schools, from books to microcomputers, also have been advertised as agents of liberation. They would change education by making students less dependent upon teachers, and by reducing whole class, lock-step, batch-processed teaching and learning. (p. 154)

Teachers may be reluctant to embrace the change Cohen comments upon simply because they have found

other changes in the past to be a false-cure for that which ails public education. If, in the past, teachers were quick to adopt innovative changes only to find that the innovations did not solve day-to-day problems, why then should teachers quickly adopt more innovations? For many teachers, it is much easier to address known problems through known solutions. Unfortunately, school cultures that do not promote change erect external barriers to teachers' adoption of innovations such as the integration of instructional technology in the classroom.

Another important facet of the problem exhibits itself in public school education: with school budgets straining under the weight of wide-scale budget cuts and decreased state funding, instructional technology can provide some relief by allowing teachers new, less costly ways of communicating with students and patrons. Yet, teachers cling to older, less efficient, more expensive communication tools. Add to that the ever-increasing emphasis placed on high-stakes testing as mandated by the federal government's *Leave No Child Behind Act*, and instructional technology quickly loses its place among school priorities. Teachers appear reluctant to embrace change.

Moursund (1997) has studied computers in education and has applied decades of personal involvement in computing and the field of education. While he has been an advocate of education reform and continues to believe that technology will have a positive effect on education, his views are tempered by experience:

In retrospect, it is clear that I have been overly optimistic. Educational systems are quite resistant to change. Progress has not occurred as fast as I had thought it would. Still, considerable progress has occurred, and the groundwork has been laid for further progress. It is clear to me that we are just at the beginning of a number of major changes in our educational system that will occur because of continuing progress in information technology. (Morsund, 1997, Preface)

Dexter, Anderson, and Becker (1999) studied teachers' use of computers and studied whether or not computers were an impetus for change. They determined that teachers used computers to facilitate change, but that computers did not cause change. Rather, teachers cited experiential reflection, continuing education, and school culture as the driving force for change. However, not all teachers see instructional technology as a positive change. Goodson and Mangan (1995) found that social studies teachers saw computer instruction as detracting from pure content instruction.

Why then do a small number of teachers embrace change and demonstrate high-level competence and integration of instructional technology while other teachers adamantly refuse to adopt or even experiment with technology? The answer lies in the culture of the school site itself.

Purpose of the Study

The purpose of this qualitative case study is to examine the organizational culture of two specific school sites in which instructional technology use by teachers is evident; to study what and who influences individual teacher preferences toward instructional technology use; and to describe the relationship of Mary Douglas' (1982, 1989, 1992) grid and group typology in the decision process to implement instructional technology. Douglas' grid and group typology provides the theoretical framework for this study. Developed in 1982, the typology has been used to study, decipher, and compare various social contexts in educational settings. Harris (1995) established that the typology is useable when applied to selected educational contexts. Stansberry (2001) applied Douglas' typology to the study of faculty instructional technology preferences in higher education. While this study is modeled after the Stansberry study, this study will focus on teacher preferences in the middle school environment.

Research Questions

The following research questions are addressed in this study:

1. How is instructional technology used in classrooms in each of the selected schools?
2. In what ways does the use of instructional technology reflect grid/group realities in each of the selected schools?
3. What other realities were revealed in each of the selected schools?
4. Was grid/group helpful in understanding differences in teachers' instructional technology use in the selected schools?

Theoretical Framework

Douglas' typology is appropriate for use in studying the length and breadth of social settings. Harris (1995) found that "one of the model's most beneficial aspects is its holistic, comprehensive nature. It is designed to take into account the total social environment and individual member interrelationships among each other and their context" (p. 619).

Douglas' (1982) typology defines both the individual working within a socially constructed group (grid) and the group itself (group) (*see Figure 1*). In this study, the individual is the teacher working within the socially constructed group, the school site. Harris (1995) summarizes the grid and group dimensions: "Grid refers to the

degree to which an individual's choices are constrained within a social system by imposed formal prescriptions such as role expectations, rules, and procedures" (p. 620). "Group represents the degree to which people value collective relationships and are committed to a social unit larger than the individual" (Harris, 1995, p. 621). In short, grid measures the amount of autonomy an individual exercises within the socially constructed organization; group measures the amount which members of the organization value the organization itself.

Each of the dimensions is measured from low to high or strong to weak (Douglas, 1982). In a high grid or strong grid environment, there is "an explicit set of institutional classifications that regulate individual interactions and restrain their autonomy" (Harris, 1995, p. 620-21). In a strong grid school setting, teachers have little say in matters such as curriculum, pedagogy, and operations. In a low grid or weak grid environment, "there are few distinctions among members; individuals are esteemed more for their behavior or character than their ascribed role status" (Harris, 1995, p. 621). Teachers in a weak grid school have much personal control over their curriculum and teaching methodologies.

According to Harris (1995), in strong group settings "there are specific membership criteria, explicit pressures to consider group relationships, and the survival of the group becomes more important than the survival of individual members within it" (p. 622). Strong group schools value collaborative work among all members of the staff and work at creating a single, unified school site. In weak group settings, "pressure for group-focused activities and relationships is relatively weak" (Harris, 1995, p. 622). Weak group schools do not encourage collaborative projects, and there is no evidence of teachers working together for the common good of the school site.

In a variety of ways, grid and group is useful in studying school culture and studying how teachers interact with that culture. Grid and group provides a framework within which individual teachers can be plotted on a scale of their "individuation" (Douglas, 1982, p. 190) and school sites can be plotted on a scale of their "social incorporation" (Douglas, 1982, p. 190).

Methodology

The participants in this study include selected teachers and administrators in two different K-12 school districts within the state of Oklahoma. These two school sites were selected by purposive sampling (Erlandson Harris, Skipper & Allen, 1993), chosen for their differing perceived organizational cultures and differing organizational contexts. Oklahoma State University College of Education faculty members who are knowledgeable of area schools were consulted in this process.

Approval from each school site was provided to the Oklahoma State University Institutional Review Board. Letters were mailed to the school site administrator requesting entry and included a copy of the Oklahoma State University Institutional Review Board application and a signature-ready memo indicating permission to study the school site.

All teachers at the selected school sites were invited to participate in an online survey designed to elicit information to assist in determining the grid and group make up of the school site. The survey instrument was developed out of the theoretical framework provided by Douglas (1982, 1989, 1992). The survey is a product of previous grid and group surveys and discussions with advisory committee members Dr. Ed Harris and Dr. Susan Stansberry, researchers who have studied grid and group typology. The survey consisted of 17 forced-choice statements respondents were required to select one statement of the pair which best describes their school site. Each pair of statements was designed to elicit teachers' perceptions of some aspect of their school site as it relates to grid and group typology. However, the language of grid and group was not used; the language for the statements was drawn from the vocabulary public school teachers would use in discussing their own social environment.

Following completion of the online survey, respondents were invited to participate in a face-to-face interview designed to gather more in-depth information about school culture and teacher use of instructional technology.

Following collection of the survey responses and interview volunteer information, appointments were scheduled at a mutually convenient time between the interviewee and the researcher. All interviews took place in the interviewees' classroom or other location in their school site. Participants in the audio taped interviews were given informed consent documentation and given opportunity to review the document prior to signing. A copy of the research report was made available upon request by the subject; in addition, the location of the report if published in any journals will be provided to the interviewee. Participants were informed of their right to decline participation in any part of the study. Participation was not mandatory; any subject who chose to decline could do so freely. Anonymity was ensured using pseudonyms given to all participants involved in this study.

Rationale for Qualitative Study

The final decision on methodology and the data collection process is always based upon the research questions and the types of research to be conducted. In order to conduct a descriptive case study, triangulation of rich data sources is necessary to inform the questions of how and why instructional technology is being used as it is. Therefore, employing both quantitative and qualitative data collection and analysis methods in a mixed method study is appropriate. It should be noted, though, that the methods are not 'evenly' mixed. Quantitatively, the study seeks only responses from school site teachers, administrators, and instructional technology professionals to 17 forced-choice pairs. These responses assist in determining where on Douglas' grid and group typology the school site falls. While this determination is vital (it informs the data collected through interviews, observations, and document analyses), it is only one part of the study and needs to be coupled with the rich, deep data from the qualitative inquiry. It is this qualitative data and the fact that the study seeks to come to an understanding of two schools sites and the use of instructional technology in those school sites that prompts the use of a case study methodology to guide the research. Survey instruments are but one of many data sources available to the case study researcher, and the use of a survey to collect large amounts of customary data is supported by Anderson (1998).

Mertens (1998) cites Stake, Yin, and the U.S. General Accounting Office when establishing a definition of case study research. She relies heavily on Stake in establishing that case study is defined not by methodology, but by the case under scrutiny. Mertens (1998) says "the commonality in the definitions seems to focus on a particular instance (object or case) and reaching an understanding within a complex context" (p. 166). This study seeks to do just that: come to an understanding of middle school teachers' use of instructional technology within the context of Douglas' grid and group typology. The conclusions drawn will aid in understanding school culture, instructional technology use, and the perceptions and attitudes about instructional technology of teachers, administrators, and instructional technology staff members.

Mertens (1998) supports the use of case study research when "the focus is on diversity among, idiosyncrasies of, and unique qualities exhibited by individuals" (p. 163). In this study, interview questions and observations sought how teachers, administrators, and instructional technology staff members perceive instructional technology and instructional technology use in the school site; how they use technology in instructional applications; and their attitudes about instructional technology use, both positive and negative. Quantitative methodologies cannot get at the richness of information needed to fully understand these perceptions, uses, and attitudes. Only through close contact interviews and observations can these details emerge.

Additionally, Patton (2002) supports the use of case study when one of three conditions is present: the need to understand humanistic values, when no statistically valid and reliable instrument is available to measure what is being studied, or as an adjunct to a quantitative study. This final reason is precisely the case here: the brief survey instrument is only one tool used in determining where the school site falls on the grid/group typology, and it does not collect the rich data about the use of instructional technology needed to come to an understanding of how the school site's typology affects instructional technology use within the school site.

Significance of the Study

This study of teacher use of instructional technology in a public school can be important for several reasons. First, Douglas' grid and group framework has not been used to date in a K-12 setting to explain the variations in preferences for instructional technology use and from a socio-cultural context perspective. It is therefore necessary to test this framework's usefulness in this setting to determine its theoretical significance for future case studies regarding teacher instructional technology use.

Second, according to Rogers (2000), teachers' attitudes about instructional technology and their attitudes about their school's support for instructional technology use are important factors in the decision to use or not use instructional technology. The need to describe why some teachers use instructional technology can only be served by exploration of the socio-cultural contexts within which preferences are defined and perceived.

Third, as schools continue to embrace instructional technology in all facets of their culture and practices, an understanding of teacher preferences for instructional technology use will be beneficial. Often, when schools consider a shift toward instructional technology, they focus on hardware and software within a specific budget. These are necessary considerations, but they should not be seen as more important than a consideration of the teachers' cultural preferences for instructional technology use (Tierney & Damarin, 1998).

Finally, the research directly benefits the research participants. Each school and each participant will receive information regarding the outcome of the study and how the study applies to the organizational culture of the school site. With this information, teachers, staff members, and administrators will better understand the organizational culture of their school and be better prepared to operate within that culture.

Maple Grove Middle School

Maple Grove School District is a technology-rich environment where teachers are given a number of tools that they may choose to integrate into their teaching. Efforts on the part of the former superintendent have created a school site where technology is taken for granted, where there are computers in every classroom everyday, where network access is not an issue, and time-shared labs are a thing of the past.

There is centralized control of resources at Maple Grove, and acquisition of resources is not a status symbol: teachers have whatever they need to do their jobs and are allowed to make decisions about classroom teaching without interference on the part of the administration. As teachers encounter a hardware or software need, they bring that need to the attention of the administration and in all likelihood the administration meets that need without fanfare or reservation.

With the exception of the school's information system, *PowerSchool*, there are no longer mandates from the administration that dictate how teachers are to use technology. This freedom to choose is one of the major indicators of the weak grid typology at work at Maple Grove.

Students at Maple Grove Middle School, too, enjoy an environment where they may make choices about technology based upon their skills and desires. Students who need to may take computers home; they have access to them throughout the school day, and often influence the use of technology in the classroom. Allowing such student choices is also indicative of Maple Grove's weak grid culture.

Instructional technology is pervasive at Maple Grove. Throughout the building, there is evidence of the extent to which Mr. Fayette went to in order to provide the technology-rich environment. Yet, teachers do not work to create a strong group culture. They do not collaborate, they do not share lesson plans or materials, and they do not identify with Maple Grove much outside the school day. They live out of district and tend to have their own networks of friends outside of school.

These observations indicate that Maple Grove Middle School is a weak grid/weak group culture which Douglas (1982) calls Individualistic. *Figure 2* illustrates the grid/group typology of specific Maple Grove characteristics.

Hillwood Junior High School

The strength of both the grid and group aspects of Hillwood Junior High are evident in the way that rules have been established under which members must operate. While there are indications of weakening of both grid and group, these are minor influences on the overall culture. In general, members enjoy the group to which they belong and identify strongly with that group. They are quick to sacrifice their own needs for the better good of the group by volunteering their time to help when that help is needed by the school.

Additionally, the administration at Hillwood may impose a number of the rules under which members operate, but at the same time, they are establishing these rules for the good of the group. They have the mission of Hillwood Junior High in mind when they work to spend limited funds so that the most good can come from the few dollars they have to spend.

Douglas (1982) calls a strong grid, strong group culture Corporate. *Figure Three* illustrates the grid/group typology of specific Hillwood Junior High characteristics.

Comparison of Maple Grove Middle School and Hillwood Junior High School

The typologies associated with Maple Grove Middle School and Hillwood Junior High are evident and can be seen in a variety of ways. Maple Grove is an affluent organization with a wide variety of instructional technology available for members to draw upon while Hillwood continues to work diligently and carefully to create a playing field that will provide more and more opportunities for its teachers. At Maple Grove, players enjoy freedom to make decisions about day-to-day classroom activities without pressures from the building principal or district administration; conversely, Hillwood principals exert strong influence over the members of the group on pedagogy and curriculum. There are few rules at Maple Grove where Hillwood teachers have distinct rules and limitations on choices. Maple Grove is an instructional technology-rich environment and those tools are used in a wide variety of ways, whereas Hillwood has limited instructional technology tools and many of the uses of those tools are regulated by the administration.

The grid and group typology was useful in describing the organizational culture in both of the school sites, and the typology was broad enough to encompass the variety of social interactions and contexts surrounding instructional technology use.

Summary of the Study

Schools like Maple Grove and Hillwood have increased the amount of technology available to teachers, assisted in increasing teachers' familiarity with technology through training, and supported and encouraged the use of technology through administrative directives. In spite of these efforts to increase the use of instructional technology, some teachers are not using instructional technology or use them only at minimal levels as prescribed by administrators.

Why do a small number of teachers embrace change and demonstrate high-level competence and integration of instructional technology while other teachers adamantly refuse to adopt or even experiment with technology?

In an attempt to answer this question, this study employed the lens of Mary Douglas' (1982) grid and group typology as a framework and vocabulary to examine teachers' use of instructional technology in two Midwestern school sites. Specifically, the study looked at:

1. How instructional technology is used in classrooms in each of the selected schools;
2. Ways in which the use of instructional technology reflect grid/group realities in each of the selected schools;
3. Other realities as revealed in each of the selected schools; and
4. Whether grid and group typology was helpful in understanding differences in teachers' instructional technology use in the selected schools.

The schools selected for the case study and analysis were a middle school and a junior high school in rural towns located in a Midwestern state. The schools were selected based on Stake's (1995) assertion that the sites be easily accessible by the researcher and be welcoming of the intrusion of the researcher into the site. Additionally, the two schools were chosen through purposive sampling (Stake, 1995) because both exhibited some use of instructional technology by teachers in the schools and were different in demographics, financial strength, and technology emphasis across the school site.

Data collection occurred using a variety of methods including interviews, observations, document analysis, and a brief questionnaire. The purpose of the data was to provide for a description of teacher use of instructional technology within the school site and to understand the school's organizational culture within which that instructional technology use occurred.

Data collection occurred over a period of months beginning in October 2003 and ending in March 2004; data analysis was ongoing throughout the study. Through multiple interviews, documents, observation, discussion with academic advisors and peers, member checks from participants in the study, and the use of a forced-choice pair survey, triangulation of the data was realized.

Summary of the Findings

Maple Grove, an Individualist (weak grid, weak group) culture, is a school where teachers enjoy a high degree of autonomy and the freedom to make decisions about their classrooms as they see fit. Teachers have access to nearly any piece of instructional technology they need and are able to negotiate acquisition for those items they do not have. A modified schedule previously allowed teachers the opportunity to have extended time on Friday afternoons each week for professional development usually centered around instructional technology integration or training on new technology acquired by the school; however during the current school year, that practice has been abandoned for a more traditional school schedule. Finally, a recent change in superintendents has caused a shift in focus that does not emphasize the use of instructional technology that has pleased some members of the faculty and disappointed others.

Hillwood Junior High School's teachers operate in a Corporate (strong grid, strong group) culture where the school administration has established a set of rules and roles to be followed in the classroom. Decisions about changes in classroom teaching strategies are approved by the administration. Teachers at Hillwood are willing to forgo their personal needs for the needs of the school: they cover each other's extended absences, they collaboratively raise funds for classroom materials, and they serve as peer resources for others in the school setting. They do not have ready access to instructional technology and do not enjoy an ability to negotiate easily for acquisition of new resources. Decisions about instructional technology purchases are made at the administrative level and administrators do not often ask for input from teachers on purchasing decisions.

Conclusions

The following research questions guided this study and are discussed below.

How is instructional technology used in classrooms in each of the selected schools? Maple Grove is a

technology-rich environment that encourages teachers to make decisions about instructional technology as best they see fit for their individual classes. Administrators support the use of technology at Maple Grove and support teachers' efforts to integrate instructional technology into their teaching.

Uses of instructional technology at Maple Grove ranged from simple document word processing and information retrieval from the World Wide Web via the Internet to more advanced uses of applications such as Microsoft PowerPoint, Excel, and Access. There is evidence of students producing HTML-based content for the World Wide Web, and uses of digital still photography and digital video production. Teachers' use of instructional technology also ranged across a wide variety of application including all those previously mentioned. In addition, teachers use *PowerSchool* as a student information management system for reporting grades and attendance. Parents and students can access *PowerSchool* to keep up-to-date on student progress. Teachers also provide web-based information sources to keep parents and students informed of classroom events, assignments, and other school happenings.

Teachers and administrators at Maple Grove also spoke of instructional technology as being an important part of the curriculum and a part of the school's mission, and they discussed how instructional technology is part of the world outside of Maple Grove that students are being prepared to enter. Mr. Randalia, the principal, hoped that technology might provide some motivation to a group of students who have little in their personal lives to motivate them and few role models to push them to greater achievements outside of Maple Grove. In this way, technology is a liberating tool that serves to give students access to a world beyond Maple Grove.

Maple Grove may take on this mission because individuals in the district in the past have envisioned that technology might serve this role. Mr. Fayette, the former superintendent, put in place the infrastructure to support this mission and laid the foundation for maintaining the infrastructure. For many years to come, Maple Grove will not need to plan for funding the infrastructure; but they will need to envision ways to encourage additional use of instructional technology. However, that direction will need to be in keeping with the Individualist organizational culture already in place at Maple Grove. If there is not an effort to provide continuing training and motivation to teachers at Maple Grove in the areas of instructional technology integration, there will be less and less use of technology.

Hillwood Junior High School presents a technology environment that is much less advanced than the environment evidenced at Maple Grove. Teachers have a single computer in their classroom, but many of them are older model computers with slow processors and operating systems as old as *Windows 95* and *Windows 98*. Teachers at Hillwood are at times envious of other schools that have better instructional technology tools and are sometimes frustrated with the lack of tools available to them.

Instructional technology use at Hillwood is limited. Teachers are required to submit grades electronically and email hourly attendance records to the school secretary. They also use instructional technology to prepare curriculum materials such as worksheets, handouts, quizzes, and tests. On occasion, they may schedule time in the computer lab for student word processing or Internet searching via the World Wide Web. But for many teachers, 'computers' is another subject in the curriculum taught by the 'computer teacher', and they do not see ways in which they might integrate into their teaching the instructional technology already in place in the school.

Student use of technology is severely limited to the point that some teacher computers are physically labeled "Teacher Use Only!" For many, the use of a computer during the school day is a reward for good behavior. Occasional lab use is evident, but even that is seen as a reward as revocation of the privilege is threatened as a consequence of bad behavior.

Teachers have indicated that one of the reasons for a lack of integration of instructional technology is the lack of access to hardware. Hillwood administration is focusing attention on this aspect by hiring an outside consulting firm to evaluate technology in the district and assist in creating a plan for reshaping the instructional technology landscape in the district. It will be important for Hillwood's success that in addition to investing in hardware and software, they also invest in training and mentoring for teachers. This training and mentoring will need to be rather basic at the outset, beginning with fundamental operations, as new technology added to the district will be unlike existent technology. However, the researcher thinks there is an environment in place at Hillwood that will encourage the adoption and integration of instructional technology. As a strong group culture, Hillwood has demonstrated commitment to mission of the group and already has in place the support structures needed for more advanced instructional technology users to mentor those less proficient. Once Hillwood makes the planned substantial investment in technology infrastructure, they must draw upon the strong group culture to make best use of the technology.

In what ways does the use of instructional technology reflect grid/group realities in each of the selected schools? Maple Grove's Individualist (weak grid, weak group) culture is evidenced by its instructional technology use. In an Individualist culture, individuals are afforded much leeway in making decision and there is less emphasis

on the contributions to or maintenance of the group as a whole.

Teachers at Maple Grove are allowed to make decisions about instructional technology integration without pressure from district- or building-level administrators. In only one way are teachers expected to use technology in their work: the required use of *PowerSchool* as a student information management system. Weak grid indicates much individual choice, and teachers evidence this. Some teachers make extensive use of instructional technology in their classes even to the point that they admit having a difficult time envisioning themselves teaching without instructional technology or even with reduced access. Other teachers use instructional technology only to the levels required by the administration. In addition, administrators encourage instructional technology use by providing the necessary tools and allow teachers to negotiate individually for additional hardware and software as these needs become apparent to each individual.

Throughout Maple Grove Middle School, other evidence of individuation is apparent. Students are given access to extensive hardware and software tools on an as needed basis. They are allowed to take computers home if a need is shown and are allowed to use building computing facilities unsupervised. Teachers at Maple Grove take on a variety of roles, both ascribed and assumed. Some teachers act as peer mentors to other teachers in the process of integrating instructional technology, and technology support personnel roles have changed over time as needs of the school have evolved. Teachers also realize a relaxed emphasis on instructional technology at Maple Grove with the change in district administration.

Maple Grove Middle School's teachers' use of instructional technology also demonstrates the weak group aspect of an Individualist culture. In such a culture, members of the group do not place emphasis on the continuation of the group, nor is there emphasis on the creation of relationships within the group. Members do not draw their identity from the group and are able to disconnect from the group outside the group's immediate environs. The group is not withdrawn from outsiders. There are few collaborative efforts underway at Maple Grove. Teachers do not work in teams and do not plan lessons in concert with one another. Staff members live outside the district and do not interact socially outside the school day. The school is open to outsiders and has been since it has emerged as a leader in instructional technology use. In fact, former employees spoke of the "daily tour" by outsiders of Maple Grove's facilities.

There is less emphasis on creating an atmosphere of instructional technology integration at Maple Grove. In the past, the school district adopted a modified schedule that allowed students to be dismissed at midday on Friday and provided a block of time for teacher training in new technologies and planning for instructional technology integration. Technology support personnel cite this loss of dedicated instructional technology training and planning time as a major contributing factor in the deemphasizing of instructional technology use at Maple Grove.

Finally, there is no sense at Maple Grove among administrators or teachers that the deemphasizing of instructional technology integration is problematic. While some teachers and technology support personnel bemoaned the loss of Friday afternoons and the block of time it afforded them, no one spoke of disappointment that facilities went unused or that some teachers did not use instructional technology as extensively as other teachers did.

Maple Grove's use of instructional technology is evidence of its Individualist cultures: much flexibility in how individuals acquire and use instructional technology and little emphasis on creating a group culture of instructional technology-using teachers.

Hillwood Junior High School's Corporate (strong grid, strong group) culture is also evidenced by the use of instructional technology, but not as clearly as Maple Grove. In a Corporate environment, there is a distinct set of rules by which individuals must operate and each individual plays a distinct role in the organization. Additionally, there is a strong sense of group among the members to the point where members work at creating sense of group identity.

Hillwood teachers are limited in the choices they may make about instructional technology integration in that there are not extensive resources available to them, and the building principal exerts strong influence over curricular matters. While the school has set a goal of placing on each teacher's desk a computer and printer, those existent computers are out-dated in both computing power and operating system. There exists a single computer laboratory that is prioritized to the technology education teacher and other teachers are allowed entry only when it does not conflict with that schedule. In addition, there is a mobile computer lab consisting of 14 laptop computers, but that resource does not see much use by classroom teachers. Future plans indicate the addition of computer laboratory facilities beyond the current facilities, yet access will be allocated on a weekly basis, and there are plans to install a pre-determined curriculum on the computers. Such allocation of resources and decision-making on the part of administrators limits the ways in which teachers may integrate instructional technology. Teachers are required by the administration to utilize technology in reporting grades and reporting attendance.

Evidence points to a need to discuss with the building principal any planned innovations in curriculum even

to the point that classroom volunteers should be cleared by the building principal prior to their service in the classroom. Teachers have been directed in which ways they may integrate instructional technology in their classes and have also been directed in which ways they may not: mathematics teachers may not use calculators in their teaching. The building principal cites as his reason that students are not allowed to use calculators on standardized tests used by the school, and he does not wish them to become dependent upon them for doing mathematics problems.

Teachers also have little choice in negotiating for additional resources. Acquisition of resources is controlled by the administrative team consisting of the district superintendent and building principals. This team accepts purchase requisitions and generally holds them until the start of the next budget year in order to be certain that requests meet the needs of the maximum number of students. Even though teachers may feel a need for a particular purchase, they are limited only to requesting the resource and then awaiting administrative approval that may be delayed until the start of the next year.

There is evidence of the strong group aspect of a Corporate culture at Hillwood as well. In a strong group culture, there is evidence of group members dedicated to the mission of the group. Members of the group develop relationships outside the immediate environs of the group, relationships that extend to their personal lives as well.

Teachers at Hillwood live in the district and actively participate in school life beyond the classroom. They have taken on each other's duties in the event of long-term illness, and they attend school events as social outings. The school office is both a professional and a social gathering place. They depend upon each other for assistance with instructional technology integration and band together to attend training off-site to maximize the return on such training, especially if attendance means additional resources be given to the school. Teachers even give of their personal time in order to raise funds to purchase resources that might not otherwise be available through traditional means. A strong parent organization has donated funds for purchases as well. Prior to moving to their current physical space, teachers at Hillwood were required to share classrooms and classroom resources.

What other realities were revealed in each of the selected schools? Leadership is an integral part of any organization and especially important in determining an organization's use of instructional technology. In each of the two typologies discovered in this study, leadership styles are different. Both Maple Grove Middle School and Hillwood Junior High School have recently undergone dramatic leadership changes in some fashion. Maple Grove's *lasses-faire* leadership by the building administration is fundamental in its Individualist (strong grid, strong group) organizational culture. Mr. Randalia, the principal, allows teachers to operate their classrooms as they see fit, using instructional technology in ways with which they are most comfortable, with the exception of the requirement to use technology for grade and attendance reporting. For him to begin to issue directives for instructional technology use would not complement the existing organizational culture. Maple Grove is also adjusting to a new district administration with a shifting emphasis in the role instructional technology plays. The former superintendent was emphatic in his instructional technology integration expectations even including technology use as part of the standard teacher evaluation. While the technology portion of the evaluation was removed prior to the current superintendent's arrival, she nonetheless has indicated to teachers that she will not be emphasizing the use of instructional technology as her predecessor.

Hillwood is coming to terms with a change in physical plant facilities and in a restructuring of administration at the building level. Both of these situations present issues of leadership: a reorganized physical plant means that teachers each have their own classroom and no longer need share resources, but it also means that additional resources must be acquired to meet the goal of placing a computer on every teacher's desk. Teachers in the current junior high had worked under the direct supervision of Mr. Randall Washington in the former intermediate school configuration. The separation of the school into two entities, an intermediate school of grades 4-6 and a junior high of grades 7-9, has placed junior high teachers under the direct supervision of Mr. Charles Riverside, though Mr. Washington is technically still the principal of record of Hillwood Junior High, and he and Mr. Riverside work in concert to make decisions that they believe are best for Hillwood's students.

There are teachers at Maple Grove who have access to extensive instructional technology resources and make little use of those resources. Likewise, there are teachers who do make use of the instructional technology available to them. Conversely, at Hillwood, there is evidence of teachers with few instructional technology resources who work diligently to use what few tools are available to them as they feel it is their duty to do so, and there are teachers who are content to use instructional technology only at the levels required by the administration.

Teachers at both Maple Grove and Hillwood are neither rewarded nor punished for their use or non-use of instructional technology. The motivation to use instructional technology and the rewards that accompany its use are intrinsic. Teachers use instructional technology because they believe they should and they believe there are benefits attached to doing so; others choose not to use instructional technology. In either case, the administration neither encourages nor discourages instructional technology use.

Was grid/group helpful in understanding differences in teachers' instructional technology use in the selected schools? Douglas (1989) described the use of the grid/group typology: "The most interesting questions [grid/group] is designed to answer are about attitudes, values, and established thought patterns which correlate with particular grid/group positions" (p. 175). Douglas's typology provided a vocabulary with which to discuss the organizational culture of each school and to describe instructional technology use within that culture. Information from interviews, observations, and document analysis contributed to an understanding of teachers' attitudes, values, and established thought patterns, and data helped establish a position within the typology for each school. However, it is critical to note that the typology is not one of absolutes; rather, each axis of the typology serve as a continuum along which a determination is made by the researcher as to the strength or weakness of the organization under study. In addition, since the combination of two axes represents a wide range of possibilities, it was difficult at times to place each school definitively on each axis. Certain aspects discovered at each school indicated both strong and weak grid and group elements; a determination had to be made as to which outweighed the other.

The availability of a vocabulary with which to describe both the organizational culture of each school and instructional technology use among its members was useful. Douglas's typology allowed for discussion of both individual choice and the relationships created by individuals. In addition, the typology allowed for a differentiation between Maple Grove's wide range of choices and few restrictions placed on them by administration and Hillwood's narrow set of choices restricted by the limited instructional technology available to them and the strong emphasis on being a part of an established group evident at Hillwood.

The typology was useful in helping to understand differences in instructional technology use by teachers at Maple Grove Middle School and Hillwood Junior High School.

Figure 1
Mary Douglas' Typology of Social Environment Prototypes

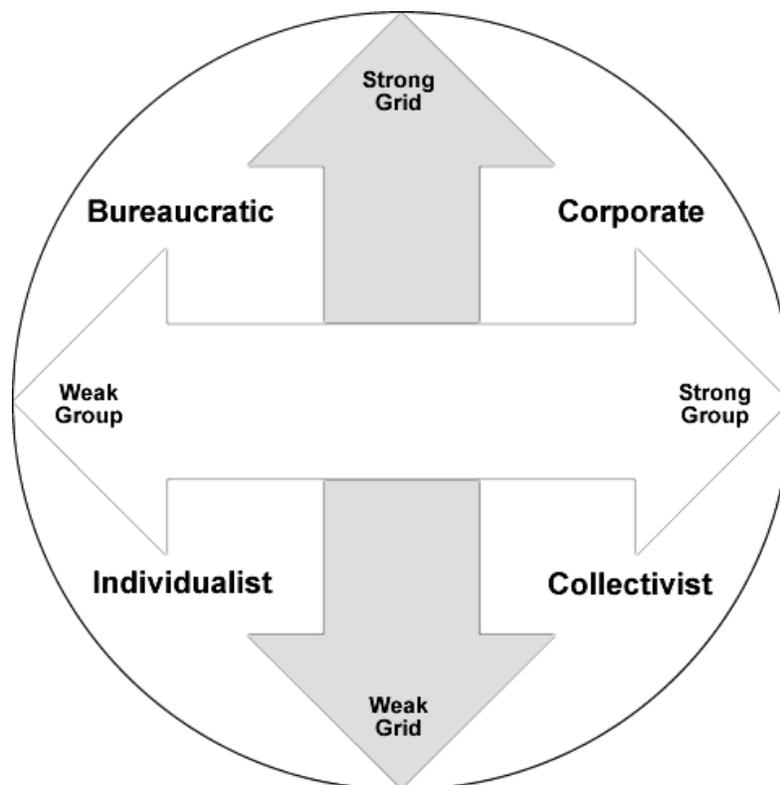


Figure 2
 Maple Grove Middle School's Grid/Group Typology

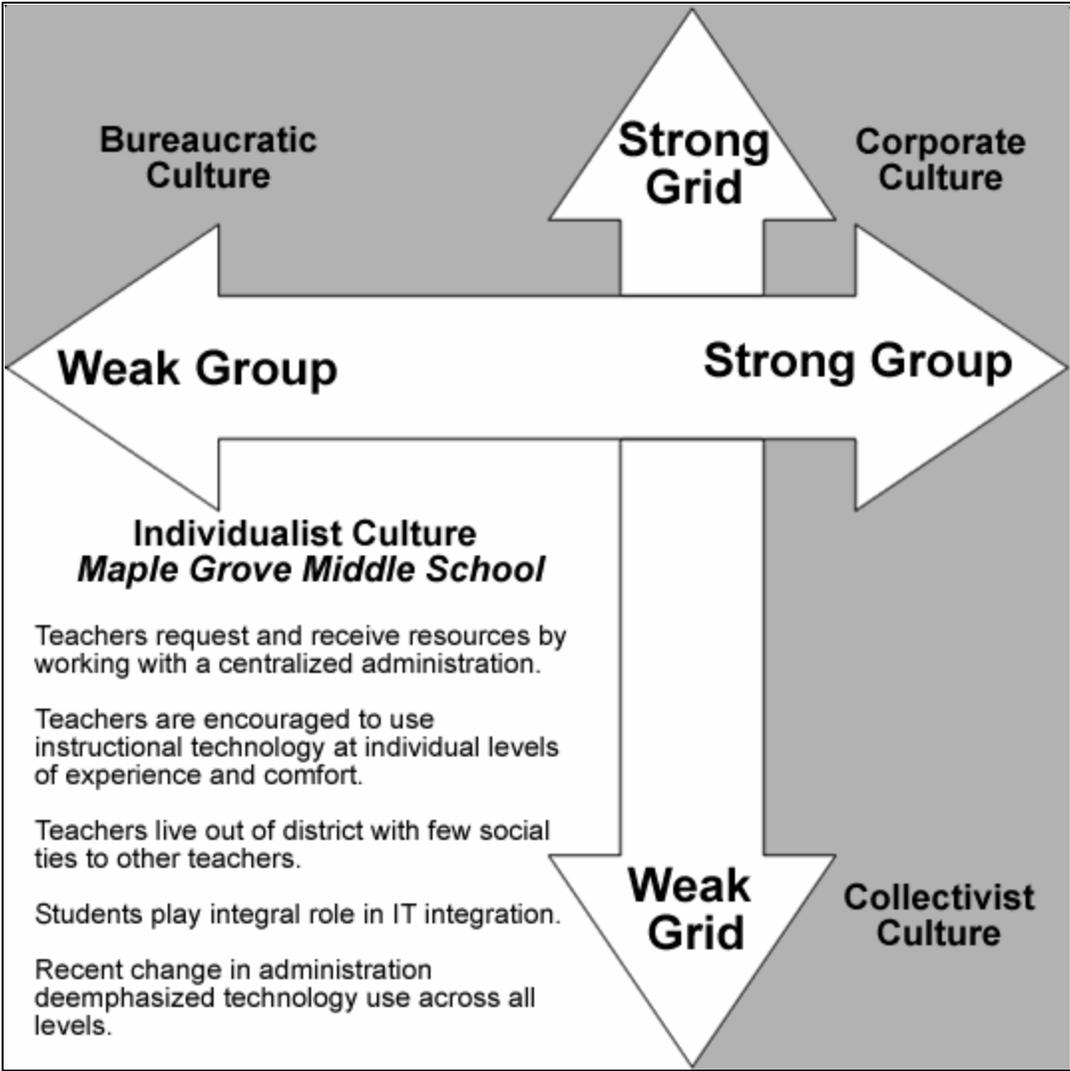
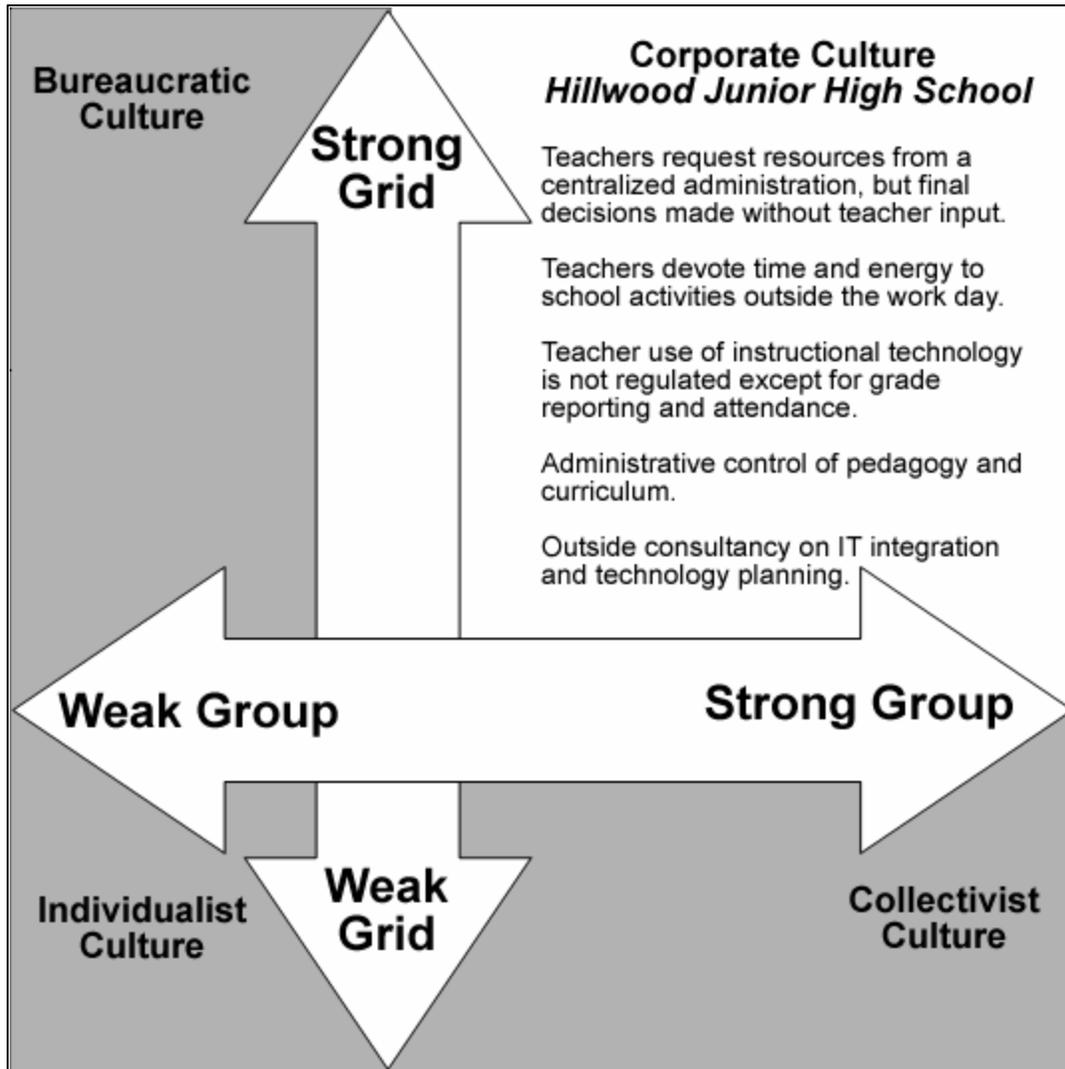


Figure 3
Hillwood Junior High School's Grid/Group Typology



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Are Two Modalities Better Than One When Learning From Online Reference Maps?

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Abstract

This study focuses on the effects of map display and modality on learning geographical maps in a computer-based environment. Participants were randomly assigned to four versions of a computer program created by crossing two levels of map display (hypertext vs. rollover) with two levels of modality (audio vs. audio and text). Results showed that the modality factor affects recall and inference test performance of college students in map learning significantly.

Purpose

Technology has improved so much today, that it is easy to teach in ways that are both interactive and communicative. The Internet and the WWW have added a new dimension to teaching and learning. It not only integrates different mediums but also their design, development and implementation. With the paradigm shift from teaching to learning, multimodality offers an excellent way for self-paced and exploratory learning more in tune with the constructivist methodology than the behaviorist methodology. According to Mayer (1997), meaningful learning “occurs when learners *select* relevant information from what is presented, *organize* the pieces of information into a coherent mental representation, and *integrate* the newly constructed representation with others”.

Theoretical Framework

Results from over forty studies have shown that geographic maps can be used as cognitive tools to increase the recall of related instructional text. The image of a map is an excellent mnemonic device to associate geographic locations contained in the map with related facts in the text (Kulhavy, Stock, & Kealy, 1993). Maps integrate both feature information and structure information which create an integrated image of the display (Verdi, Johnson, Stock, Kulhavy, and Ahern, 1997). This integration results in an economical unit that makes it easy for learners to switch their attention across an image while simultaneously processing information from a related text (Larkin and Simon, 1987). The feature-to-fact referential connections (Mayer and Anderson, 1992) create additional retrieval cues that learners can use to improve their recall of map and text information (Verdi, et al., 1997).

Paivio's dual coding theory (Paivio, 1986) contends that the cognitive system functions with two symbolic systems that are distinct, yet referentially connected. The verbal system stores information generated through the processing of language while the nonverbal system stores information received during the processing of images. Conjoint retention (CR) theory, an extension of dual coding theory (Paivio, 1986) has been applied to map learning. According to CR theory, maps are stored spatially in the nonverbal system as intact units while text information is stored linearly in the verbal system. The presence of referential connections between these two separate memory stores can help in the study of geographical maps.

Computer environments offer a far greater scope to make use of dual coding theory than print media. It offers far greater scope to use multimedia. Print maps are usually drawn on one page and the opposite page has the narrative. Sorting through the narrative to reference a particular location is not only time-consuming but also leads to extrinsic cognitive load. Extrinsic load can be brought down to a large extent by bringing in the contiguity factor. According to the contiguity principle, instructions in multimedia are more effective when words, pictures and audio are presented contiguously, rather than separately in time or space. The contiguity factor takes into account the severe limitations of the human processing system (Baddeley, 1986) which leads to cognitive load. In a computer environment it is possible to have feature-to-fact referential connections both in terms of temporal contiguity and spatial contiguity as well as an image of the map with or without an accompanying text and audio. Contiguity helps to bring cross-code referential links lowering the cognitive load and thus helping in better cognition of the

geographical content. According to Mayer (2002) spatial contiguity occurs when instructional elements such as text and image or text and audio or image and audio are physically close. In a computer environment this occurs when the instructional elements are on the same screen rather than on different screens. This is achieved by having a rollover effect. When the cursor is over an image or at a particular location the text immediately pops up or the audio message immediately starts. But since in this situation the text and/ or the audio message pop up immediately on the same screen this could very well be considered to have both the temporal and spatial contiguity simultaneously. However in the hypertext effect the learner selects a map feature by clicking on it with a computer mouse. This opens a new screen with the text and or audio in it. Since separate screens are involved here the instructional elements are separated in time and not space, it can be considered to have temporal contiguity.

This study examines the effects of text and audio (dual modality) and audio only in learning from an online map in temporal with spatial contiguity conditions and temporal only conditions. The question that is being studied is to what extent modality plays a role in learning from an online map. The second question being looked into is under what contiguity conditions modalities affect learning. It is hypothesized that dual modality will influence learning under both contiguity conditions because the feature to text cross-reference is being further augmented by using dual channels of visual and auditory senses. This augmentation should help learners to make better use of their information processing system.

Design and Subject

One hundred and seventy-six undergraduate students from a large southwestern university were randomly assigned to one of four conditions in a 2 X 2 factorial design. There were two levels of map display (hypertext vs. rollover) which were crossed with two levels of modality (audio vs. audio and text) to form the factorial design. Students were given a fictitious map with twenty locations having fictitious names on it. Each location had a fact describing its unique feature. Depending on the condition they were assigned to, students would either receive an audio message (audio modality) or both audio and text message (dual modality) telling them the unique feature of the location. Students could access this information by either clicking on the location (hypertext) using the computer mouse when the embedded text with the narration or the audio alone would open up in a different screen or by placing the cursor on a particular location using the computer mouse when the text with the narration or the audio alone would be presented contiguously with the location. Students received course credit for participation.

Materials

The materials consisted of a computer-based reference map depicting fictitious feature names from the island of Malta and two manipulations of a 470-word text (i.e., hypertext and rollover) containing facts about the features. Text narration with audio could be heard through headphones.

The map contained 20 fictitious features randomly distributed across the map surface. There was one fact associated with each map feature.

Procedure

All participants were given verbal instructions, guiding them to learn as much as possible from the map. All participants were given 20 minutes to study the map. After studying the map, all participants were given three paper-based instruments with two retrieval measures and one inference measure, to determine the effects of the treatment conditions. A free recall measure was used to test participants on the map features and facts they studied for which they were given 10 minutes. Participants were then given eight minutes to take the second retrieval measure which was a map reconstruction task. They were given a sheet with the computer screen border drawn for this task. Finally, a twelve-item multiple-choice test designed as the inference measure was given to assess the participants' ability to make inferences about the information on the map. To correctly answer the items the participants had to infer information from the map that was not specifically stated in the materials. This was viewed as a higher-order thinking task as opposed to free recall. This measure was scored by giving one point for each item answered correctly. All statistical tests were performed with an alpha of .05.

Results and Conclusions

ANOVA revealed a main effect on the modality variable for fact recall $F(1, 73) = 6.008, p = .017$. Further analysis revealed significant display type by modality interaction effects on the inference test $F(1, 73) = 5.616, p = .020$ and the name recall test $F(1, 73) = 4.384, p = .040$. Analysis of the inference test interaction shows that hypertext (temporal contiguity only) students in the text and audio conditions (dual modality) outperformed students in the hypertext (temporal contiguity only) in the audio only conditions, but the opposite effect occurred in the

rollover conditions. Further, analysis of the name recall interaction revealed that roll-over (temporal and spatial contiguity) students in the audio only condition outperformed students in the roll-over (temporal and spatial contiguity) text and audio (dual modality) condition for the name recall, while the opposite effect occurred for those in the hypertext conditions.

The results are partly in tune with the hypothesis. Dual modality does have a positive effect on learners but not in both the contiguity conditions. It appears to help learners more in a temporal contiguity condition than those in temporal and spatial contiguity, which can be considered as dual contiguity. Dual modality with dual contiguity does not seem to serve its purpose. Dual contiguity with single modality (audio in this case) and single contiguity (temporal in this case) with dual modality seems to do a better job at improving understanding of geographical maps. This could be explained in terms of the cognitive-load theory. Two simultaneous contiguity conditions (rollover) with both audio and visual gives rise to unwanted redundancy. This in turn may generate a heavy cognitive load that is unfavorable to learning (Chandler & Sweller, 1991; Sweller, 1988, 1989; Sweller, Chandler, Tierney, & Cooper, 1990). It is also possible that the speed with which learners read the text could be different from the speed of the audio which might not have been conducive to learning. In the single audio modality this overlapping is absent and learners have performed better. Another possibility could be that learners in the rollover condition have a split-attention problem as they have to use the visual channel for both the image of the map as well as to read the text. Addition of audio to this scenario has not helped.

The hypertext condition does better in dual modality as there is no split attention problem. On clicking on a location the text opens up in a new screen. Since the image of the map is not visible anymore, learners are able to concentrate on the text and audio. But when audio alone is presented learners are unable to get the fact-feature cross-reference.

It is interesting to note that the interference effect is seen only in the inference test and name recall and not in fact recall and name to fact match. Though the trend is maintained, it does not reach the level of significance.

Educational Importance

The results of this study have some practical implications in the use of audio for educators interested in designing online instruction involving geographic maps. Online instruction containing geographic maps should employ the computer's capability to offer different modalities (audio and dual) to enhance learning. This study also provides evidence that using both audio and text to present verbal information may be more effective than using audio alone in single temporal contiguity conditions while the reverse is true for dual contiguity (temporal and spatial contiguities) with single modality.

With digital books becoming more and more common this research has lots of implications as it could lead to better use of technology for improving standards of education.

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Singin' the Blues On the ICN

A Study In Applied Music Distance Education

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As the 21st Century progresses, music teachers and/or coaches are no longer bound to the confines of their studios. With the advent of distance education technology and the Internet, lessons and coachings can be conducted over hundreds or thousands of miles, or even across a continent.

Since 1993, at Iowa State University, hundreds of students have participated in master classes, lessons and coachings at a distance. The Iowa Communication Network (ICN) connects over 750 sites in the state to comparable sites across America and throughout the world. Users employ a fully interactive, broadcast quality audio-video, digital fiber-optic network, capable of connecting hundreds of sites simultaneously. Sites are conveniently located in public schools, colleges, universities, and additional governmental, educational and business locations. The cost is reasonable and is often subsidized by the state. In Iowa, participants pay only a small \$5.00-\$10.00 per hour connection fee per site. For multiple participant activities such as master classes, the technology is particularly cost effective.

By employing the ICN, students can gain access to master teachers and coaches hundreds of miles away and interact with them as if they were in the same studio.

To examine the effectiveness of distance education technology in applied music, participants in ICN lessons and master classes were given brief pre- and post experience surveys. The results are presented below:

- ◆ Do you believe it is feasible to teach (or learn) applied music instruction at a distance (asked prior to the distance learning experience)?

| | |
|-----|----|
| No | 44 |
| Yes | 25 |

- ◆ What do you believe will be the greatest drawbacks to distance learning in applied music instruction (pre-experience)?

| | |
|------------------------------|----|
| Sound Quality | 31 |
| Video Quality | 1 |
| Ease of Use | 9 |
| Classroom/Student Management | 7 |
| Interactivity | 19 |
| Other | 7 |

- ◆ What were the greatest drawbacks to distance learning in applied music instruction (post-experience)?

| | |
|------------------------------|----|
| Sound Quality | 15 |
| Video Quality | 1 |
| Ease of Use | 5 |
| Classroom/Student Management | 7 |
| Interactivity | 13 |
| Other | 27 |

- ◆ What do you believe will be the greatest benefits in distance learning in applied music instruction (pre-experience)?

| | |
|--------------------|----|
| Access to Experts | 51 |
| Interactivity | 10 |
| Ease of Use | 5 |
| Low Cost | 1 |
| Increased Feedback | 12 |
| Other | 3 |

- ◆ What were the greatest benefits of distance learning in applied music instruction (post-experience)?

| | |
|--------------------|----|
| Access to Experts | 51 |
| Interactivity | 13 |
| Ease of Use | 10 |
| Low Cost | 2 |
| Increased Feedback | 13 |
| Other | 3 |

- ◆ Please rate the quality of the sound on a scale of 1 – 5 with 5 as the highest.

| | |
|-----------------------|------|
| Speech Sound Quality | 4.2 |
| Music Sound Quality | 4.03 |
| Overall Sound Quality | 4.11 |

- ◆ Please rate the quality of the video image on a scale of 1 – 5 with 5 as the highest.

| | |
|--|------|
| Video Quality of Print Media And Graphics | 4.31 |
| Video Quality of Teacher And Performers | 4.45 |
| Overall Video Quality | 4.38 |

- ◆ Please rate the ease of use of the distance learning technology on a scale of 1 – 5 with 5 as highest.

| | |
|---|------|
| Ease of Use as an Active Participant | 4.38 |
| Ease of Use as an Auditor | 4.38 |
| Overall Ease of Use | 4.38 |

- ◆ How effective did you believe applied voice distance teaching (learning) would be on a scale of 1 – 5 with 5 as the highest?

| | |
|------------------------|------|
| Expected Effectiveness | 3.66 |
|------------------------|------|

- ◆ How effective was applied voice distance teaching (learning) would be on a scale of 1 – 5 with 5 as the highest?

| | |
|----------------------|------|
| Actual Effectiveness | 4.44 |
|----------------------|------|

- ◆ Compared to other forms of learning how do you rank your applied music instruction distance learning experience on a scale of 1 – 5 with 5 as the highest?

| | |
|--|------|
| Comparison to Other Forms Of Learning | 4.43 |
|--|------|

Is teaching/coaching/learning singing at a distance a viable methodology? Does it really work?
 Unequivocally, YES and YES!

When should this technology be used?
 Whenever circumstances inhibit or prevent face-to-face learning!

For example:

- Master Class Broadcasting
- Continuing Education or In-Service Workshops
- Special Topics Workshops or Coaching
- Outreach And Extension Activities
- Recruiting Activities
- When Travel Is Prohibited
- Other?

What does the future hold for distance learning technology?

- Within years a widely available, cost effective PC based Internet Delivery Systems.

“Applied Music Distance Education” will be commonplace, with the technology as close as your laptop computer.

The Effect Of Oral Description In Complementing Animated Instruction In A Web-based Learning Environment On Undergraduate Students Achievement Of Different Educational Objectives

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Mine Munyofu

Khusro Kidwai

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Abstract

The purpose of this study was to test the principle of modality by using audio to deliver verbal information when that information is designed to support non-verbal information such as animations in a computer-based lesson. This was done by comparing the effect of two types of audio support mechanisms- a simple support mechanism consisting of declarative statements explaining the animated sequence and a complex support mechanism consisting of questions and answers explaining the animated sequence- on undergraduate student achievement of conceptual, rule and procedure knowledge. A control group consisting of the same computer-based lesson without any auditory support of the animation was also employed. Learning was measured through drawing, terminology, and comprehension tests. The results indicate student achievement was not enhanced by the addition of auditory support.

Introduction

With computers coming equipped with multi-media features such as the ability to play sound and animation, teachers and instructional designers are able to develop and deliver lessons in novel ways using both the visual and auditory channels of students. But, is student performance improved by the use of both channels as opposed to the traditional delivery method relying solely on the visual channel? And, at what learning level (the factual, conceptual, rule & procedure level) is there improvement in performance when both channels are used?

According to cognitive load theory (Kalyuga, Chandler and Sweller 1988, 1989; Sweller 1988; Baddeley 1986, 1992) methods of instruction reducing working memory load in order facilitate the encoding and storing of the information in long-term memory are effective. One such method is dual coding theory (Sadoski and Paivio 2001; Clark and Paivio 1991; Paivio 1971, 1986, 1990). Dual coding theory assumes we have two information processing systems: a verbal system, comprised of words, whose strength lies in its sequentially ordered hierarchy, each bit of information paves the way for the next, and a non-verbal system whose strength lies in its synchronous (holistic) hierarchy.

Using audio to deliver verbal information when that information is designed to support non-verbal information such as graphics, pictures, and animations can enhance the effect of using both the verbal and visual systems. This is known as the modality effect (Clark & Mayer 2003; Penney 1989; Paivio 1986). The modality effect (Clark & Mayer, 2003, pp. 93) states “people learn more deeply from multimedia lessons when words explaining concurrent animations or graphics are presented as speech rather than as onscreen text.”

The studies reviewed indicate that the modality effect works well at improving student’s verbal recall of factual information (Mayer 1991, Mayer 1992, Barron 1993, Mousavi 1995, Mann 1995, Mayer 1996, Mayer 1998, Moreno 1999, Mayer 2001, and Moreno 2002). There is also indication that the modality effect works at improving student’s ability to solve problems (Mayer 1991, Mayer 1992, Barron 1993, Mayer 1994, Mousavi 1995, Mayer 1996, Mayer 1998, Moreno 1999, Chuang 1999, Mayer 2001, Moreno 2002). However, there is limited information regarding the effect of modality of student achievement of learning concepts, rules and procedures. The studies conducted by Mayer (1998) and Moreno (1999, 2002) found evidence to support the positive effect of modality on student’s ability to learn conceptual information but these learning levels were not isolated and studied on their own. In these studies, student’s ability to recall facts, identify concepts, and solve problems were tested together. This leaves open the question of how effective is the use of modality if the goal of the lesson is to facilitate achievement

of conceptual and rule/procedure knowledge? This study seeks to begin filling in the gap in the literature by isolating these two intellectual skill learning-levels.

Literature Review

Studies Exploring The Effect Of Dual-Coding: Using The Visual And Verbal Channels

Mayer, in his study on how computer based animations can be used to promote scientific understanding (1991) and in his study aimed at identifying the role of student's spatial ability in learning from words and pictures (1994), found that undergraduate college students, given a lesson in an area of non-expertise, performed better on recall and problem solving tests when both the verbal and visual systems were utilized. Mayer also found that the effect of dual coding was enhanced when the verbal and visual information was presented concurrently, at the same time as the animation rather than before or after it (Mayer 1991, 1992, 1994). This finding was duplicated by Moreno (1999) who tested undergraduate college students with low prior knowledge of meteorology, ability to recall information about the process of lightning. Chuang (1999) found similar results working with seventh grade students in Taipei, Taiwan when studying the role of gender and field dependence/independence on the ability to solve math problems.

Placing supporting text near the animation it is meant to support is known as the contiguity principle (Clark and Mayer 2000) or the split-attention effect (Chandler and Sweller 1992; Sweller, Chandler, Tierney, and Cooper 1990; Tarmizi and Sweller 1988). The split-attention effect happens when students must divide their attention between multiple sources of information (Mousavi 1995). The split-attention effect can be reduced by placing printed words next to the animation they are supporting (Clark and Mayer 2000).

The positive effect of dual coding in reducing cognitive load also was evident in studies exploring the impact of reducing cognitive load in the lesson summary. In his study to see if reducing cognitive load in lesson summaries would help increase student's retention, Mayer (1996) found that undergraduate students performed better on tests of recall and problem solving when summaries included both illustrations and text.

The results indicate the effectiveness of verbal, in the form of text, support of animation in reducing cognitive load. Animation complemented with a textual explanation enabled students to take greater advantage of their capability to process information on two levels by stimulating the visual system and by reducing the load placed on the verbal processing system. This re-shuffling of information in working memory increased their ability to make meaning out of the information in preparation for storage in long-term memory. The placement of the supporting textual explanation next to the animation further reduced cognitive load and enhanced performance.

Studies Exploring The Effect Of Modality: Using The Spoken Word In Place Of The Written Word To Support The Visual Channel

While animation helped to reduce cognitive load it was not reduced as much as it could be because both text and animation have to pass through the same (the visual) sensory channel (Mousavi 1995; Chandler and Sweller 1992). This meant that students were forced to shift their attention between the text and the animation while going through the pattern recognition and selective perception processes. Miller (1956, pp. 85) referred to the limitation of the sensory register as our "channel capacity." Channel capacity is the maximum amount of information we can hold in our sensory memory at any given point in time.

When animation is supported by a spoken explanation, as opposed to a textual explanation, cognitive load is further reduced. This time the reduction comes through the way that information passes from the environment through sensory memory and into working memory (Chandler and Sweller 1992; Paivio 1986; Penney 1989).

Mann (1995), in a study testing student's ability to construct a solution to an educational problem, used temporal sound, spoken information that highlights or details static or moving visuals, in a computer-based lesson to more effectively use student's channel capacity in sensory memory by using sound with text to support concurrent animation. Mann found that students were able to recall a greater amount of critical detail when temporal sound was used.

While Mann used both written text and temporal sound simultaneously, Mayer (1998), in a study that tested student's ability to recall how lightning works, compared the effect of using either temporal sound or written text to support concurrent animation and found that students were able to recall more information and perform better on problem solving tests if they received the lesson using temporal sound.

Lai (2000), in her study testing the various types of visual illustrations on concept learning, also found that students receiving lessons using temporal sound to support static graphics performed better on matching tests than students receiving lessons that used text to perform the same function.

Similar to spatial contiguity, the placement of text near the animation it supports, the contiguity effect also applies when temporal sound is used to support animation. Temporal contiguity occurs when visual and spoken

materials are presented simultaneously rather than successively (Moreno 1999). Moreno (1999), using a lesson on the process of lightning formation, found that learning was negatively impacted if the temporal sound was not placed concurrent with the animation it supported matching Mayer's (1994) findings with written text.

Using written text or temporal sound that closely matches the animation it supports without a lot of extraneous details is also an important factor for success. In a study on reducing the cognitive load in lesson summaries, Mayer (1996), using a lesson on the process of lightning formation, found that students receiving concise lesson summaries, that included both visual and verbal information, performed best on verbal recall and problem solving tests. Similarly, Moreno (2002) found that extraneous details hurt student performance when using the lesson on the process of lightning formation.

Issues Of Instructional Consistency

Instructional consistency (Canelos 1983; Gagne and Medsker 1996) states that intellectual skills are hierarchical in nature and that lower order skills are prerequisite for learning higher order skills. Verbal skills comprise the base of the hierarchy and are the ability to recall factual information. Verbal skills are a prerequisite for learning discriminations. Discriminations, the ability to distinguish between things, come next and are a prerequisite for concept formation. Concepts are the ability to classify information based on its critical attributes and are a prerequisite for the learning of rules, which are the ability to specify the relationship between concepts. At the top of the hierarchy sits higher order rules, the ability to use multiple rules in order to perform a task or solve a problem (Gagne and Medsker 1996, pp. 32-33).

Therefore, if the objective is to generate solutions the instructional unit must contain the rules/procedures, concepts, and facts that represent the prerequisite knowledge needed to solve the problem. In the studies reviewed animation supported by narration increased students ability to recall factual information and to generate solutions to problems. The majority of studies reviewed explored student's ability to recall factual information and solve problems (Mayer 1991, 1992 1996; Mousavi 1995), to solve problems (Barron 1993; Mayer 1994, 2001), or to recall information (Mann 1995). These studies do not give us an indication of where or how animation supported by narration works in the instructional hierarchy. Is animation supported by concurrent narration effective at teaching concepts or rules/principles? Or is there something about the animation with narration that enables students to build connections among intellectual skills?

This study aims to build on the existing knowledge base and begin to fill in the gaps in the literature by testing the hypothesis that animation supported by concurrent temporal sound is better at teaching concepts and rules/principles than animation alone.

Purpose Of This Study

The purpose of this study was to test the principle of modality by using audio to deliver verbal information when that information is designed to support non-verbal information such as animations in a computer-based lesson. This was done by comparing the effect of two types of audio support mechanisms - a simple support mechanism consisting of declarative statements explaining the animated sequence and a complex support mechanism consisting of questions and answers explaining the animated sequence- on undergraduate student achievement of conceptual, rule and procedure knowledge. The questions the current study seeks to provide insight into include:

1. Do students receiving the treatment consisting of the simple audio support (declarative statements explaining the animation) perform better on tests of conceptual and rule & procedural knowledge than students receiving the treatment with animation alone?
2. Do students receiving the treatment consisting of complex audio support (questions followed up with declarative statements explaining the animation) perform better on tests of conceptual and rule & procedural knowledge than students receiving the simple audio treatment and the treatment consisting of animation alone?

Research Design And Methodology

A posttest only design method was used. The placement and use of animation and temporal sound was derived based on the results of two pilot studies. In the first study a computer-based lesson using Dwyer's (1977) lesson on the human heart, titled "The Heart And Its Functions", was used to determine where to place the animation. Since the goal of the primary study was to test student's ability to perform on tests of conceptual and rule/procedure knowledge, the lesson was designed using programmed instruction to ensure that adequate factual knowledge was achieved. An item analysis was completed to determine where to place the animation in the lesson for the subsequent study. A difficulty level of .60 was used as the cutoff meaning that any item with a difficulty

level below sixty percent was targeted for animated support.

A series of four tests consisting of 20 questions each were used to assess student achievement. An identification test was used to assess factual knowledge. A drawing test and a terminology test were used to measure conceptual knowledge. A comprehension test was used to measure rule/procedure knowledge. The validity and reliability of the tests was reported by Dwyer and Moore (1978). Based on the outcomes of the pilot study, 18 animations were developed and placed in the lesson adjacent to the textual material they were designed to support.

A second pilot study was conducted in order to determine which of the animated sequences required the use of temporal support. Again, item difficulty was set at .60 with any items supported by animation scoring below sixty percent targeted for support using temporal sound. The same four tests were used to assess student achievement. Based on the results of this analysis two treatments, one using simple audio support and another using complex audio support, were developed to support the animations.

For the primary study, eighty-eight undergraduate students were recruited from a management class, an educational psychology class, and an information systems class. These students were randomly assigned to one of three experimental groups: A control group that received the lesson with animation but no audio (NA) support. A treatment group assigned a lesson that used simple audio (SA) explanations, in the form of declarative sentences, in support of the animation. And, a treatment group assigned a lesson that used complex audio (CA) explanations, in the form of Questions and answers, in support of the animation. Twenty-nine students received the treatment with no audio support. Thirty students received the treatment with simple audio support. Twenty-nine students received the treatment with the complex audio support. All students received extra credit towards their final grade in the class for participating in the study.

All three experimental groups (NA, SA, CA) received a treatment where the beginning of the lesson was comprised of programmed instruction to ensure the prerequisite factual knowledge was gained. However, due to the nature of the content it was impossible to deliver the lesson with each learning level isolated. Therefore, the programmed instruction section also contained conceptual information along with the factual information. The programmed instruction consisted of a web page containing one or two pieces of factual knowledge. This meant that these pages also contained animation or animation with temporal support if the item analysis indicated it was needed.

After a series of three to four pages like this, students were asked to answer a series of practice questions based on the material just presented. If the student's score was satisfactory they were able to move on to the next part of the lesson. If the score was unsatisfactory they student was brought back to the beginning of that series of content. There was no limit placed on the amount of time or the number of times the student could spend on one section. Once the student satisfactorily completed the programmed instruction segment they were given a pencil and paper drawing test in which they were asked to draw and label the main sections of the human heart. Once that was completed the students were asked to complete an online identification test. In this test a picture of a heart was presented with an arrow pointing to the section to be identified. Students were asked to select the name of the section from a list of four choices.

The second part of the lesson was primarily focused on rule/procedure information although there was also some conceptual information presented. Students went through a series of web pages describing the flow of blood as it passes through the heart. Some pages contained animated support of the content and some pages contained animation along with temporal support. The control group (NA) lesson contained only animation. Where the SA group received temporal support for animation it was in the form of simple declarative sentences. For example, if the animation were designed to show that the ventricles are the thickest walled chambers of the heart, the student, when he/she selected the play button would see the animation and simultaneously hear a statement that said, "The ventricles are the thickest walled chambers of the heart."

The CA group received the same treatment as the SA group except that the temporal support was delivered in a question and answer format. Continuing the example above regarding the ventricles, a student in the CA group would hear while the animation was playing, "What are the thickest walled chambers of the heart? The ventricles are the thickest walled chambers of the heart."

The same voice was used in both treatment groups and the speed at which the animation was played was adjusted to fit the length of the temporal support. In all three experimental groups, students were allowed to replay the animation, as many times as they felt was necessary to understand the material.

At the end of the lesson students in each group were asked to complete a terminology test where they were asked to complete a sentence by selecting the appropriate word or phrase from the choices provided, and a comprehension test where they were asked to answer a question by selecting the appropriate answer from a list of choices. The identification, terminology, and comprehension tests were built into the computer-based lesson and completed on-line.

Results And Implications

ANOVA was conducted to compare the differences between the three experimental groups on scores on the four criterion tests. Alpha was set at the .05 level. Comparisons were made at two levels: using all items and using only the items identified by the item analysis. Comparisons were made using all four tests.

Results Using All Items

The table below details the mean and standard deviation for each treatment group counting all items

| | | Mean | Std. Deviation |
|---------------------|---------|-------|-------------------|
| drawing test | control | 15.97 | 3.257 |
| | simple | 16.00 | 3.280 |
| | complex | 17.31 | 2.714 |
| | Total | 16.42 | 3.125 |
| identification test | control | 17.62 | 2.470 |
| | simple | 17.40 | 2.094 |
| | complex | 17.88 | 2.215 |
| | Total | 17.62 | 2.247 |
| terminology test | control | 11.93 | 5.028 |
| | simple | 12.70 | 4.170 |
| | complex | 12.58 | 5.077 |
| | Total | 12.40 | 4.714 |
| comprehension test | control | 11.00 | 3.464 |
| | simple | 11.27 | 3.600 |
| | complex | 12.08 | 4.069 |
| | Total | 11.42 | 3.688 |
| Test Total | control | 56.52 | 11.903 |
| | simple | 57.37 | 10.545 |
| | complex | 59.73 | 9.298 |
| | Total | 57.80 | 10.637 |

The F statistic for the drawing test was 1.787; the F statistic for the identification test was .319; the F statistic for the terminology test was .218; the F statistic for the comprehension test was .621. The F statistic for the total of all tests was .659. These results indicate that there were no significant differences in the performance of students in each group. The reliability coefficient was .8612.

Results Using Only Items Identified Through Item Analysis

The table below details the mean and standard deviation for each treatment group for only the items identified as deficient through item analysis

| | | Mean | Std. Deviation |
|------------------|---------|------|-------------------|
| Drawing Test | control | 3.28 | 1.601 |
| | simple | 2.97 | 1.450 |
| | complex | 3.93 | 1.163 |
| | Total | 3.39 | 1.458 |
| Terminology Test | control | 4.14 | 2.489 |
| | simple | 4.93 | 2.243 |
| | complex | 4.73 | 2.539 |
| | Total | 4.60 | 2.416 |
| Comprehension | control | 4.38 | 1.635 |

| | | | |
|------------|---------|-------|-------|
| Test | simple | 4.60 | 2.010 |
| | complex | 4.69 | 2.074 |
| | Total | 4.55 | 1.893 |
| Item Total | control | 11.79 | 4.378 |
| | simple | 12.50 | 4.392 |
| | complex | 13.27 | 3.853 |
| | Total | 12.49 | 4.222 |

The F statistic for the drawing test was 3.547; the F statistic for the identification test was .851; the F statistic for the comprehension test was .198. The F statistic for the item total on these tests was .835. These results indicate that there were no significant differences in the performance of students in each group. The reliability coefficient was .7778.

Implications Of The Results

The lack of significance in performance between the experimental groups indicates that using either animation or animation along with temporal support may be problematic when it comes to teaching concepts and rules/principles. These results are interesting in lieu of prior studies whose results indicated animation supported with temporal sound was effective at teaching facts and problem-solving skills. With factual knowledge being a prerequisite for learning concepts, rules/principles and rules/principle knowledge being a prerequisite for problem solving learning it was thought that animation supported by temporal sound would have been effective at teaching concepts and rules/principles. However, the results of this study do not support this hypothesis.

These results do, however, suggest possibilities for further research. Some possible avenues for exploration include: What is it, of there is anything, about the nature of concepts and rules/procedures that may not make them amenable to animation based learning? Does temporal sound increase cognitive load when the lesson is aimed at conceptual or rule/principle information? Does the kind of content being presented limit the effectiveness of modality? Are methods other than simple declarative sentences or questions followed by answers better suited for teaching concepts and rules/procedures?

Summary

Using temporal sound to support animation in computer-based lessons has been effective when the goal is to teach factual knowledge. There is also indication that it is effective for teaching problem-solving skills. This study, however, did not find evidence to support that using animation with temporal sound to teach concepts, rules/principles is effective. The results indicate that there is a problem of instructional consistency when applying the modality effect to the learning of intellectual skills.

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Using Course Syllabi to Determine Amount of Student Exposure to and Use of Technology in Instruction: PT3 Assessment

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Abstract

During the spring semester 2003, faculty members in the Colleges of Education and Arts & Sciences were asked to submit their fall 2002 semester syllabi that reflect the integration of technology into the courses they teach as a result of attending 12-15 weeks faculty development/training workshops. Furthermore, a survey was designed to extract information as to what extent faculty use technology into their courses and to what extent they require their students to use technology in the classroom. During the 2001-02 academic year, 32 faculty members from the Colleges Education and Arts and Sciences participated the PT3 faculty development implementation grant workshops. The purpose of this study is to share our experiences related to this faculty development effort during the first year.

Background

During the spring semester of 2002, University of Toledo began its first group faculty development/training workshops to prepare faculty to integrate technology into the college classrooms. The main goals and objectives of the project were to enhance student learning simply teaching the use of technology tools to pre-service teachers, and also by modeling the application and integration processes. Preservice teachers must be shown, systematic approach, how to integrate technology and eventually exhibit these same processes them selves. It is this teaching and modeling of best practices that cements a pre-service teacher's commitment to the application and adaptation of technology with the expectation that it will carry over to the classroom of the new teacher.

The integration of technology into college-level teacher education curriculum has become a catchphrase in both higher and K-12 education. Unfortunately, the missing element in this technological innovation seems to be faculty development. While most schools recognize the need for students to master and utilize technology, the missing element in this technological innovation is in the area of faculty development. Although most faculty recognize the integration of technology into the curriculum requires new approaches to the teaching and learning process, not enough consideration is being paid to ensuring that the faculty who are teaching with the new innovative technologies have been adequately trained (Rowe, 1999). In order to facilitate faculty in effectively integrating technology across curriculum in the classroom, the U.S. Department of Education "Preparing Tomorrow's Teachers to Use Technology (PT3) implementation grant projects are playing an essential role in disseminating information to ensure that our future K-12 teachers are technology-wise and can use the multimedia facilities available in today's schools. Ultimately, upon graduation, these future teachers will not only practice their skills in the classroom but will model the effective use of technology to their students. First, faculty development and training must be available and must include the most current technological tools in order to provide an understanding of how to integrate the effective use of technology into the teaching and student learning process.

In spite of the tremendous growth of technology in our nation's schools and the belief by a majority of educators that all students must have access to technology to be truly successful in today's world, there is evidence that many teachers still do not use technology at all in their teaching (Education Week, 1999). According to a national survey (DeMedio & Teclehaimanot, 2001), 90 percent of schools in ten states have Internet access to classroom. In addition, according to a report from the research of the CEO Forum on Education and Technology (2000), 80% of schools in the United States have access to technology, but few teachers are ready to use technology in their classroom activities. The Department of Education Survey found that approximately 33% of teachers believe that they could use technology in their classrooms (National Center for Education Statistics, 2000). A national survey by Backer (1999) supports the finding that majorities of teachers, as many as 70%, are not using the technologies available to them.

Faculty belief and attitude toward technology, fear factors or complexity issues, lack of time and a lack of support, limited access, lack of faculty development training and lack of organizational support have been identified

as major barriers. There are many factors to change, such as lack of computers in the classroom, access to the Internet, updated software and hardware, lack of release time for faculty to learn how to integrate technology into the curriculum. Teachers must be allowed adequate time to learn new technologies (Maney, 1999). While numerous studies have examined the use of technology in the K-12 classrooms, few have taken the focus one step further to determine the extent, to which technology is used and required in the undergraduate teacher education programs. The purpose of this study is to share our experiences related to this faculty development effort during the first year.

Faculty members of the spring 2002 TIPT technology workshops were asked to submit fall 2002 semester syllabi that reflected the integration of technology into their courses as a result of attending these workshops. Of the 30 faculty participants, 20 returned syllabi to date and 5 indicated that they were either not currently teaching the courses they had adapted or they were away on sabbatical. Syllabi from these 5 will be collected in spring 2003 along with those of the fall 2002 participants. Syllabi from the remaining 5 participants are still being solicited.

Design

The rubric used to measure technology use/exposure can be found at the end of this report. Syllabi were rated in two general areas: (1) the faculty member uses and models it and, (2) students themselves are required to use it. Faculty use of a technology tool was given one point for each tool and student use, based upon constructivist educational strategies, was given two points per tool. In addition to specific tools listed, a category entitled "Other" allowed for the tallying of technology not covered by the survey. The use of word processing was not included as it already plays a prominent role in the university classroom (prior to any technology training workshops). Scores could range from 0 to over 30 depending upon the amount of "other" uses listed.

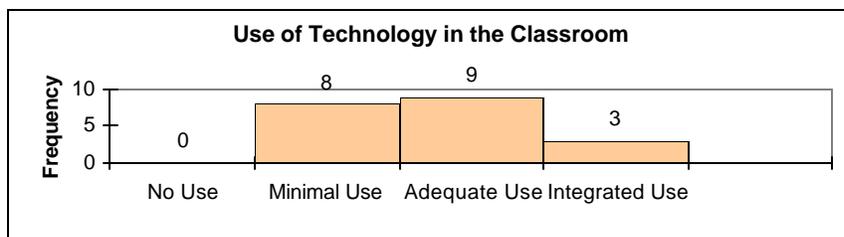
Tallies were then placed in an ordinal scale that ranked the use from "No Use/Exposure to Technology" to "Integrated Use/Exposure". The actual scale is as follows:

| <i>Category</i> | <i>Range</i> |
|-------------------------|--------------|
| No Use/Exposure | 0 |
| Minimal Use/Exposure | 1 - 7 |
| Adequate Use/Exposure | 8 - 14 |
| Integrated Use/Exposure | 15+ |

Categories are based upon the amount of student exposure that was considered reasonable by the TIPT advisory committee. It was felt that a minimum rating of 15 indicated quite a bit of exposure and use without compromising course integrity due to overuse of technology for the sake of technology itself. No attempt was made, however, at this time to determine the appropriateness of the integration of technology. This issue will be measured spring 2003.

Findings

Overall ratings ranged from 1 to 21. Mean average was 8.85 (adequate use/exposure) with a standard deviation of 4.97. This calculation was based upon the frequency of tools used (interval scale) rather than the ordinal categorization. Frequencies of scores in the ordinal categories are displayed in the graph below:



Frequencies indicate that 12 or 60% of the respondents have already incorporated the use of technology into their course instruction at an adequate level. It is expected that continued professional development, along with the sharing of ideas and strategies among faculty members, would increase this percentage to at least 75%.

In addition to examining overall scores, sub-scores in both the faculty and student use categories were inspected. In this case, one point was assigned on both the faculty use and the student use in order to compare the amount of tools that were incorporated amongst the two groups. Nine tools were listed as well as the "Other" category that was not limited in number. Faculty use ranged from 1 tool to 7 and student use ranged from 0 (3 courses had this rating) to 7. The tools most commonly used by faculty were email (17) and the use of the Internet

for research (11). Student use paralleled faculty use with 16 courses requiring students to use email and 10 requiring students to research on the Internet. Full results are listed in Table 1.

Table 1: *Faculty and Student Use of Technology*

| Tool | Faculty Use | Student Use |
|-----------------------|-------------|-------------|
| Email | 17 | 16 |
| Internet for research | 11 | 10 |
| Web pages and courses | 6 | 6 |
| Multimedia devices | 5 | 1 |
| Presentation software | 5 | 1 |
| Electronic portfolios | 0 | 0 |
| Other | 21 | 22 |

The “Other” category included the following tools:

- Use of listserves
- Video
- Bulletin boards
- Library databases
- Adaptive technologies for visually impaired
- Foreign language teaching forums and labs
- Teleconferencing
- Studying the use of technology in teaching languages
- Live text software
- Digital archives
- Graphing calculator
- Statistical software

Conclusions

After one TIPT workshop series, faculty members have already begun integrating technology into the university classroom. While the most common uses are still the more traditional tools (email and internet), many participants have reported using technology in creative ways to enhance the teaching/learning experience. It is recommended that future workshops place more emphasis upon and assistance in the application of other technology tools to enhance instruction (when appropriate). A fine line has to be drawn between using technology to enhance instruction and using technology simply for its own sake. Electronic portfolios were not reported as being used. However, the College of Education’s Technology Task Force is currently working on developing guidelines for electronic portfolios and their integration into college capstone courses. These guidelines should be available spring 2003.

Findings should be viewed with caution as the rating scale was determined somewhat arbitrarily and the quality or appropriateness of the use of technology was not recorded. It is encouraging, however, that many faculty participants are already making use of the knowledge gained through the TIPT workshops. This first assessment will serve as a baseline from which progress can be gauged.

TIPT Infusion of Technology into the Curriculum Scoring Rubric

This rubric is to be used to evaluate course syllabi. When the syllabi do not indicate the extent to which technology has been incorporated into the course, faculty comments will be solicited.

College/department of course: _____

| Technology Tool | Faculty Uses It (1 pt.) | Students Use It (2 pts.) |
|-----------------------------|-------------------------|--------------------------|
| E-mail | | |
| Internet research | | |
| Web-based course | | |
| Multi-media (cameras, etc.) | | |

| | | |
|-------------------------------------|--|--|
| Teaching tools (grades books, etc.) | | |
| Presentation software | | |
| E-portfolio | | |
| Tutorials | | |
| Concept mapping | | |
| Other (list below) | | |
| Total per column: | | |

Total score: _____

Please list other uses not mentioned in the rubric:

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Online Learning Students' Profiles

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Introduction

Interest in online education has grown rapidly over the past and will continue to grow (Bonk, 2002; Sofres, 2001). An increasing number of universities are offering online learning (OL) opportunities (Duffy & Kirkley, 2004b). Teacher professional development is part of this trend as well. Numerous recent studies of online teacher professional development environments have been published. Most renowned are the cases of Tapped In (Schlager, 2004), ILF (Barab, MaKinster, & Scheckler, 2004), LTTS (Duffy, Kirkley, del Valle, & Malopinsky, 2004), and the Math Forum (Renninger & Shumar, 2004).

As Duffy & Kirkley (2004a) point out, while many view OL as a highly promising educational opportunity, offering several advantages including not only access aspects, but also reforming teaching practices and offering new models for life long learning, others view OL as a threat to education that lower the quality of instruction. Like in traditional face-to-face learning, OL design and implementation vary widely, and so do instructional quality and levels of students' engagement and learning. OL might simply repeat the problems of traditional professional development, but it can be used to implement alternative professional development approaches while meeting the practical needs of teachers.

Multiple studies have compared online versus face-to-face learning, with some results showing positive outcomes for OL (Hiltz, Coppola, Rotter, & Turoff, 2000; Olson, 2002), and others yielding non-significant results (Russell, 1999) showing that web-based can be as effective as campus-based environments (Hall, 1999). But more important than media comparisons are the instructional approaches used (Clark, 1983, 1994), the variables that might affect learning in each environment, and the affordances and constraints they have. These factors, along with quality implementation and design, determine how effective a learning approach can be.

In general, we know that what students "do" or do not do is critical to their learning. We expect students to read, reflect, write, discuss, etc. From a constructivist perspective, the learner's goals affect what they do and therefore what is learned and how it is learned (Duffy & Cunningham, 1996; Duffy & Orrill, 2004; Jonnasen, 1999). If a teacher is taking a course mainly to renew her license, she will learn differently than if she is working on the course to apply what she learns in her classroom. The understandings she is constructing will be different, and so will her approach to the course activities, and the amount of energy devoted to them.

One of the seeming advantages students perceive in asynchronous courses is having the freedom and flexibility in organizing their learning activities. They have the ability to make decisions about what resources or tools to use, when, in what order, or for how long. Flexibility and learner freedom are attributes that are particularly present in online open-ended, learner-centered environments. The possibilities for sustained discourse and discussion using asynchronous tools, in which learners have time to think, and contributions are recorded, have great potential for promoting critical thinking. OL can also support the instructor's ability to provide just in time feedback, and develop one-on-one mentoring strategies. Easy access to a variety of learning resources, and the possibilities for supporting communities of practice, also illustrate the enormous potential OL has (Barab, Kling, & Gray, 2004; Bonk & King, 1998; Duffy, Dueber, & Hawley, 1998; Duffy & Kirkley, 2004b).

We began the previous paragraph noting the "seeming" advantage of the asynchronous, online environments; while many students flourish with the freedom, many others flounder. High dropout rates in distance education reflect this situation (Bonk, 2002; Parker, 1999). Thus, as asynchronous learning environments flourish, it is important to begin to understand OL strategies. To understand how learners work online, how they interact with the facilitator, how they use available resources, and how those strategies relate to learning are salient questions for both course design and mentoring strategies.

Unfortunately, we do not know much about how learners work online. In traditional face-to-face contexts, it is usually possible to observe learners. But in OL environments, especially asynchronous ones, this is not feasible: since we cannot observe them, we do not know what students are "doing," or what their reactions, attitudes, and levels of engagement are. In OL we can get a good sense of what students "click on," but it is harder to know what they do after the click. Nonetheless, OL courses can offer information about what learners are "doing" at home when they are working online, which is not possible in face-to-face environments. Complex log-files (click-stream data), along with other forms of data, allow us to paint a rich description of what learners do while working online.

Click-stream data is not limited to counting the number of clicks. Structural measures (patterns of activity), and temporal measures (when and for how long) can complement basic “click” data to help us follow and understand the “footprints” learners leave when working online.

There have been several studies in recent years examining how learners use hypermedia and web based environments. Most of these studies use log files as an efficient and non-intrusive way of studying and understanding the dynamic nature of web based learning (Hall, Balestra, & Davis, 2000; Young & McNeese, 1995).

Barab, Young, & Wang (1999), and Hall et al (2000) focused on the impact of different learning interfaces and learner control, others focused on individual differences and students profiles (Barab, Bowdish, & Lawless, 1997; Barab, Fajen, Kulikowich, & Young, 1996; Ford & Chen, 2000; Lawless & Kulikowich, 1996, 1998).

Barab, et al. (1997), for example, presented students with a campus Kiosk and gave students tasks of finding information. Using cluster analysis to analyze click stream data of the types of pages examined and the depth of those pages they were able to identify 4 types of users according to the way they navigate on the kiosk:

- *Model users*: compliant and earnest, pick the simplest task, fewer deviations
- *Disenchanted volunteers*: rebellious and impatient, explored very little
- *Feature explorers*: featured oriented and confused, use help screens, lowest self-efficacy
- *Cyber cartographers*: curious, goal directed, longer time, deepest levels, highest self-efficacy

Some studies analyzed student’s hypermedia traversal focusing on the number of pages they visit (on different categories), others on the pattern they use. Hall et al. (2000) considered both approaches using a cardinal measure (numbers of times a page is visited), a structural measure (pattern of linking), and adding also a temporal one (time on pages). With this comprehensive model for the analysis of hypermedia navigation, Hall et al. analyzed student’s use of a traditional linear interface versus a non-linear “hypermap” interface. The results indicate that the two groups were similar on the cardinal navigation measure, but the temporal and structural measures clearly differed, showing that a comprehensive analysis of navigation patterns can provide useful insight to understand hypermedia processing.

Lawless & Kulikowich (1998) emphasize the importance of cognitive and affective variables, especially domain knowledge, individual interest and situational interest, with regard to different profiles. Their research lead to the following profiles: Knowledge seekers, Feature Explorers and Apathetic hypertext users (Lawless & Kulikowich, 1996).

It is important to notice that it only makes sense to study online learning profiles within a flexible environment in which learners have the freedom to make enough decisions about their work so clearly distinguishable approaches may emerge. A fixed linear environment with a strictly defined set of required readings and activities would most probably leave very little space for different learning profiles to emerge.

The studies we have reviewed offered a flexible environment, but they were conducted mainly over brief experiences, most of them in experimental context, in which the learner interacted with the environment over a relatively short period of time with an instructional task assigned by the researchers. While those studies provide a context for the present research, this one focuses on authentic and more prolonged learning environments; real in-service and pre-service teachers taking online professional development one-credit courses.

Method

Learning Environment

The freedom learners have while working in online learner-centered-environments is especially prevalent in the Learning to Teach with Technology Studio professional development environment (LTTS: <http://ltts.indiana.edu>). LTTS consists of a catalogue of 50 facilitated self-paced web-based courses. The increased freedom of the self-paced environment provides the students with even greater control over their learning practices, permitting them to use the approach that is comfortable in their learning. They can plow through systematically, jump around, procrastinate and then rush through it, be thoughtful and systematic, etc. Considering these characteristics, LTTS courses were used as the study learning environment. Courses are short (between 20 and 25 hrs), entirely web based, self-paced, individually mentored, and address technology integration on learner centered teaching. Course design is guided problem solving (Malopinsky, 2000; Savery & Duffy, 1996), providing a non-linear, resource-rich environment with an open-ended structure. Four to seven tasks guide student work, and the outcome is a student-designed product to use in his/her professional work.

Participants and Procedure

The participants were graduate students enrolled at a large Midwestern university in the graduate course

“Elementary and Secondary School Curriculum”. Twenty of twenty-three students selected LTTS as their option to fulfill the technology integration requirement in the course, and all twenty agreed to participate in the study.

Fifteen of the twenty participants were between the ages of 20 and 30, while five were over 40. Eight of the participants had been or were full time teachers returning to school, while the other twelve had only field work and student teaching experience. Of those with no full time teaching experience, one was a technology coordinator and one was a library specialist. A wide range of subject areas and grade levels were represented and this is reflected in the fact that thirteen different LTTS courses were selected by the twenty participants. All learners were randomly assigned to one of two LTTS trained facilitators.

Click stream data, including cardinal, structural, and temporal measures, were collected for all actions learners made while online. Table one describes the eight critical variables that were defined in order to determine student profiles on LTTS self-paced online courses. Although the amount of click stream data LTTS collects would allow us to define dozens of variables, hierarchical cluster analysis requires that only a limited set of meaningful and distinct variables is selected. In this study only those variables that were meaningfully related to student’s online freedom and flexibility in the LTTS environment were selected.

Table 1: *List of variables and their scales and definitions*

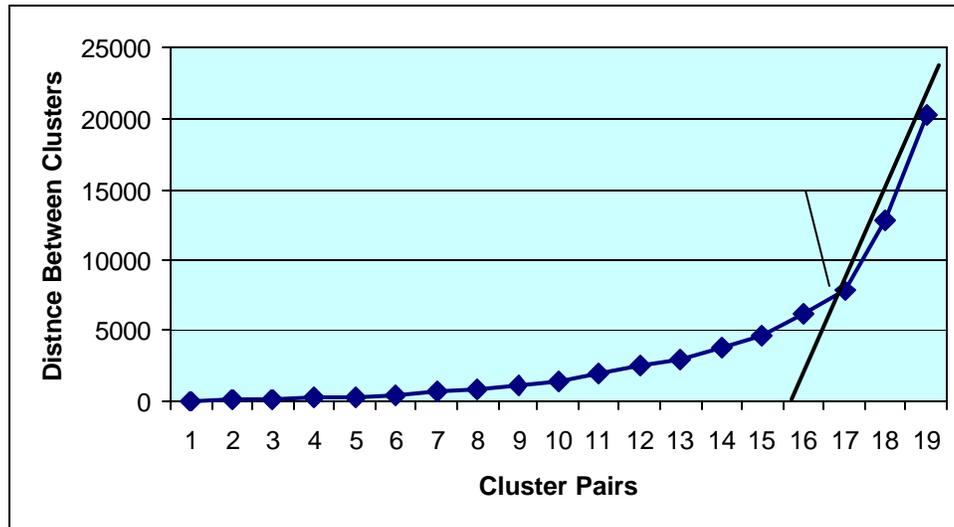
| Variable | Definition |
|-----------------------------|--|
| Sessions | Number of sessions used to complete the course. A session is defined as a series of activities not more than 15 minutes apart, so after a user is inactive for more than 15 minutes the session is consider being over |
| Days | Number of calendar days from beginning to completion of the course |
| Online Time | Total number of hours spent online |
| Interval Mean | Average number of days between logins |
| Interval Standard Deviation | Standard deviation of number of days between logins |
| Time on Resources | Proportion of time spent on content resources provided on the course |
| Messages Read | Number of facilitator messages read. Facilitator messages consist mainly of feedback for course activities, and they are critical to the LTTS pedagogical design. Students post their work on a workbook, and their messages outside this environment are reduced to a minimum, therefore they were not considered. Facilitator messages are often long and rich in content so students often go back to them. Thus this variable considered each time a message was read. |
| Transitions | Number of times the learner “jumped” between course activities not following a linear path. Following a total linear path through the course activities would imply zero transitions. More transitions indicate going back and forward through course activities. |

Results and Analysis

Cluster Analysis

Click stream data were collected for all 20 participants until they completed the course. Following Barab et al (1997) Ward’s (1963) hierarchical cluster analysis was used to identify naturally occurring groups of students. A scree-plot (Figure 1) was used to evaluate the between clusters distances, and determine the number of meaningful clusters according to the larger between clusters variability. When the coefficient drops below 7500, between clusters 16 and 17, the scree-plot levels off indicating that the variability between clusters stops suggesting the existence of separate groups. Therefore, the data supports the existence of three clearly differentiated clusters or groups of learners with similar approaches to online learning according to the defined set of variables.

Figure 1: Scree-plot used to determine number of meaningful clusters



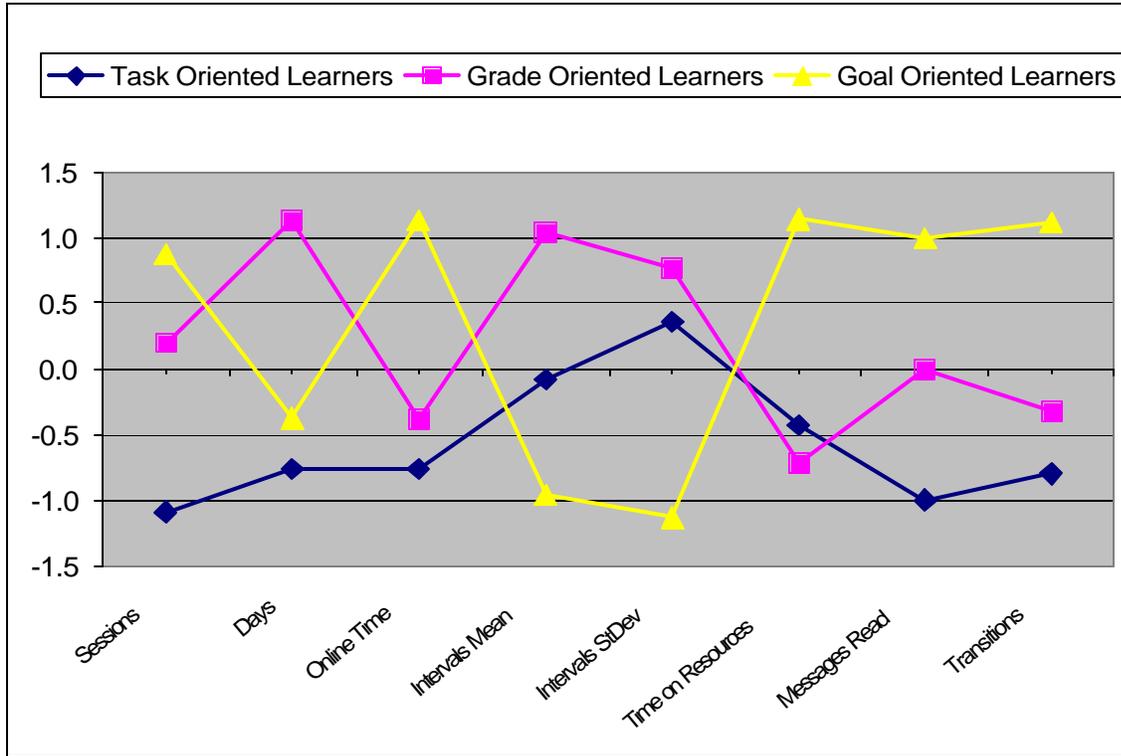
Mean scores and standard deviations for each dependent variable on all three clusters (Table 2) show how clusters comparatively behave on each variable. Refer to table 1 for a detailed description of the variables and their scales.

Table 2: Mean scores and standard deviations for each dependent variable separated by cluster

| Variable | Cluster 1 Task Oriented Learners (n=3) | | Cluster 2 Grade Oriented Learners (n=14) | | Cluster 3 Goal Oriented Learners (n=3) | |
|-------------------|--|-------|--|-------|--|-------|
| | M | SD | M | SD | M | SD |
| Sessions | 22.33 | 6.66 | 37.21 | 10.21 | 45.00 | 14.11 |
| Days | 23.67 | 8.39 | 60.79 | 6.65 | 31.33 | 7.77 |
| Online Time | 5.17 | 3.30 | 6.22 | 2.28 | 10.54 | 4.42 |
| Interval Mean | 1.24 | 0.67 | 1.84 | 0.73 | 0.76 | 0.29 |
| Interval SD Mean | 2.84 | 1.81 | 3.32 | 1.72 | 1.09 | 0.55 |
| Time on Resources | 19.17 | 15.48 | 17.86 | 9.38 | 26.03 | 13.71 |
| Messages Read | 19.00 | 3.61 | 34.43 | 8.11 | 49.67 | 2.31 |
| Transitions | 2.67 | 2.08 | 16.21 | 8.50 | 57.00 | 24.25 |

Standardized means were used to compare clusters scores in a complex set of variables that had different scales and a wide variety of ranges. A graphical depiction of the Z scores for the eight studied variables (Figure 2) illustrates how learners on each of the clusters comparatively behaved on each of the variables that shaped the profiles in a unique way.

Figure 2: Depiction of the standardized means of the 3 clusters on the studied variables



Naturally Occurring Profiles

T

The following are the profiles of the three clearly differentiated resulting clusters.

Task oriented

Task oriented learners

Individuals on the first cluster (n=3) present in average the lowest number of course sessions (M=22, SD=6.66), the lowest online time (M=5.17 hours, SD=3.30) and the lowest number of days invested in the course (M=23.67, SD=8.39). According to these results, they tend to spend only the indispensable time on the course without spreading it over several days or sessions. They tend to be focused on their work, completing the course as soon as possible with an average of just over 3 weeks. At the same time, they have the lowest number of transitions (M=2.67, SD=2.08), indicating a linear path through the course activities with minimal deviations, revisions of previous work or exploration of future activities. They also have the lowest number of facilitator messages read indicating less contact with their facilitators, and minor reviewing of feedback messages. Regarding the use of resources, they spent about 20% of their online time reviewing the content resources provided on the course. Considering these characteristics, we describe this group as “task oriented learners”; they have an assignment, and they want to complete it efficiently and quickly.

Grade oriented learners

The second cluster is the largest one (n=14). Members of this cluster used the highest number of days to complete the course (M=60.79, SD=6.65), and their work intervals are the most extended ones with an average of almost two days between logins (M=1.84, SD=0.73). They tend to spread their work over time, with not very frequent logins, and on average took them almost nine weeks to complete a course. Nevertheless, despite of all days spent on the course they have only an intermediate total online time (M=6.22, SD=2.28), intermediate number of messages read, intermediate number of transitions (wander around the course and review some activities), and the lowest time on resources. As a result, we called this group “grade oriented learners”. They seem to have no hurry to complete, and want to earn the course credit spending only a minimum time on the available resources, with an intermediate level of commitment.

Goal oriented learners

The third cluster (n=3) represents those students with the highest number of course sessions (M=45.00, SD=14.11), and the highest online time with an average of 10.54 hours (SD= 4.42). They also have the lowest work intervals, and an intermediate number of days spent on the course with an average of 31.33 days (SD=7.77). They work very intensively on the course, and logged in very often spending an average of about 4 weeks to complete the

course. They also have the highest number of transitions, the highest time on resources, and the highest number of messages read. This indicates that they tend to revisit their course work, review previous and subsequent activities, and ponder facilitator feedback. Taking into account these characteristics, we have labeled this profile as “goal oriented learners” since they seem to be highly committed to the course and self-driven in their work.

Discussion

The present study used click stream data, including cardinal, structural, and temporal measures, to identify online student’s profiles. Coinciding with the informally reported perceptions that LTTS facilitators have about the different approaches learners take when working on the courses, cluster analysis led to the identification of three clearly differentiated groups of learners: task oriented, grade oriented, and goal oriented learners.

The sole existence of these three groups confirms that different learners make a different use of the freedom and flexibility provided by the self-paced environment. For example, while some learners (goal oriented) tend to “jump around” the course having a high number of transitions, others followed a more linear path.

Regarding the use of time, learners do make use of the flexibility provided by the self-paced environment having three clearly differentiated groups. Nevertheless, those that used more days to complete the course (grade oriented) were not the ones that spent more online time or had more courses sessions. Similarly, different learners spent different amount of time using the course resources, this being in some cases over 40% of their total online time, and in others less than 10%. In this sense, it seems relevant to provide enough resources for all types of learners, and the flexibility to use only part of them.

Even if students’ approaches to OL are not substantially different from those of face-to-face courses, online environments, and the reasons why learners take online courses, might exacerbate the characteristics of different profiles, or perhaps online courses augment a self selection of certain learning approaches. Given how online learning might meet the personal goals and practical needs teachers have when pursuing professional development, we could have expected that the task and goal oriented profiles would amount for a larger number of students, but those two profiles account for only 30% of the participants. Nevertheless, it is important to notice that although participation in the study was voluntary, participants choose to take an LTTS course in order to fulfill a requirement of the graduate course they were enrolled in. This situation may have affected the predominance of students in the grade oriented learner profile (70%).

The results of this study might have important implications for the type of support mentors have to provide to different students. For example, while task-oriented learners seem to rest less on facilitator feedback, grade-oriented and goal oriented-learners tend to interact more with facilitators. In the same way, facilitators can expect to have some learners that will promptly complete the course (task-oriented) while grade-oriented learners will probably need frequent reminders in order to pursue their work. If this is the case, future studies should also investigate how mentoring strategies in online learner-centered environments (Collison, Elbaum, Haavind, & Tinker, 2000) relate to students’ OL approaches.

Since this study was conducted with participants that completed the online course they were taking, one important group that obviously could not be analyzed was the students who dropout of OL. Reasons for learner attrition in general (Tinto, 1987), and in OL in particular (Beatty, Malopinsky, & Duffy, 2003) have been studied, yet we need to investigate what can be done, from a design and facilitation perspective, in order to support teachers and other professionals seeking online professional development, and to reduce their attrition rates. Taking into account the existence of different OL profiles might prove useful in these efforts.

Although LTTS presents a rich, unique, and successful online teacher professional development environment (Duffy et al., 2004), using only one learning environment is a limitation of this study. The possibility of replicating these efforts using other learner-centered online environments should be explored.

Unfortunately, this study was conducted using a small sample. Nevertheless, current results call for promising replications, and more studies, with larger samples, linking these profiles to other variables affecting OL are needed. In addition, collecting qualitative data would be helpful for interpreting results, and for triangulation to support or dispute findings.

Linking OL profiles with variables affecting OL strategies, including self-efficacy, trust, learning goals, beliefs about learning, and previous experience would provide a rich context to study online learning strategies. In addition, studying the interaction between different learner profiles and outcome variables such as learner satisfaction, perceived and actual learning, and transfer expectations, will also be relevant for the future of OL, especially in the context of teacher professional development.

This study, and the results of other similar studies we are currently conducting, might yield interesting findings that will help the OL community understand effective online learning and facilitation strategies for adult learners (teachers). Findings could have implications for the type of support facilitators must provide for learners

with different profiles, and for how online courses are designed and implemented. Finally, if one approach were found to be more successful than others, then investigating how to foster that approach using specific facilitation strategies and course instructional design, would also be relevant.

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Effects of Online Cognitive Facilitation on Student Learning

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Interest in online learning (OL) has grown rapidly and will continue to do so (Bonk, 2002; Sofres, 2001). An increasing number of universities are offering OL opportunities (Duffy & Kirkley, 2004). A number of studies have discussed and linked online collaboration through group discussions with better opportunities to promote quantity and quality of student interaction, engagement, satisfaction, and higher-order learning (Hiltz, Coppola, Rotter, & Turoff, 2000; Mikulecky, 1998; Nachmias et al., 2000). Nevertheless, it is common to see little discussion among online groups that work collaboratively. Participants tend to post without replying to other participants' contributions, and they remain in their comfort zones (Collett, Kanuka, Blanchette, & Goodale, 1999). Threaded discussions often end in trivialized conversations in which frequently several members remain as passive observers (Klemm & Snell, 1996). As Kanuka & Garrison (2004) point out "To date there have been few empirical studies on the use of asynchronous text-based Internet communication technologies and their ability and/or effectiveness to facilitate higher levels of learning" (p.31). OL might have great potential to promote critical thinking, however, to implement OL, and especially online discussions in a way that actualize this potential has proved to be a real challenge.

One of the main arguments in studies that have linked online collaboration through group discussions with better learning opportunities is that group discourse serves as a core in increasing individual critical thinking within OL environments (Angeli & Bonk, 2003; Garrison, Anderson, & Archer, 2001; Jeong, 2001). Critical thinking is defined as "the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning or communication, as a guide to belief and action (Paul & Elder, 2001)." Duffy, Dueber, & Hawley (1998) place inquiry at the heart of learner-centered online environments, and associate critical thinking with an inquiry process in which a learner inductively or abductively solves his puzzlement through hypothesis generation, data gathering and evaluation, considering alternatives, and resolving for a rational solution.

While critical thinking tends to be defined as an individual cognitive process, Garrison, Anderson, & Archer (2000) developed a "community of inquiry" model that provides a conceptual framework to study learning in online environments, placing critical thinking in the context of collaborative work. In this model they use the term "cognitive presence" to refer to "the extent to which learners are able to construct and confirm meaning through sustained discourse in a critical community of inquiry (Garrison et al., 2001)," focusing in this way on the sustained interactions that help individuals to develop critical thinking as a process and outcome (Archer, Garrison, Anderson, & Rourke, 2001; Garrison et al., 2000).

In addition to cognitive presence, Garrison et al. (2000) also emphasize the importance of social presence in their community of inquiry model. Social presence is the sense of relationship that can arise among people participating in online environments, because participants project their personal characteristics into the community of inquiry, thereby presenting themselves as real people (Rourke, Anderson, Garrison, & Archer, 2001). In OL social presence can be mediated using text based communication, and it appears to be relevant to promote student satisfaction and engagement (Richardson & Swan, 2003). Nonetheless, Wise, Chang, Duffy, & del Valle (2004) found that only a basic threshold of social presence is required in order to support online learners.

The role of online facilitators who cultivate learners' cognitive presence has been considered as an important factor in promoting students' critical thinking (Anderson, Rourke, Garrison, & Archer, 2001; Archer et al., 2001; Collison, Elbaum, Haavind, & Tinker, 2000; Richardson & Swan, 2003). Thus, identifying guidelines for facilitating cognitive presence in online settings is an essential issue in order to encourage learners to think critically in a collaborative environment. Collison et al. (2000) identified several facilitation strategies to promote critical thinking in online environments. These strategies suggest that facilitators should promote cognitive presence in two stages: in the first stage, the facilitator uses techniques to help learners clarify their ideas, and come to a common understanding in order to "sharpen the focus". In the second stage, the facilitator supports learners to deepen their

thoughts and dialogue by articulating more in-depth discussions on the common ground. In this context the facilitator is not acting as a content expert but as an experienced learner and mentor that promotes students critical thinking and knowledge construction, mainly by asking questions that will further push their thinking and inquiry.

The purpose of this exploratory experimental study was to examine how online cognitive facilitation that promotes cognitive presence, while keeping facilitator's social presence constant, affects student learning and satisfaction in an online community of inquiry. In this context, we explored the following questions:

- 1) Does online high cognitive facilitation promote collaboration and critical thinking?
- 2) Does online high cognitive facilitation promote student learning and improve satisfaction?

Methodology

Participants

Participants were 12 graduate students studying in the Instructional Technology Department of a large Midwestern university, with 11 of them enrolled in the distance education (DE) masters program, and one of them a residential student. Participants were equally distributed in terms of gender (50% male, 50%female). Two participants were in the age range 20-30, three in the range 31-40, five in the age range 41-50, and two of them were over 51.

The participants were randomly assigned to four 3-person groups. Three of the participants dropped from the study after the first days of discussion, which caused 3 groups to continue as 2-person groups. Additionally, two participants who were active during the discussion, for unknown reasons did not complete the online final instruments.

Task

During the study, students were involved in an 11-day online asynchronous discussion about the use of DE in K-12 environments. The whole discussion period lasted 13 days, but there was a 2-days break within that period due to the Thanksgiving holiday. To facilitate the discussion each group was asked to identify the five most important issues that should be considered in determining the role of DE in K-12 education. They were to think of their team as consulting to state departments of education on the use of DE. Participants were asked to post the issues they agreed on and the rationale for each of them by the end of the discussion. Four brief magazine articles on the K-12 DE topic were selected to serve as resources for the discussion. One of these articles was given to all members in each of the groups. The other three articles were distributed randomly among the members of each group in order to minimize the workload of the participants, and to foster the diversity of ideas in the discussion. The participants were instructed not to look for more articles on the topic, not to share articles with their teammates, and not to discuss the topic with other members of their class. They were to make at least one posting everyday, and avoid using email except in emergency or to communicate personal information to the facilitator.

Design

The independent variable was the degree of cognitive facilitation provided by the facilitator, with two groups receiving high cognitive facilitation and two groups receiving low cognitive facilitation.

There were two facilitation teams each of which consisted of three people from the research team. Each team was responsible for the facilitation of one group in the high cognitive facilitation condition, and another group in the low cognitive facilitation condition. One person from each team took the lead in generating and posting messages, and the others gave feedback before the messages were posted. Facilitators were to post a message every day.

In both high and low conditions, facilitators avoided using didactic teaching strategies, acting as content experts, and introducing new material. Both facilitators included high social presence in their postings. For the purpose of this study facilitator high social presence is defined as a style of communication that makes active use of written expressions to compensate for the lost non-verbal cues in computer mediated communication (Rice & Love, 1987). The intentional use of social presence cues (Swan, 2003; Rourke, Anderson, Garrison, & Archer, 2001; Abdullah, 1999) should allow facilitators to be perceived as friendly within the mediated communication. The cues used were humor/playful asides, expression of emotion, self-disclosure, addressing people by name, greetings/phatics, and allusions of physical presence.

In the high cognitive facilitation condition the overall goal of the facilitators was to promote critical dialogue and evidence based argumentation among team members without providing direction or points of view on the specific content. Cognitive facilitation included inquiry learning facilitation techniques such as asking for the clarification and elaboration of the presented ideas, promotion of the use of the articles, and the sorting and synthesis

of ideas. In the low cognitive facilitation condition facilitators did not use any of these strategies but rather encouraged the students to discuss and share their ideas.

Facilitators were trained in responding with high and low cognitive facilitation messages. Throughout the facilitation process they used two facilitation guides prepared by the research team; one for each condition. The high cognitive facilitation guide (Table 1) included specific strategies and detailed examples for each one. The low cognitive facilitation guide focused mainly on social and motivational presence, and instructed facilitators to avoid using any of the strategies used on the high cognitive facilitation. The strategies on the high cognitive facilitation guide (Table 1) were drawn from the model defined by Collison et al. (2000).

Table 1: *Cognitive Facilitation Strategies** (adapted from Collison et al., 2000)

| General Strategy Category | Specific Strategies |
|---|--|
| <p>SHARPENING THE FOCUS</p> <p>These strategies seek to clarify ideas and find common understanding among participants. Highlight relevant ideas and key contributions, bringing coherence and pushing the dialogue forward.</p> | <p>IDENTIFYING DIRECTION: Selectively highlight or paraphrase relevant discussion items in order to refocus or redirect conversation, possibly weaving several discussion threads or ideas to provide a new focus.</p> <p>SORTING IDEAS FOR RELEVANCE: Ask students to classify or form comparisons. Alternatively, if needed you can call attention to sorting of ideas, making public the sorting mechanism, to focus on relevance and importance. Highlight ‘hidden gems’ in postings to bring them out of obscurity.</p> <p>FOCUSING ON KEY POINTS: Ask them to summarize or synthesize. If necessary eventually you can highlight key contributions, essential concepts, and connections so far. Bring to light potential gaps or tensions. Provide big picture, but do not summarize in detail or infer future directions – push participants to draw these inferences and assessments by themselves. Ask them to evaluate the strength on their ideas, seek judgments and assessments, and eventually reach consensus.</p> |
| <p>DEEPENING THE DIALOGUE</p> <p>Build on common ground by promoting that participants examine their own beliefs and assumptions, reflecting on perturbations to build new levels of understanding.</p> | <p>FULL-SPECTRUM QUESTIONING: Use a wide questioning approach (Who? What? When? Where? Why?) to push participants to examine their own personal, or collective, thoughts and beliefs.</p> <ul style="list-style-type: none"> ▪ Push them to go beyond by asking “so what?” in a specific context ▪ Ask them to consider other perspectives that they may not have thought about before ▪ Ask them to clarify or elaborate of their ideas ▪ Ask them explore their assumptions and sources, and provide a rationale or examples for their ideas ▪ Ask questions to identify cause and effects/outcomes ▪ Ask the team to solve discrepancies in the ideas ▪ Ask questions considering appropriate action or inquiry especially if the discussion is stuck <p>MAKING CONNECTIONS: Stretch the participant’s imagination or conceptual frames to consider obscure but essential similarities. Moving beyond the barriers of previously held beliefs or assumptions that may block these connections across contexts or at deeper levels.</p> <p>HONORING MULTIPLE PERSPECTIVES: Lay out the landscape of different views present on the discussion. This is usually the last stage before the group completes their final task.</p> |

* Note: examples included on the facilitation guide are not shown on this table

Instruments

All of the instruments used in the study were administered online. They included a pre-survey, a post-survey, and two final tests.

Pre-survey. The first section of the pre-survey consisted of two demographic items: name and age. The second section included 10 five point Likert-type items where 1 “Strongly Agree” and 5 “Strongly disagree”, that

were designed to assess participants' attitude towards the use of DE (three items), their interest in the topic (four items) and their attitude toward current state of K-12 education (three items). Although the internal consistency for questions on the three topics was not high enough to validate the existence of scales, individual items still provide useful information about the three indicated aspects. The last section consisted of 6 five point Likert-type items designed to assess the participants' level of trust. The trust items were drawn from Yamagishi & Yamagishi's (1994) scale of general trust, reaching in this study an internal consistency of .92.

Post-survey. The post-survey consisted of 31 five-point Likert-type items where 1 "Strongly Agree" and 5 "Strongly disagree". Six variables were measured. The first three scales were designed to assess the success of the treatment, and measured participants perceived cognitive facilitation (nine items with an internal consistency of .87), perceived facilitator social presence (seven items with an internal consistency of .89), and perceived facilitator motivational presence (three items with an internal consistency of .87). The last three scales assessed overall perceptions of participants' experience during the discussion, and measured overall satisfaction (six items with an internal consistency of .8), perceived learning (three items with an internal consistency of .79), and relevance/use of the articles (3 items with an internal consistency of .57).

Independent samples *t* tests were used to compare the results of the initial and final surveys reliable scales.

Recall Test. A recall test prompted the participants to remember as much as ideas they could from the articles they read and from their group discussion. This test was used as a basic measure of learning. Participants were instructed not to go back to the articles or the discussion forum before or during the recall task, and they were to use at most 20 minutes to complete the test and to report the time they used to complete it.

Open-ended Test. An open-ended test was used as a more elaborated measure of learning. It was a short test including four open-ended questions focusing on student's understanding of some of the basic issues included across all K-12 DE articles that were read.

Procedure

The discussion took place on the SiteScape asynchronous discussion forum (SSF). Because the participants had been using the same forum for their class discussions, they were familiar with the interface.

One day before the discussion activity began all participants were sent an email message including a link to the online pre-survey, and an attached file including the task instructions. The task instructions were also available on SSF.

Once all the pre-survey responses were received, facilitators posted their first message on SSF. Two different welcome messages were composed as the first facilitators' posting, one for the low cognitive facilitation, and one for the high cognitive facilitation condition. In addition to posting the welcome message on SSF, the same message was sent to participants by email in order to let them know that the discussion had started. After the welcome message, each facilitator made up their own messages according to the flow of the discussion, and according to the experimental condition of the groups. Due to lack of response from some participants, both facilitators did not post any message in a few occasions towards the end of the study in order not to dominate the discussion. Facilitators used email only as a reminder to those who were not actively participating. In these emails students were instructed not to reply but to post their contribution to SSF.

Two days after the discussion activity ended, all participants received an email message including a link to the post-survey, and another link to the recall and the open-ended tests.

Analysis

Content Analysis. Garrison et al.'s (2001) content analysis categories were used to assess the degree of critical thinking exhibited in the online discussion. These categories divide critical thinking in four phases: *triggering event, exploration, integration, and resolution*. Archer et al. (2001) define these phases as the idealized logical sequence of the process of critical inquiry. The first phase, triggering event, is an initiation phase of inquiry in which an issue or problem is raised. In the exploration phase participants' brain-storming, questioning, and exchange of information takes place. Moving beyond exploration learners come to the integration phase which is an iterative effort to construct shared meaning within the community of inquiry. The fourth phase is the resolution of brought up in the triggering event. The data that did not belong to any of these categories were put under a fifth category called *other*.

In addition to critical thinking two other variables were analyzed: *collaborativeness* of the participants during discussion and the *source of support* they used as evidence for their arguments. Collaborativeness was defined as participants' referring to the arguments of their teammates in a capacity to extend their contributions. Collaborativeness was coded into three categories depending on the reference to other participants: no reference to others, referring to one posting of a teammate, and referring to two or more postings of teammates. The source of

support was divided into two categories according to the types of evidences used in the arguments: support by referencing the readings, and support by referencing personal experience.

Two coders were responsible for the content analysis of the discussions. Sentence-level idea units for assessment of critical thinking and message-level idea units for assessment of collaborativeness and support were used for being the most appropriate in terms of usefulness and reliability. Coders worked on a small sub-set of data to develop the rules to define the analysis units and code them. After there was agreement on the definitions and rubrics of these idea unit analyses, the coders also practiced assigning data to these categories.

Since one of the coders was also a facilitator, and in order to avoid possible bias, before analyzing the discussion postings a third person removed the facilitators' messages, changed participants' names in each message to a pseudonym, and altered the order of the messages. The two trained coders broke the data into idea units individually and then compared their results. The level of agreement for this initial unitization was 96% using Holsti's Coefficient of Reliability measure. In all, the coders agreed on 852 sentence units within the 72 posted messages. After resolving discrepancies between the unitization results through discussion, coders individually coded a fifty percent sample of the messages into the critical thinking, collaborativeness, and support categories, according to the established rubrics. Results of coding were then combined and contrasted. Inter-rater reliability for content analysis was not as high as expected and therefore average scores from the two coders' results were used for analysis purposes.

Test Analysis. To assess participants' learning, the answers for the recall and the open-ended test were analyzed. The results of the recall test were scored by two different raters. Using a set of rules defined during practice sessions, raters compared the results to a predefined set of 142 possible items to recall that was extracted from all the articles used during the discussions. Raters reached a 75.5% of agreement on their scoring results. The results of the open-ended test were also scored by two different raters using a three points rubric with two criteria for each question, reaching a 78.9% of agreement. Independent samples *t* tests were used to compare the results of the final tests.

Results

Participants' Incoming Variables

Results on the initial online survey (with a 5 point Likert scale where 1="Strongly Agree" and 5="Strongly Disagree"), indicate that overall participants' (n=12) trust levels were high (M=1.61, SD=0.42), excluding one outlier (2.5 standard deviations from the sample mean) that showed low trust levels (M=3.5) according to the instrument. No significant differences were found between participants on the low and high groups on this variable. This result is relevant considering the importance of trust in student participation in online discussions (Yamagishi, 2001), and indicates that any possible effects were independent of participants' trust levels.

All participants also showed a positive attitude toward DE. When asked if they agree with the idea that "Distance education is a strategy that will provide real educational opportunities world wide," eight chose the "Strongly Agree" option and four "Agree" (M=1.3, SD= 0.5). When asked for their interest in the discussion topic, again all participants showed high levels of interest. To the statement, "The use of DE is a topic that interests me", all but one participant answered, "Strongly Agree," and the remaining answered "Agree" (M=1.1, SD=0.3). Finally, when asked about their attitude toward K-12 education, when asked to react to the following statement "We are doing all we can to provide the best education we can in the US," again participants reacted similarly, in this case disagreeing with the statement (M=4.1, SD=0.8).

Overall these results indicate that all participants were in similar conditions to participate in the discussion. They were all interested in the topic; they valued the potential of DE, and had some concerns about the current state of K-12 education. All these are indicators that they could have a live discussion on the proposed topic: the use of DE in K-12 settings.

Participants' Perception of the Treatment

The three final survey scales (Table 1) that assessed how successful the treatment was, indicate no significant differences between conditions for their perceived facilitator social and motivational presence. Nonetheless, despite of the small sample size a significant difference $t(5) = 3.17, p = .025$ was found for the results of the perceived cognitive facilitation scale. These results indicate that the intended manipulation was successful and perceived by the participants. They should all have the same levels of social and motivational presence but differ in the level of cognitive facilitation.

Table 1: *Treatment perceptions for high and low cognitive facilitation conditions (5 point Likert scale 1=SA and 5=SD, N=7)*

| Condition | | Social Presence | Motivational Presence | Cognitive Facilitation |
|-----------|------|-----------------|-----------------------|------------------------|
| High | Mean | 1.52 | 2.00 | 2.15* |
| | SD | 0.36 | 1.20 | 0.65 |
| Low | Mean | 1.75 | 2.00 | 3.36 |
| | SD | 0.88 | 1.05 | 0.37 |

* Significant at the .05 level

Discussions Analysis

In the context of an exploratory study, content analysis results serve the main purpose of revealing patterns and trends that should inform thinking for subsequent studies. Thus, rather than reporting a detailed statistical analysis we carried out the content analysis focusing on conceptual indicators.

In terms of critical thinking, several patterns emerged indicating differences between treatments. Table 2 shows combined analysis by averaging the coders' ratings and the two groups on each condition. Results indicate a considerably higher percentage of critical thinking by sentence units in the high cognitive facilitation groups.

Table 2: *Percentage of idea units by critical thinking category. Combined coders, combined groups*

| Content of idea units | Low cognitive facilitation groups (n=178 units)* | High cognitive facilitation groups (n=248 units) |
|-----------------------|--|--|
| Other | 33.99% | 12.40% |
| Trigger | 5.90% | 2.72% |
| Exploration | 35.96% | 39.72% |
| Integration | 17.42% | 42.34% |
| Resolution | 6.74% | 2.82% |

* n = mean number of idea units at the *sentence* level for combined treatment groups

Regarding collaborativeness, results show similar levels of collaboration between treatments (Table 3), with a slight tendency in the high condition for having in total more references to other participants' messages.

Table 3: *Number of messages by level of collaborativeness – Combined coders, combined groups.*

| Number of prior messages referenced | Low cognitive facilitation groups (n=41 units)* | High cognitive facilitation groups (n=31 units) |
|-------------------------------------|---|---|
| None | 62.20% | 59.68% |
| One | 28.05% | 33.87% |
| Two or more | 9.76% | 6.45% |

* n = mean number of idea units at the *message* level for combined treatment groups

Regarding the use of resources to support discussion postings (Table 4), there was an important difference between high and low groups, with high cognitive facilitation groups providing article based support to their postings more than twice those on the low cognitive facilitation groups.

Table 4: *Number of messages by article based support – Combined coders, combined groups.*

| Support on articles data | Low cognitive facilitation groups (n=41)* | High cognitive facilitation groups (n=31) |
|---------------------------------|--|--|
| Yes | 12.20% | 27.42% |
| No | 87.80% | 72.58% |

* n = Mean number of idea units at the *message* level for combined treatment groups

Personal experience support was a coding decision made based on whether messages showed evidence of including examples from the participant’s experience with the intention of using them to support an argument. Table 5 presents combined coder and treatment group results for personal experience support, showing very little difference between the high and low cognitive facilitation groups, both exhibiting personal experience support in nearly 30% of the messages.

Table 5: *Number of messages by personal experience support – Combined Coders, Combined Treatment Groups*

| Personal Experience Support | Low cognitive facilitation groups (n=41)* | High cognitive facilitation groups (n=31) |
|------------------------------------|--|--|
| Yes | 30.49% | 29.03% |
| No | 69.51% | 70.97% |

* n = mean number of idea units at the message level for combined treatment groups

Final Survey Results

The three final survey outcome variables; overall satisfaction, perceived learning, and self-reported use of the articles, indicate no significant differences between conditions. Nevertheless, in all cases there is a clear tendency for participants on the high cognitive facilitation groups to have higher ratings, as shown on Table 6. They were more satisfied with the discussion, their perception of learning was higher, and their self-reported use of the articles was also higher.

Table 6: *Final survey results by facilitation conditions (5 point Likert scale 1=SA, 5=SD, n=7)*

| Condition | | Overall Satisfaction | Perceived Learning | Self reported use of articles |
|------------------|------|-----------------------------|---------------------------|--------------------------------------|
| High | Mean | 2.00 | 2.00 | 1.11 |
| | SD | 0.60 | 0.33 | 0.19 |
| Low | Mean | 2.42 | 2.42 | 1.67 |
| | SD | 0.52 | 0.63 | 0.38 |

Final Tests Results

In terms of learning outcomes (Table 7), no significant differences were found, but there is a tendency for those in the high cognitive facilitation groups to have a higher number of recalled items and a higher score on the open ended test.

Table 7: *Learning outcomes by conditions (n=7)*

| Condition | | Number of items recalled | Test Score(24 points scale) |
|------------------|------|---------------------------------|------------------------------------|
| High | Mean | 11 | 20.38 |
| | SD | 7.35 | 2.10 |
| Low | Mean | 9.5 | 19.13 |
| | SD | 6.03 | 1.93 |

Discussion

The purpose of this pilot study was to explore the relationship between high cognitive facilitation, critical thinking, and learning in online collaborative environments.

According to the results of the initial survey all participants were in similar conditions to participate in the discussion. They were interested in the topic, valued the potential of distance education and had some concerns about the current state of K-12 education. In addition, all participants (with the exception of an outlier) showed high trust levels, which was relevant for the study considering the importance of trust in student participation. All these were indicators that the manipulation could work and that participants could have a live discussion on the proposed topic. Cognitive facilitation was successfully manipulated and participants in the high condition did perceive their facilitator as providing a significantly higher level of cognitive facilitation. Simultaneously, there was no difference in the perception of the facilitator as being friendly (high social presence), and providing good motivation for the discussion.

These results are relevant for future studies on cognitive facilitation, because they show that cognitive facilitation can be successfully manipulated. The results also indicate that potential differences among conditions were not due to different levels of personal interest or trust, neither to different levels of social or motivational presence on the facilitator's side.

The first research question considered if high cognitive facilitation promoted critical thinking among participants or not. Based on the results of our analysis, we do see support for a link between high cognitive facilitation and critical thinking. Although our sample size was very small, we did see evidence of more critical thinking taking place among participants in the groups receiving high cognitive facilitation than among those receiving low cognitive facilitation. While the low group had 66% of critical thinking units, the high group had 88%. Specific support to this trend comes from the higher percentage of idea units classified as integration for groups receiving high cognitive facilitation. According to Garrison et al.'s (2003) model, integration is the most important category indicating critical thinking process. Low cognitive facilitation groups had a high number of idea units classified under other (34%), i.e. social or general postings with no direct relation to critical thinking, and concentrated their critical thinking on the two initial levels of the process (trigger and exploration 42%).

Concerning the additional categories examined, personal experience was problematic due to low inter-rater reliability. We think there was a good deal of confusion between the coders in the definition used to code this category. This disagreement may also have had an impact in the critical thinking coding as well, since personal experience was used as specific indicators in Garrison et al.'s examples (2003). We recommend that clearer definition and agreement be reached on the meaning of personal experience.

While our inter-rater reliability was lower than we would have preferred, these indicators give us hope that high cognitive facilitation may positively impact critical thinking in OL, and would therefore be a worthwhile practice to foster.

There were other relevant problems that arose in this study that need to be addressed and considered on future studies. The rating cues for critical thinking, based on the Garrison et al.'s model (2003), were not equally understood by the two raters, and better agreement could be reached by a clearer definition of the categories. In particular, the ambiguity between integration and exploration categories needs to be clarified. These categories created the most recognizable differences in coding between the coders.

One of the coders in this study was also a facilitator for two of the groups. This coder's familiarity with the discussions, and the potential of inferring context from memory, may have had an impact on the coding results, particularly his higher count for integration. It is recommended that future coding is not done by one of the study facilitators.

Context is also an important consideration. We "sanitized" the data and changed the order of the messages so the coders would not recognize the postings as being from one of the conditions. Nevertheless, the flow of an entire discussion thread could have provided clearer indication of the content categories for individual messages. If coding is done by non facilitators the original flow of the discussion could be used with no foreseen problem.

Unitization was a struggle for this study. We originally wanted to code at a "unit of meaning" level, but had much difficulty reaching agreement between coders on these units. To reduce ambiguity, we decided to code at the sentence level. This created much higher inter-rater reliability in unitization, but introduced the problems of volume of units (852 sentences), and lack of context. Garrison et al. (2003) decided to unitize at the message level. This makes logical sense as most messages are trying to accomplish one predominant task. Additionally, the model we used for analysis was developed and previously applied for coding at the message level, and did not translate ideally for applying it at the sentence level. We would recommend future studies use the message level for unitization, or develop a better rating scale more suited to the agreed upon units.

The second research question considered if high cognitive facilitation, and the consequent higher presence

of critical thinking among participants, results in higher levels of learning among participants or not. Results indicate that there were no statistically significant differences between the learning outcomes of the two conditions, or between the effects on perceived learning or satisfaction. Nevertheless, results also suggest a consistent tendency in which participants in the high condition showed higher satisfaction, higher perceived learning and higher use of the articles. In terms of learning outcomes, no significant differences were found in both the recall and the open ended tests, but again there is a tendency for those in the high cognitive facilitation groups to have, in average, a higher number of recalled items, and a higher score on the open ended test.

The fact that we had a small sample size might have prevented us from finding significant differences among conditions. Additionally, the instruments might not have measured learning in a way that would help us discriminate enough what participants learned during the discussion, and what came from their prior experience. Another factor that could have impeded appropriate discrimination was that each team member in addition to the shared article received an extra one, which made the recall test scoring complicated. Perhaps an interesting topic in which participants have none or reduced previous experience could have been selected to avoid this problem. Future studies should consider these aspects when further investigating online cognitive facilitation and student critical thinking in online environments. Nonetheless, as far as we know online cognitive facilitation has not been experimentally manipulated before, and results of this study open an interesting avenue for future research on facilitation, critical thinking, and collaboration in online learning environments.

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Integrating Technology, Art, and Writing: Creating Comic Books as an Interdisciplinary Learning Experience

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Abstract

Although commonly considered something that is for “after school” and best left out of the K-12 curriculum, the creation of comic books incorporate several skills from multiple academic curricula. This paper outlines two summer programs, one offered to ages nine through 15 year olds and another offered to 15 through 18 year olds. The programs teach students how to create their own digital comic book and emphasize proper writing skills, storyline development, fine arts skills, and the use of scanning, graphic design software, and page-layout design.

Overview

Although originating in the very late 1800s, comic books hit their stride as a media in the 1920s and 1930s. Thus, reading comic books has long been something that school-aged kids spend their free time doing, but the actual creation of comics for these same children hasn't been possible until the availability of multimedia software and hardware to the public and to schools. Often thought of as a pastime, comic book development incorporates several skills from multiple academic curricula. Creative writing, storyline development, various fine arts skills, graphic design, document layout, and computer literacy are all involved with comic book creation. Students are also motivated to learn when it comes to comic books!

Papert (1993) postulates that when individuals design or create things that are meaningful to them (or those around them), some of the most powerful learning occurs. In the last decade or so, computers have been developed which have the capacity for high-level creation. Music, graphics, video, simulations, web pages, and games are all creations that can be produced using our current computer technology.

Technology has also integrated well with both the fine arts and English language arts. Kaagen (1998), Garner (1990), and Livermore and McPherson (1998) all investigate the use of technology in art in K-12 schools, both in the U.S.A. and abroad. Lawn (1998) explores art and technology in higher education and finds the need for the use of mission statements when combining the two fields. Sistek-Chandler (2003), Groeber (2003), and McDonnell (2003) all discuss various aspects of writing and technology, including strategies for writing, literacy software, and rubrics.

Few have investigated or explored technology, fine arts, and English language arts. In her work, Scali (1991) presents classroom projects that integrate technology, fine art, aesthetics, writing, and science. Marshall (1998) describes how technology is interwoven through the various fine arts curricula at Minnesota State Arts High School. Despite these examples, few have combined and written about the interdisciplinary combination of technology, writing, and art. The current program was an attempt to further this important learning experience.

Designed for nine to eighteen year old male and female students, the program targets individuals with an interest in comic books and a penchant for writing stories and/or drawing. It occurs during the summer, when students have a break from school, and encompasses approximately 40 hours of instruction and lab time. Two versions of the program are taught within the context of two separate educational initiatives. One version of the program is offered during “Upward Bound” to 15 and 18 year old students over the course of five weeks. The other version of the program is taught during “Summer Safari” to nine through 15 year olds over one intensive week.

Upward Bound is sponsored by the United States Department of Education, within the Office of Postsecondary Education. It began in 1964, with monies from the Economic Opportunities Act. Currently, it is, along with Talent Search and Student Support Services, one of the federally sponsored educational opportunity initiatives comprising the “TRIO” Programs. Upward Bound provides support, in the form of workshops, classes, and programs, to individuals preparing for college. To be eligible to participate in Upward Bound, a student needs to be from a low-income family, a family in which no parent holds a bachelors degree, and/or a first-generation military veteran. Literature, foreign language, composition, laboratory science, and math instruction must be provided in any Upward Bound program. Many other types of courses or experiences are also available (United States Department of Education, 2004).

Summer Safari is a program sponsored by Plattsburgh State University College Auxiliary Services in

Plattsburgh, New York. It is a not-for-profit initiative and is entirely self-supporting (supplies and instructor fees are supported by registration fees). Instructors are chosen for their expertise in specialty areas and a wide variety of educational enrichment courses and workshops are offered through the program. As its name indicates, Summer Safari is only offered during limited weeks during July and August when students are released from school for an extended break in upstate New York. It is available for five to 15 year olds with no economic or educational prerequisites, but specific courses may be geared for a much more narrow age range.

The objectives of the current program are included below.

Upon completion of the program, students are able to:

- develop a story line for a comic book character or group of characters;
- write dialog for their comic characters, using proper grammar, sentence structure, and cohesive ideas;
- sketch rough drafts, or “thumbnails” of their comic characters either by hand;
- illustrate their stories through conventional methods of pencil and paper;
- scan pictures and save them, in the proper format, onto a disk and the hard drive of a computer;
- color comic characters and scenes using a graphic design software such as Adobe Photoshop;
- construct a portfolio of their work on their comic book, documenting the various stages of development;
- and
- reflect on the process of creating their project either through a written essay or verbal presentation.

The highlight of this multidisciplinary workshop is the seamless, integration of writing, fine arts, and computer technology to facilitate learning of curricula in each discipline. Students completed projects virtually without even being aware of all the content and skills they were attaining. They were too busy having fun to even consider that they were learning. As well, with a final-day presentation and display in the local comic book shop, stakeholders in the community are able to instantly see the results and value of a program of this nature.

Method

Participants

As per the delivery of the workshops, the participants were grouped into two separate programs. The first program, Summer Safari, consisted of 11 males and one female, aged nine-14, while the demographics of the second program, Upward Bound, was comprised of three males and seven females, aged 15-18 years old. Although both groups utilize the same tools and followed very similar instructions, Upward Bound is geared towards introducing the participants to career possibilities, whereas Summer Safari is used to introduce and encourage the wonderful world of comic books as an art form.

Participants are expected to have some prior knowledge before participating in these programs. They must know what a comic book is, show that they have some artistic abilities, and have acceptable writing skills.

Materials

A group orientation, incorporating DVD interviews on how professionals create comic books, was given on the first day. This was then followed by a distribution of supplies. These supplies included specialized paper that measures 11”x17” with a work area marked off by “non-repro” blue lines; regular pencils, rulers and erasers; regular 9”x11” drawing paper; tracing paper and lined paper for brainstorming, script writing and [for Upward Bound only] journal entries. Participants were also given Crow Quill Pen Holders and various size Nibs to use with India ink for outlining and shading and Opaque White to make any necessary corrections.

Paper portfolios were also distributed to the students so they could carry their artwork and supplies back and forth to the workshops. Carrying the portfolio also gave each student a sense of “eliteness”. Portfolios visibly communicate to the general public that the individual carrying a portfolio as a “tool-of-the-trade” is in fact a creative and artistic individual. This acts as a confidence builder for many of the participants.

Heavy reading assignments were required for the Upward Bound participants to be able to gain a better understanding of the concepts behind the techniques. Examples from anatomy books and excerpts from “how-to” books published by DC Comics, owned by Turner/Time Warner Corporation where distributed. For the Summer Safari, reading material was lighter, yet very informative. Publications, such as “Wizard: The Comics Magazine,” and “Sketch” contain short articles on drawing techniques, inking pages layouts, digital coloring, anatomy, as well as what is needed to put together a well-organized portfolio to showcase to comic book companies.

Since both programs involved the use of technology, participants were also given a list of comic book websites (www.marvel.com, www.dccomics.com etc) as well as a list of online resources (www.bluelinepro.com

www.wizarduniverse.com, etc.). Several of the resources provided have tutorials for many of the techniques incorporated in this workshop.

Procedures

Each unit of the program covered a sequential topic that is necessary for creating comic books. The modules were covered in a linear fashion and students were not allowed to skip a unit and progress to the next without finishing all previous units. The units are outlined below:

Unit 1: students flesh out their storylines and sketch initial drawings of their characters. They use the tracing paper to transfer their best images to the specialized paper.

Unit 2: students outline their drawings with India Ink using specialized nibs and pens.

Unit 3: students scan their comic book pages and save them onto a floppy disk/zip disk/CD or a computer hard drive.

Unit 4: students digitally color, detail, and retouch their drawings using a graphics program such as Adobe Photoshop.

Unit 5: students finish digitizing their comics and begin compiling their portfolios (both digital and hard copy) for presentation the next day. The newly created comic books are presented to the class as well as any parents/guardians/guest who wish to view the creations. Each student takes home both a digital and a hard copy version of their comic book. For those who give permission, their comic books are also displayed in the local comic book shop for the community to view and appreciate.

Due to the one-week, Monday to Friday from 9am-3pm, schedule for the Summer Safari program, each unit of this workshop took from a day to a day and a half. Conversely, Upward Bound is a program that runs for five weeks. Their scheduling consisted of one hour on Mondays and Tuesdays and two hours on Wednesdays thru Fridays. As a result, the day-to-day schedule of the Summer Safari program was then applied to a by-the-week schedule for Upward Bound.

In both programs, participants learned what goes on behind the scenes of creating a comic book. This involves brainstorming ideas; writing stories; developing character descriptions and page layouts; the art of “inking” a page; and utilizing technology to scan the “inked” page and color the page via graphic design software.

Criterion Measures

A 16-item Teacher/Course Evaluation Survey assessed both sets of participant’s satisfaction with various aspects such as materials, content, instructor, etc. of the workshop in which they participated. The survey was one traditionally used to assess courses in the Upward Bound program and no modifications were made to it. Permission to use the identical survey in the Summer Safari workshop, for purposes of comparison, was obtained from the Summer Safari Director. The survey consisted entirely of selected-response items, with five response choices. Sample items from the survey are below:

Please rate the following items:

| Item | Excellent | Good | Fair | Poor | Bad |
|--|-----------|------|------|------|-----|
| 3. The instructor makes the subject interesting. | | | | | |
| 15. The materials were relevant. | | | | | |

Data Analysis

Mean scores for the Teacher/Course Evaluation Survey were tabulated on a five- to one-point scale (Excellent = 5 points, Good = 4 points Fair = 3 points, Poor = 2 points, and Bad = 1 point). Means were tabulated for both groups, Summer Safari and Upward Bound, individually and collectively.

Results and Implications

Results of the Teacher/Course Evaluation Survey are discussed below by mean scores for Upward Bound, Summer Safari, and overall mean scores per item. There were 10 respondents for Upward Bound, 14 for Summer Safari, and 24 responses overall.

As shown in Table 1 below, overall both Upward Bound and Summer Safari students rated the instructor highly. Upward Bound participants scored item one “the instructor has thorough knowledge of the subject,” item nine “the instructor shows respect for students,” and item 10 “the instructor provides an atmosphere in which students feel free to ask questions,” with a 5.00. Summer Safari participants rated both item one “the instructor has thorough knowledge of the subject,” and item 13 “the instructor has a sense of humor,” with a 4.58. These scores

would indicate that, in part, participants enjoyed the courses due to the individual that taught them. As one would expect, having knowledge of the subject matter (in this case comic books), was found to be important. However, an instructor possessing a sense of humor was also found to be highly valuable by both age and grade groups comprised by Summer Safari and Upward Bound. This finding is supported by well-established instruction and lesson design models (Sullivan & Higgins, 1983). Some learning theories also discuss the use of humor as a motivational technique when teaching. Clearly, some of the success of the comic book workshops described here has to do with the instructor's use of humor with the target age groups.

Both Upward Bound and Summer Safari participants also scored item 15, "the course materials were relevant," highly with scores of 4.50 and 5.00 respectively. This indicates that although these courses were given in the summer, participants found that the assigned supplementary readings were of value. Asking participants from ages 9-18 to read materials in preparation for a course may seem like homework and is often met with resistance, especially in the summer. If participants feel that the reading materials are important for a course in which they show interest, the results here reveal that they will find them of value and likely resist completing this task less.

Interestingly, and perhaps most importantly for these participant groups is that Upward Bound students rated item 16 "the course information will help me in the coming year," with a 3.0 while Summer Safari students rate the same item higher with a 3.75. This finding is particularly intriguing when considering the age level of Upward Bound is 15-18 years old and the age level of Summer Safari is nine to 14 years old. Upward participants are clearly much closer to entering and preparing for college than are Summer Safari students. As well, overall Upward Bound students rated the course more positively than Summer Safari students (4.60 compared to 4.48). This would indicate that although Upward Bound students enjoyed the course more than did the Summer Safari students, they felt it was less applicable to their immediate future and education. Perhaps younger participants such as the Summer Safari individuals felt that they had more school and summer time to explore creative, "off-beat," areas such as comic book art and story-writing before getting down to the "serious" business of college. If this is the case, it is interesting that both younger and older K-12 students perceive college as an institution in which creative and unique interests cannot be explored.

Table 1 *Responses to Teacher/Course Evaluation Survey*

| Item | Excellent | | Good | | Fair | | Poor | | Bad | |
|---|-----------|------|------|------|------|------|------|------|------|------|
| | UB | SS | UB | SS | UB | SS | UB | SS | UB | SS |
| 1. The instructor has thorough knowledge of the subject. | 5.00 | 4.58 | 0.0 | .33 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2. The instructor is well organized. | 5.00 | 1.67 | 0.0 | 2.00 | 0.00 | .50 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3. The instructor makes the subject interesting. | 4.50 | 3.75 | .40 | .67 | 0.00 | .25 | 0.00 | 0.00 | 0.00 | 0.00 |
| 4. The instructor keeps appointments. | 4.00 | 3.33 | .80 | .33 | 0.00 | .50 | 0.00 | .17 | 0.00 | 0.00 |
| 5. The instructor is on time for class. | 3.00 | 2.08 | 2.00 | 1.67 | 0.00 | .25 | 0.00 | .17 | 0.00 | 0.00 |
| 6. The instructor answers questions completely and carefully. | 4.50 | 4.17 | .40 | 0.00 | 0.00 | .25 | 0.00 | 0.00 | 0.00 | .08 |
| 7. The instructor is willing to give extra help when needed. | 5.00 | 3.75 | 0.00 | 1.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 8. The instructor encourages student participation. | 4.50 | 2.92 | .40 | .67 | 0.00 | .25 | 0.00 | 0.00 | 0.00 | 0.00 |
| 9. The instructor shows respect for students. | 5.00 | 3.33 | 0.00 | 1.00 | 0.00 | .25 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10. The instructor provides an atmosphere in which students feel free to ask questions. | 5.00 | 3.33 | 0.00 | .67 | 0.00 | .50 | 0.00 | 0.00 | 0.00 | 0.00 |

| | | | | | | | | | | |
|---|------|------|------|------|------|------|------|------|------|------|
| 11. The instructor is sensitive to students' feelings. | 4.50 | 2.50 | .40 | 2.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 12. The instructor compliments students who have done well. | 4.50 | 2.50 | .40 | 1.67 | 0.00 | .25 | 0.00 | 0.00 | 0.00 | 0.00 |
| 13. The instructor has a sense of humor. | 5.00 | 4.58 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | .17 | 0.00 | 0.00 |
| 14. The instructor is able to relate well to students. | 4.50 | 2.50 | .40 | 1.33 | 0.00 | .50 | 0.00 | 0.00 | 0.00 | 0.00 |
| 15. The course materials were relevant. | 4.50 | 5.00 | .40 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 16. The course information will help me in the coming year. | 3.50 | 3.75 | 1.20 | 1.33 | 0.00 | .25 | 0.00 | 0.00 | 0.00 | 0.00 |
| TOTAL Mean Scores | 4.60 | 4.48 | 2.48 | 1.28 | 0.00 | .31 | 0.00 | .04 | 0.00 | .01 |

*N.B. UB = Upward Bound, SS = Summer Safari.

Conclusions

With growing initiatives such as a “No Child Left Behind” impacting more stringent curricula, perhaps PreK-12 teachers are either directly or indirectly impressing upon their students to “stick to the program” in order to be successful in school. Students may interpret that there is no room to explore outside interests in school any longer and extrapolate that impression through to college. What a shame it would be if the youth of today no longer think that there is room to explore creative interests in their school curricula.

Mitchel Resnick (2002) states that while the 1980s included an “Industrial Society” and the 1990s incorporated a “Knowledge Society,” he looks to the new millennium to produce a “Creative Society.” He posits that our society’s “success in the future will not be based on how much we know, but [rather] on our ability to think and act creatively.” Clearly, our children are the key to this type of societal shift, especially as childhood is one of the most creative times in our lives. Programs such as the one described here, which are multidisciplinary, integrate technology, and teach valuable academic and creative skills need to be celebrated and treasured.

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Scaffolding Pre-Service Teachers in Constructing a Technology Enhanced Learning Environment

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Abstract

One of the critical tasks confronting teachers today is to integrate technology in their classroom to facilitate learning and enhance student achievement. This is not an easy task. Teachers in these technology integration courses face multiple challenges from pre-service teachers: limited experience of instruction design and classroom implementation, limited skills of educational technology (hardware and software), and limited understanding of theoretical framework behind technology integration. This paper shares with you the experience of scaffolding pre-service teachers in constructing a technology enhanced learning environment.

Introduction

Driven by increased use of technology in K-12 schools and NCATE and ISTE standards, many teacher preparation programs offer courses on educational technology to prepare pre-service teachers in technology integration (Vannatta & Beyerbach, 2000). Teachers in these technology integration courses face multiple challenges from pre-service teachers: limited experience of instruction design and classroom implementation, limited skills of educational technology (hardware and software), and limited understanding of theoretical framework behind technology integration. This paper shares with you the experience of scaffolding pre-service teachers in constructing a technology enhanced learning environment.

Background of technology integration course

Pre-service teachers refer to those students in various teacher preparation programs to obtain their teaching certificates. Specifically in this paper, pre-service teachers refer to those students in the Teacher Education Environments in Mathematics and Science (TEEMS) Programs at Georgia State University. Now TEEMS programs develop to include not only Mathematics and Science Teacher Programs but also the programs in English, RLL – ESOL (Reading, Language and Literacy – English as a Second Language), and Social Studies. After successfully completing of the TEEMS program, qualified candidates will receive initial certification to teach grades 7-12 in their specific subject area.

According to Grabe and Grabe (2004, xix), technology integration is to use technology as a powerful tool “...in helping your students acquire the knowledge and skills of the content area or areas you will teach.” Many scholars (Grabe & Grabe, 2004; Jonassen, et al. 2003; Newby, et. al., 1996; Roblyer & Edwards, 2000) advocate a systemic approach towards technology integration with a focus on appropriate and effective use of technology in facilitating student’s learning and performance with technology.

IT 7360: Technology for Educators offered at Georgia State University is a three credit hour required course in all TEEMS programs that prepares pre-service teachers to integrate technology in their instructions. It goes beyond the basic use of computer programs. The students in this course are required to complete a series of assignments that involve using technology to solve instructional problems they identified. For each assignment, students will write documentation describing how the technology is integrated in their instruction and reflecting upon their technology integration efforts. At the end of the course, students are required to demonstrate competence in instructional design and technology integration through the planning and creation of a technology enhanced learning environment in his/her subject which includes their instructional unit plan, lesson plans, student-centered learning activities, and assessment plan (Shoffner, 2004).

Scaffolding pre-service teachers

Scaffolding defined

Scaffolding originates from the practice of apprenticeship far back in human history. Its theoretical roots stemmed from Vygotsky’s social learning theory and “zone of proximal development”. According to Vygotsky (1978), scaffolding is defined generally as temporary support or assistance, provided by someone more capable that permits a learner to perform a complex task or process that he or she would be unable to do alone. It is a special assistance that helps learners to move toward new levels of understanding of concepts, skills, and ability of solving

problems. Scaffolding in this paper refers to the assistance built in IT 7360 course that helps pre-service teachers (TEEMS students) to construct a technology enhanced learning environment by integrating technology into their classroom instruction.

Scaffolding built in IT 7360 includes three dimensions of technology integration: Theoretical concepts, instructional design and development processes, and technology integration products. The following reports what the instructor did in IT 7360 course to scaffold TEEMS students in constructing a technology enhanced learning environment.

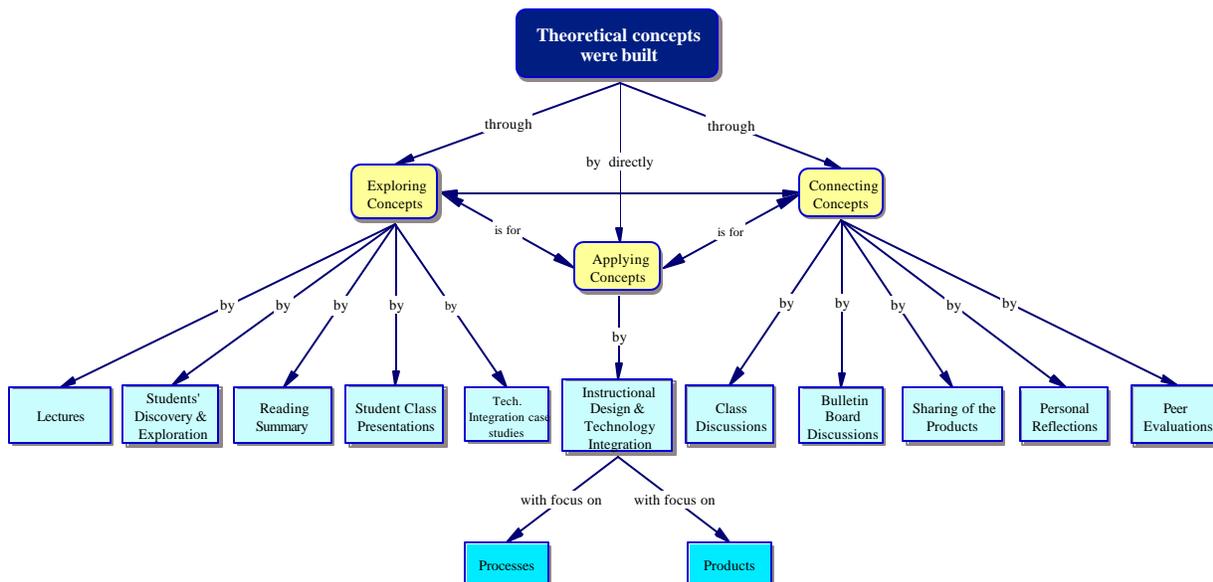
Theoretical concepts in technology integration

The theoretical concepts refer to those learning theories, instructional design and development models, and the understanding of important issues in and related to technology integration. Scaffolding TEEMS students' learning in this dimension involves exploring, connecting, and ultimately applying those theoretical concepts in their technology integration efforts. Some of the major theoretical concepts covered in the course include the following

- Basic theories of learning and implications for instruction design
- Instructional design models and principles
- Learning environment and technology
- Internet and instruction
- Information literacy
- Visual literacy
- Technology integration
- Copyright issues in technology integration

To explore these theoretical concepts at the beginning of the course is to build a foundation for technology integration efforts. The purpose is to seek the theoretical implications to guide TEEMS students in technology integration. Their actual applications in technology integration consolidate the theoretical concepts explored and make those theoretical concepts meaningful to them. Various discussions and reflections on their technology integration efforts also help connect those theoretical concepts to their personal experiences of technology integration. TEEMS students' learning in this particular course, starts with exploration of theoretical concepts and ends with reflections upon their practice in technology integration as shown in Figure 1.

Figure 1: Scaffolding in exploring, connecting, and applying theoretical concepts



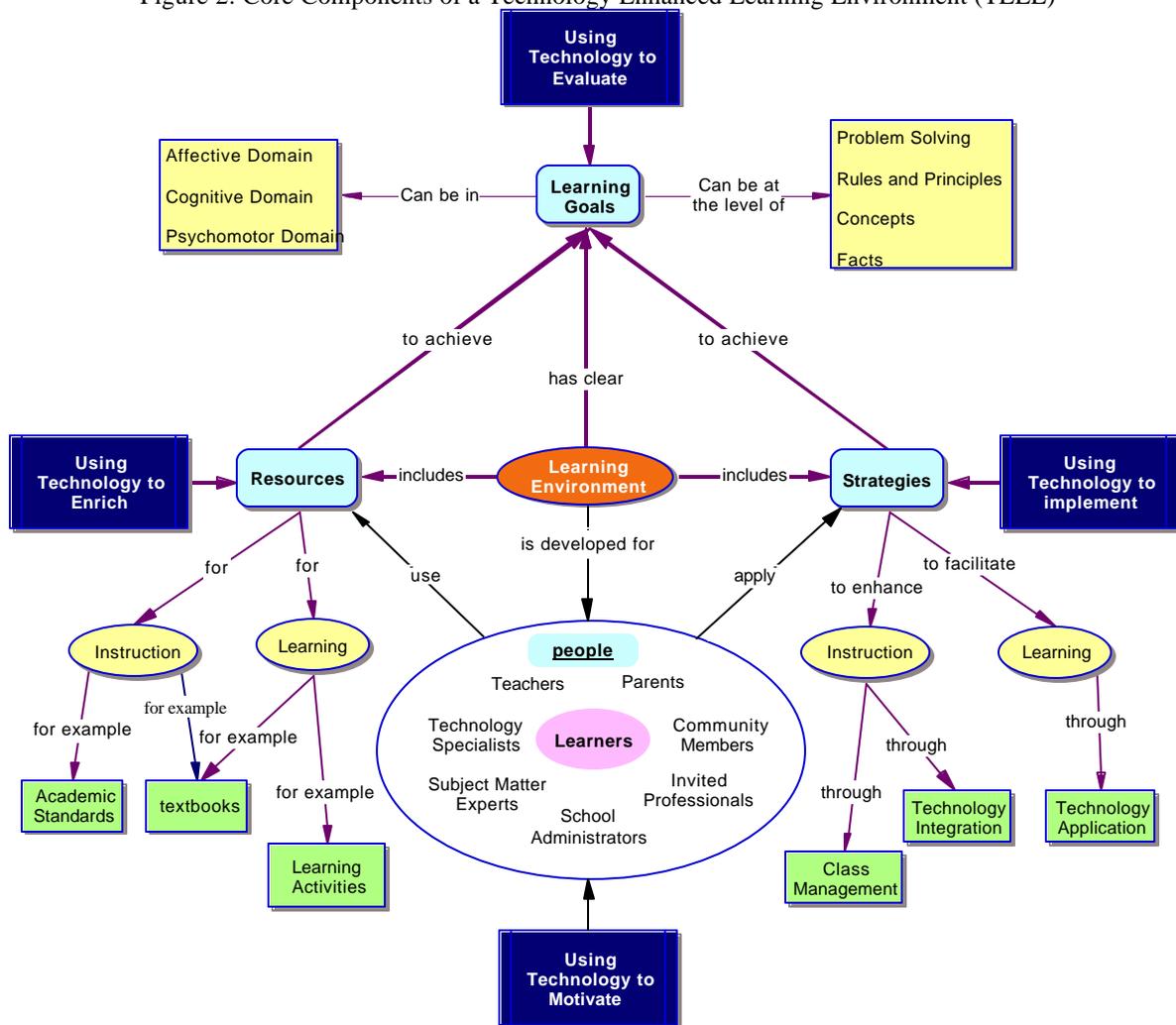
An example of scaffolding

Learning environment is one of the theoretical concepts that TEEMS students have difficulty to understand. Learning environment, according to Grabinger (1996), is a "broadly and carelessly used" term in educational literature. The explorations of TEEMS students both online and from reading produced a long list of learning

environments: “Constructivist learning environment (Jonassen & Rohrer-Murphy, 1999)”, “student-center learning environment (Land & Hannafin, 2000)”, “problem based learning environment (Barrows, 1996)”, “project-based learning environment (Kraft, 2003)”, “Computer-Supported Intentional Learning (CSILE) (Scardamalia & Bereiter, 1991, 1994)”, “online learning environment”, “multimedia learning environment”, and “web-based learning environment” to name a few. The richness of literature on “learning environment” indicates that learning environment is a crucial factor in learning and instruction. However, it confuses pre-service teachers at the same time.

Students’ explorations bring forth multiple perspectives on learning environment and the guided discussions both in class and through WebCt Course site bulletin board provide students opportunities to negotiate within their learning community what a learning environment is and how it can be created. As a result, a working definition of learning environment from an instructional design perspective is created. A learning environment is defined as a complex and dynamic system where people apply certain strategies and use available resources to achieve pre-determined learning goals. This definition of learning environment clearly states its core components (learning goals, people, resources, and strategies in a dynamic system) to offer TEEMS students very concrete building blocks for the construction of their learning environments. Figure 2, *Core Components of a Technology Enhanced Learning Environment (TELE)*, depicts the relationships among the four core components of a learning environment and the characteristics of TELE.

Figure 2: Core Components of a Technology Enhanced Learning Environment (TELE)



Then, according to this definition, a TELE is designed and developed. After TEEMS students finished the development of their TELE, they will put it in function and test it in their classrooms. Following the test of their TELE, TEEMS student are required to reflect on their instructional design and technology integration efforts. The reflection at levels of individuals, groups, and the whole class makes those theoretical concepts of technology

integration meaningful to the TEEMS students. It connects those theoretical concepts to their personal experience of technology integration which does not only strengthen those theoretical concepts but enhances their understanding of those theoretical concepts to a new level.

Instructional design and development processes

The analysis, design, development, implementation and evaluation (ADDIE) model of instructional design are introduced to TEEMS students at the beginning of the course. Following basic theoretical concepts, they are involved in actual instructional design and technology integration processes. To facilitate their technology integration efforts, both process prompts and components displays are used (Lin, et. al. 1999). Process prompt guides student’s attention to specific aspects of processes during technology integration while component displays assisting students instructional design efforts to ensure the quality of their instructions designed. For instance, in the process of analysis of learners and problems, following prompts are given to the TEEMS students in addition to their discussions and reflections.

| | |
|--------------------------------|--|
| Description of learners | |
| • | General characteristics |
| • | Specific entry competencies |
| • | Learning styles |
| • | Academic and social information (Kemp, Morrison, & Ross, 1998) |
| • | Implications for instructional design from learner analysis. |
| Description of problems | |
| • | Problem phenomena observed |
| • | Causes of the problems |
| • | Impacts of problems on student’s learning |
| • | Proposed solutions and rationale |

Also to assist TEEMS students to go through their instructional design, following matrix of designing components is used.

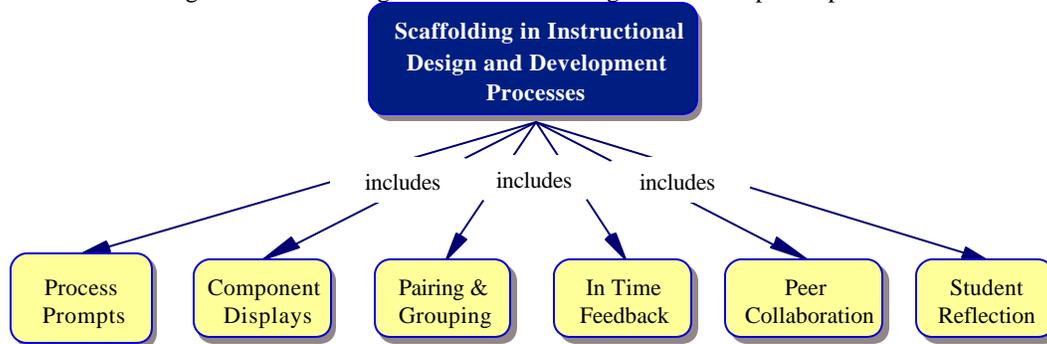
| A matrix of designing components | | | | |
|---|--|------------------------|-----------------------------|---------------------|
| Learning goals: _____ | | | | |
| Academic standards to be addressed: _____ | | | | |
| Learning objectives: _____ | | | | |
| Learners: _____ | | | | |
| Time and Space: _____ | | | | |
| Learning/ Performance | Criteria and Methods for Evaluation | Learning Strategies | Instructional Strategies | Resources Needed |
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 (It goes on as needed) | | | | |

Both process prompts and components displays clearly spell out detailed and required efforts in technology integration processes that a TEEMS student, who are not experienced in instructional design, tends to ignore. These prompts also help TEEMS students see how a systemic approach can be used to solve problems and to produce an effective instruction products (instructional materials, lesson plans, etc.).

The scaffolding TEEMS student's going through the instructional design and technology integration processes is not limited to providing guidance from the instructor. TEEMS students in IT7360 are usually diverse in computer skills and instructional design experience. Carefully pairing and grouping them by the instructor in constructing a TELE are very important and the scaffolding provided by more capable peers in instructional design and development process is highly recommended in technology integration courses. Actually, pairing and grouping students in instructional design and development processes as a scaffolding strategy is reported as "facilitating collaboration" and "beneficial" in TEEMS students' reflection papers.

In-time feedback provided during instructional design and development processes and moderation on their peer collaboration in constructing a technology enhanced learning environment are also part of scaffolding built in IT 7360. Figure 3 illustrate the scaffolding strategies built in instructional design and development processes.

Figure 3: Scaffolding in instructional design and development process



Technology integration product

The ultimate goal of technology integration is to facilitate learning and improve performance. The exploration of theoretical concepts and the guided efforts in technology integration processes are meant to enhance the quality of technology integration. The systemic evaluation of the instructional products helps TEEMS students come to understand that technology integration is not a simple use of technology but a systemic approach to facilitate learning and performance.

Scaffolding in technology integration product of IT 7360, a TELE constructed by TEEMS students focuses on appropriate and effective use of technology to address instructional problems identified by TEEMS students. Lin and her associates (Lin, et al., 1999) listed three important implications of social learning theory for understanding the reflective thinking and designing technology-based environments that support reflection. First, reflective thinking involves social interactions because one needs multiple perspectives and feedback on their own performance and understanding. Second, reflective thinking is an active, intentional, and purposeful process of exploration, discovery, and learning. Third, reflective thinking ultimately involves understanding one's own process of learning.

Scaffolding in technology integration product of IT 7360, a detailed instruction and specification on technology integration product and how it will be eventually evaluated is given and discussed in class. Students are advised to use the evaluation rubrics as a checklist to conduct self evaluation of TELE they created for their students. Another scaffolding strategy to enhance the quality of technology integration product is to orient TEEMS students' technology integration effort around *Quality Core Curriculum* (QCC) by Georgia Department of Education and other academic standards such as *Georgia Technology Standards for Students*, *Georgia Technology Standards for Teachers*, *National Education Technology Standards for Students*, and *National Education Technology Standards for Teachers*. This does not only prepares TEEMS students in technology integration by connecting their learning experiences with the actual tasks in the real world but also pave their way of technology integration in their future career.

Both in formative and summative evaluations, instructional consistency and congruency are emphasized. TEEMS students are required to check consistency of their instructions to ensure that specific entry competencies required to perform learning tasks are built up. Additionally, TEEMS students are required to check if their instructional objectives, instruction, and assessment are congruent. That is, they are aligned so that instructional objectives, instruction, and assessment deal with the same type of knowledge and skills and at the same level of learning as revealed below by Figure 4.

Figure 4: Concept of instructional consistency and congruency

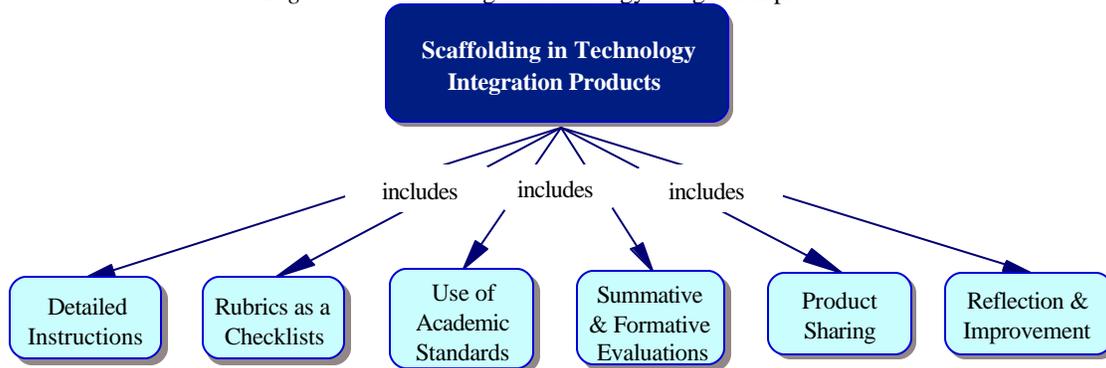
| Learning Hierarchy | Instructional Congruency | | |
|--------------------|--------------------------|-------------|------------|
| | Objectives | Instruction | Assessment |
| Problem Solving | ▼ | ▼ | ▼ |
| Rules/Principles | | ▼ ▼ | |
| Concepts | | ▼ ▼ ▼ | |
| Facts | | ▼ ▼ ▼ ▼ | |

Instructional Consistency

Adapted from Class handouts of INSYS 575C, Summer 2000 taught by Dr. Francis Dwyer

Sharing technology integration products developed by TEEMS students in class is another scaffolding strategy. This experience sharing and TELE sharing in class present multiple views and perspectives about technology integration and how TELE can be effectively designed and developed. It broadens the views of TEEMS students, creates a wonderful opportunity for them to learn from each other, enriches the contents for their reflections and offers suggestions for improvement in their TELE construction. It is believed that the appropriate and effective use of technology for instruction is situational. Learners, learning goals and objectives, learning resources, learning context, and learning strategies should be considered as a whole learning system to determine the appropriateness and effectiveness of technology integrated in instruction. Figure 5 summarizes the scaffolding strategies used to enhance the quality of TELE created by TEEMS students.

Figure 5: Scaffolding in technology integration products



Conclusion

To prepare pre-service teachers such as TEEMS students to appropriately and effectively integrate technology into their instructions is a very challenging task. The course survey, the technology integration samples, documentations, reflection papers yield many positive comments on this three dimensional approach of scaffolding in this technology integration course with TEEMS students. The quality of technology integration products of TEEMS students improves greatly when TEEMS students experience technology integration in these three dimensions.

Following are a list of major activities that TEEMS student reported very beneficial to them in this course according to the survey and reflection papers.

- Guided exploration of information literacy
 - A series of group activities that require students to search for information, analyze and evaluate the information, and synthesize information for class presentations on different aspects of information literacy within one hour.
- Guided exploration of visual literacy

- A series of group activities that require students to search for information, analyze and evaluate the information, and synthesize information for class presentations on different aspects of visual literacy within one hour.
- Defining learning, instruction, and technology integration
 - A series of both small group and a class activities that require students to search for information, analyze and evaluate the information, and synthesize information for class presentations on learning, instruction, and technology integration within two two-hour sessions.
- Sharing of Assignments
 - A number of assignments done by TEEMS students are shared and discussed in the class.
- Building class knowledge base
 - Collaboration among a whole class. It collects a various useful resources located online, well-done class assignments, students' discoveries and explorations of various topics covered in the course, etc.
- Guided exploration of copyright issues
 - A series of group activities that require students to search for information, analyze and evaluate the information, and synthesize information for class presentations on different aspects of copyright issues within one hour.

Although positive effects of learning were reported in the course survey and student reflections, the systemic study of this approach is needed to provide empirical evidence of how scaffolding built in these three dimensions would effectively prepare TEEMS students in technology integration not only during the semester when they are taking the course but also later in their actual teaching career! Furthermore, scaffolding in these three dimensions is one way to meet challenges teacher educators face in technology integration. Through the paper, I sincerely hope to exchange ideas with other teacher educators and seek more effective ways to prepare pre-service teachers in technology integration.

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Taking Synchronous Online Courses in the United States: The Perceptions from Asian Students

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Abstract

Online learning has become a new paradigm in education, but very few research-based studies have addressed the multicultural aspects of online learning. Using interviews and observations, this study examines the perceptions of Asian students while taking synchronous online courses in the United States. The specific questions explored in this study are: (1) How do Asian students shift their learning styles from physical classrooms to synchronous online learning environments? (2) What are Asian students' opinions of synchronous online courses? (3) How do Asian students interact in synchronous online learning environments? (4) How do the instructional dimensions of synchronous online courses accommodate the needs of Asian students?

Introduction

Many institutions of higher education in the United States have entered the distance learning arena because it makes economic sense, and also provides more educational opportunities. An important premise under this new instructional approach is that these educational opportunities should be responsive to the needs of students and the world in which they work and live (Palloff & Pratt, 1999). As a result, the instructional design of online environments should be informed by the needs and special characteristics of the learners. International students are one of the groups that need special attention because they are from different cultures. How to accommodate cultural considerations in online learning environments has become an increasingly important issue to explore, especially as online courses extend their markets around the globe. This study focuses on international students from Asia already studying in the USA with the goal of analyzing their perspectives of taking synchronous online courses in the United States. The synchronous (real time) online course uses a web-based tool which includes both audio and textual communications. These students are in the ironic position of traveling halfway around the world for higher education and then finding themselves enrolled in synchronous online courses. The findings of the research are expected to contribute to the literature about multicultural considerations in synchronous online learning environments as well as to provide suggestions for enhancing the design and implementation of online courses in general.

Toward multicultural considerations

The computer and networked technologies have opened the way for educators to reach the learners “beyond brick and mortar” campuses (McIsaac, 2002). Potential learners are not just from local areas, they could be from other countries around the world. Harasim (2000) has proclaimed that online learning is no longer peripheral or supplementary; it has become an integral part of mainstream society. A new paradigm in learning is just about to emerge.

Following this trend, research in distance education has reflected the rapid growth in the field. However, the literature has indicated little published research on the cultural aspects of online learning and teaching, and there have been few research-based studies (Gunawardena, Wilson, & Nolla, 2003). Matsumoto (1996) described culture as “the set of attitudes, values, beliefs, and behaviors shared by a group of people, but different for each individual, communicated from one generation to the next” (p.16). It is hard to notice how culture influences people without seeing actual artifacts. Artifacts such as foods and advertisements are shaped by culture, but this process is usually activated unconsciously when people think and interact with the external world. Henderson (1996) has reminded us that instructional design is a product of culture, and it cannot and does not exist outside of a consideration of culture. McLoughlin (1999) also stated the need to ensure the coverage of every culture is important in the beginning of adopting an instructional design model. While accommodating cultural differences sounds good in theory, a dilemma happens when there is a conflict between the cultures under consideration. These are the challenges mentioned by Reeves and Reeves (1997) when the core pedagogical values in one culture are culturally inappropriate in another. This dilemma not only causes uncomfortable feelings among learners, but sometimes it will cause serious misunderstandings. McLoughlin (1999) warned that even seemingly innocent design features in the learning environment may nevertheless cause cultural misunderstanding. For example, the color of text in an

online learning environment is critical to Chinese students (Tu, 2001). Chinese interpret red text as a warning, but the instructor or instructional designer may use red just to emphasize the content.

Ku and Lohr (2003) in their case study regarding Chinese students' attitude in online learning experience suggest that teachers should attempt to increase students' self-confidence and motivation in the early stage of the course, design small group activities for giving feedback, maintain a self-directed design of the learning environment, provide various opportunities for writing and reading, and if possible, encourage face to face interactions among group members and the instructor. Based on their teaching experience, some researchers have also concluded that social and cultural understandings need to be explicitly and honestly discussed in a class (Chen, Mashhadi, Ang, & Harkrider, 1999). In addition, the cultural factors in learning environments need to be negotiated carefully because students from different cultural background usually have different relationships among teachers and students as well as different ways to comment on the work of others (Schallert, Reed, & D-Team, 2003). International students are often unwilling to address the teacher or other students in the class because they are unfamiliar with the ways of holding public discussions in the class. Schallert et al. (2003) also mentioned that teachers need to encourage international students to keep writing in an online class and to lower their internal editor when composing their messages. The instructors need to provide some guides for students to appropriately communicate online such as how to use common paralinguistic (Tu, 2001).

Additionally, these online learning experiences are also influenced by the perceptions they hold. Research has shown that not only the online environment itself, but also the perceptions of students will influence their interaction in an online learning environment (Tu, 2001). Different social contexts nurture various perceptions that hold in students' mind. Tu also provided an observation that Chinese students maintain tradition reactions during online learning interactions. For example, "saving face" remains just as important in an online course environment as it does in a physical classroom. In an ongoing longitudinal study, Pan, Tsai, Tsai, Tao, and Cornell (2003) have tried to analyze the elements embedded in Confucian pedagogy and Western pedagogy, and then seek if there is symbiosis or asymbiosis for these different pedagogies. From their draft report, some preliminary results can be applied to online environment course design. For example, one principle they espouse is "encourage Asian students to not work together in the same project groups, thus provide the Asian students with direct opportunities and challenges in using English." (p. 324).

Other than cultural considerations, Asian students also face language barriers in their learning. However, research (Schallert et al., 2003) found that despite the constraints on international students' input in both oral and written discussion, computer-mediated discussion offered increased opportunities for international students to contribute ideas in the class. To what extent Asian students improve their learning experience in online classes is unknown, but it is clear that the online learning environment does have impact on their learning. In addition, most of the studies which have been done so far were focused on asynchronous online learning environments. What would be the differences if the online environments are synchronous rather than asynchronous for Asian students? Do the advantages or disadvantages of Asian students in online learning environments remain the same in both synchronous and asynchronous? More studies are needed to address this issue.

Research Questions

In order to better understand cultural factors in synchronous online learning environments, this study adopts qualitative methods to examine how the synchronous online learning environment and individual cultural differences interact together, and more specifically how Asian students adapt from learning in traditional face-to-face classrooms to learning in synchronous online learning environments. The synchronous online learning environment in this study is a two-way (audio and instant message) communication web-based environment. Students can hear the instructor's lecture, speak to the group, type instant messages and view the PowerPoint slides through the web-based tool. Except for the first class, the course is conducting completely online synchronously. Four specific questions are explored in this study:

- How do Asian students shift their learning styles from physical classrooms to synchronous online learning environments?
- What are Asian students' opinions of synchronous online courses?
- How do Asian students interact in synchronous online learning environments?
- How do the instructional dimensions of synchronous online courses accommodate the needs of Asian students?

Methodology

Participants

Eight participants are expected in this study. However, because the course is only offered in the spring semester, I have only been able to find three participants to join in this study so far. All of these participants participated in a face to face interview, and one of them also took part in the participant observation. The participants are international students who are from Korea, Singapore, and Taiwan, and they are or have been enrolled in the graduate-level synchronous online course on which this study is focused. Data collection and analysis is continuing at this time. These participants so far are all Masters students and they are required to take this course in order to complete their Masters degree. The time they have been in the United States ranges from less than one year to almost two years. Additionally, for one of them, this is the first time taking an online course in the United States. Other demographic factors like gender or age are not considered in this study. However, this study will attempt to have equal number of the participants in both genders and nationality.

Data collection

This study uses semi-structured interviews and participant observations to generate data. Three different audio recorded semi-structured interviews were conducted during March and April, 2004, and another four will be conducted during the spring semester, 2005. The interviews are face-to-face and followed the interview protocol. Each interview is around one hour long. In addition, a one hour long participant observation was conducted during the spring semester, 2004, and another two are expected to be conducted during spring semester 2005. In the observation, I was virtually and physically staying with the participants to observe their interactions both in the online classroom and outside the online classroom during a one-hour period in the class. I recorded the observations in the field notes, and a short informal interview is being conducted to clarify the findings in the observations.

Data analysis

This study adopts part of Carspecken's (1996) reconstructive method to analyze the interview transcriptions and observation field notes. The first step is to employ low-level coding to make out both frequently mentioned concepts and unusual ones. In this study, we use one of the interviews to generate the primary codes. The process is to go through the whole transcription and list examples which can support these primary codes. Then, using these emerging codes as the pre-determined codes in other interviews, those interviews are analyzed to find more examples. Meanwhile, if there are any special events or frequently mentioned concepts in other interviews that did not appear already; new codes will be added with the examples. In addition, some statements related to self identification, such as "I am a person who likes to try different experiences" are also listed in the document.

After the primary codes with supported examples are marked out from these transcriptions, the internal consistency check is performed. This process is to make sure that the examples really support the codes, and to determine whether any new codes or sub-codes should be distinguished from the original primary codes. For the participant observation, similar processes are employed into the data analysis. Specifically, the goal is to make out the patterns of online interaction and strategies the participant used during the online course. The results found in the observations are incorporated into the findings in the interviews.

Using this coding scheme, the results of the interviews and observations are being used to reveal the themes and patterns in the participants' perspectives of their experiences in the synchronous online learning environment.

Findings

Several primary codes and categories are emerging from the data. By integrating these categories and comparing the codes constantly, the data are synthesized into several main themes. The findings below are organized by these themes and interview excerpts are provided to support the findings.

Opinions of synchronous online courses

Synchronous online learning is useful because the participants do learn things from it and the environment is actually better than they originally expected. Originally, the participants thought that synchronous online courses might be just require listening to lecture and exchanging ideas in a simple way, like one participant says:

"Originally I think that maybe just describe something and o.k. I can get some information and hear some some listen to somebody's thinking, just that."

However, after experiencing this synchronous online course, they found it is better than their original expectation. As one participant says:

“And this environment I think is .um.. Also better than I expected. The sound quality and the instant message, I think that’s good enough for learning than I expected.”

Although the participants think synchronous online learning is a useful way of learning, they still think students need to meet face to face. One participant, after mentioned several benefits of synchronous online courses still pointed out the concern that *“Basically, the students need to come face to face.”* More critically, one participant addressed that synchronous online course cannot substitute traditional course. As he says:

“I think it a good way of thinking, but it can...I don’t think it can substitute traditional course.”

He further addresses the point that the use of synchronous online technology should depend upon the course contents. As he says:

“We cannot apply online course to all courses. It should be depended on the property of the material.”

In addition, another participant pointed out that the online learning environment is not absolutely a learner-centered design. It will depend on the instructor’s pedagogy. As he says,

“...rather it (synchronous online course) is teacher-centered or student-centered actually depends on the lecturer himself...I think it’s not so much about the medium, It’s more on the methodology the teacher adopts.”

Learning experiences in synchronous online courses

The participants feel the learning experience in the synchronous online course is enjoyable and convenient, because they do not need to come to the physical campus and can be more relaxed during the class. As one participant says:

“Learning experience, in a way for me, it is quite an enjoyable one...The class is conducted online and it’s pretty convenient for me ... ”

Although the participants feel more relaxed physically, this does not mean that they pay less attention during the class. One participant addressed his point:

“We can be very casual, because you are not sitting in a face to face class. So, we can be very causal, and very at easy. Yeah, having our snack at the same time. Ok. All right, that’s one thing, you can be very relaxed. Relaxed doesn’t mean not pay attentions, but at least physically you can be very relaxed and listening”

Another thing which is convenient for the participants is that the participants can review the previous course through the archives in the web site. The participants can listen to the course one more time if they need. As the participant describes:

“But..um..it is useful..um..it was useful for me to review the..review the content on the website.”

Besides, the participants feel nervous when they need to speak out their ideas online, because they are afraid of making language mistakes and other classmates might not understand them. As they describe:

“Speak...I...will be a little nervous. Yeah, because you know many potential students, classmates are listening to you. Yeah, so I am afraid that I was saying something wrong or umm...grammar...grammatically incorrect.”

“I found sometimes I still stumbled a lot when I need to present my ideas...You will be thinking if I speak in a correct way, so that the rest of the class knows what I am talking about.”

In addition to the feeling of taking synchronous course, the participants think they lack the interactions with other students except for the students in their own sub-group. There are not much inter-group interactions, and as a result, the whole class lacks the sense of learning community. As they describe:

“...actually we don’t have many interactions with rest of group members except within our own group”

“There was no chance to communicate with them (other students)...we use to communicate within the team.”

“Not enough to build a learning community.”

Challenges in synchronous online courses

A big challenge mentioned across the participants is the communication issue. The synchronous online communication lacks the facial expression, and this makes it harder for the participants to understand what their classmates are saying. This relates to the language barrier issue, but seeing people would help them to understand different accents or guess what their classmates are saying. As one of the participants describes:

“...it’s always easier for us to meet face to face because meeting face to face at least you are able to get expression, and another person you are able to tell sometimes even though you are not able to understand the words, but you are able to tell how he or he is expressing at that moment.”

In terms of communication, synchronous online learning makes it difficult for students to illustrate their ideas or do a live demonstration. Especially when the participants cannot articulate their ideas clearly by speaking, being able to draw a graphic would help to express their thinking. This challenge as one participant says:

“Online is pretty difficult to so call draw your idea for the three of us, but if we meet face to face we are able to draw down our ideas as you draw things out. To draw a diagram and so on so far.”

In addition, in the synchronous online course asking questions is not as easy as in the traditional face-to-face course. The instructor might not see your messages, or you have to wait for a while. One participant describes:

“... online class when you need to carry out a doubt, you have to take turns. You have to give cue...and it's just a long cue at a time to just ask a question. So, at least at face to face you have eye contacts, and easier to get attentions of the lecturer”

Besides, there are fewer opportunities for informal interactions in synchronous online courses, and thus it is harder for classmates to become friends in synchronous online courses. One participant mentioned this in the interview:

“Because many informal interactions are sitting in traditional class..., so there is much less chances for us, students to interact informally (in online class).”

Another challenge found both in the interview and participant observation is that the participants cannot listen to the lecture and type or read instant messages at the same time. As one participant describes:

“I...will have to concentrate to what Dr. XXX said, so I listen to him. If I umm...if I pay attention to the message below here, I cannot read and listen. You will be confused.”

Learning barriers in synchronous online courses

Language is biggest problem for the participants. It affects not only their understanding of others, but also their expression of ideas. For example, there are communication problems. As one participant describes his experience:

“There are times when I need to ask certain questions I found that there are times when my lecturer might not surly understand or misunderstand what I am speaking. So there are certain times I need to rephrase few times.”

Other common issue mentioned by the participants is that other students sometimes speak too fast for them to catch what they said. In addition, as noted above in the paper, sometime the participants cannot understand what other students say because of their accents. This problem was mentioned by a participant:

“Some students they speak so fast that I cannot fully understand, so I have to guess. I don't like the feeling to guess everything.”

In addition, due to the language barrier, the participants tend to be more reserved in the class, and the consequence is that they seem to be not really participated in the class. As one participant describes:

“I think yes the biggest constraint will be the language, because if you are not at easy with that language that being used so what happen was that you tend to be more reserved, and then you cannot do discuss more. So, what happened is that then you will seem to be as not really participated in that class.”

Ways to improve synchronous online learning experience

The participants would like to establish some regular face-to-face meetings during the course, so that they can know each other better and clarify some communication problems during those meetings. As one participant describes:

“At the midpoint, the lecturer might consider to gather all of us to meet face to face. Maybe just in the midpoint we probably as a group hang out. Those strategies we can communicate better. Just to take feedback of what difficulties everyone has in communicating in online, so that we can all come out with something.”

In addition, some asynchronous techniques could be adopted so that topics can be followed up and the participants would have more time to write and think about their responses. For example, adopting an online forum might be a good way to do that. As one participant says:

“I always have the idea that a forum can actually help. Do encourage participants in the online class to post their ideas, because in a forum. Questions and doubts can always be followed up. Everyone can come in holds a view on a certain idea, and at anytime.”

With respect to what the instructor can do, the participants think maybe there should be more inter-group activities so that they can experience more interactions with other classmates. As one participant describes:

“I think the teacher could have the groups in the class interact more with each other, because I think although I have difficulty, I don't know much about other groups. We are basically very much in our group.”

Other potential way to improve the participants' learning in synchronous online learning is to incorporate more multimedia elements, such as movies. The participants also mention the possibility to have a video conference in the class. As the participant describes:

"If it can incorporate more multimedia..um...materials, such as movies or such as what I just said. Like video conference. It will provide more information other than just the white board."

Cultural factors and other considerations in taking synchronous online courses

Very few findings have been explicitly identified as cultural factors in this study. One thing mentioned by one participant is that he seems to be more reserved compared to his American classmates. As he describes:

"I only see it's only appropriate for me to ask question when it's very quiet, No one else is asking question ... I think coming from Asian background, somehow, just more reserved. In that sense very different from USA counterparts."

Another participant also mentioned that it is nearly impossible for him to understand the conversation when the content is related to American culture, even if he knows every word being used in the conversation. He provides an example:

"Some American idiom stories and I totally have no ideas what he is talking about. Even I understand the terms being used, I still don't understand the whole story. Additionally, when they say some jokes I cannot understand neither, even I know what the words mean."

Since the language barrier is obviously a big concern while taking a synchronous online course, I also asked a hypothetical question to find out what factors would influence their decision making about whether to take a synchronous online course if English comprehension was not a problem for them. The results show that the participants think this will depend on the location, cost, course contents, and their personal schedule. If they lived far away from the campus, they might consider taking online course. If the online course were cheaper than face to face course, they might consider taking the online course. If the course contents were difficult and need more thinking such as statistic course, they might consider taking it face to face. In addition, the decision will depend on their personal schedule. If the time for the synchronous online course does not fit their schedule, they would not take it.

Conclusion

Although it is still ongoing, this study suggests that there are not many differences in terms of the way the participants learn and prepare for class between traditional face to face courses and synchronous online courses. The participants still need to spend the same amount of effort to work on the assignments, as well as attend the course discussion online at the specific time block. One difference is that the participants are more physically relaxed in the synchronous online course. One disadvantage for these Asian participants in the synchronous online course is that they cannot listen to the lecture and read the instant messages at the same time. They have to concentrate on one or the other of them.

In this study, several patterns regarding the participants' views and learning experiences emerged. Each pattern represents a concern of the participants and also provides the answers to our research questions regarding Asian students' communication in the synchronous online course as well as their opinions of it. These findings can be summarized as follows:

- Synchronous online courses are useful, but they cannot substitute for face to face courses
- Synchronous online courses lack the sense of learning community, and lack the informal interactions with classmates
- Asian students are nervous of speaking out in the synchronous online course because they are afraid of making grammatical mistakes
- Language barriers are the biggest challenge for Asian students in synchronous online courses
- Asking questions and expressing ideas is more difficult in synchronous online courses

In addition, several ways have been identified to improve Asian students' learning experience in the synchronous online course:

- Establish some regular face to face meetings for synchronous online courses
- Speak slower in synchronous online courses (both the instructor and students)
- Incorporate some asynchronous techniques to enhance learning in synchronous online courses
- Design some inter-group activities to encourage interactions in synchronous online courses
- Summarize course discussions at the end of class

Future studies

This study has provided a clearer picture of taking synchronous online courses in the United States from the perspectives of Asian students. Some potential topics for further research have emerged from this study. They are:

- Identify the asynchronous online techniques which can help Asian students to express their ideas, as well as how to incorporate these components into synchronous online courses.
- How to manage two way communications in synchronous online courses?
- How to design group and inter-group activities to help Asian students get involved in course discussions?
- How to balance online and face to face components in a course to help Asian students learn better?

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Students' Lived Experience Of Using Weblogs In a Class: An Exploratory Study

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Abstract

Recently, attempts have been made to use Weblog and other personal webpublishing technologies to support individual and social reflection in higher education. Due to Weblog's highly individual and reflective nature, students' experiences and perceptions of the technology and practice is of primary importance in furthering its educational use. In this phenomenological study nine participants, who maintained Weblogs in a graduate course, were interviewed. Initial data analysis indicates that participants found Weblogs helpful for learning, reflecting, and building a sense of community. However, participants expressed concerns over the lack of structure for Weblog usage and the public nature of the reflective process.

Introduction

Reflective learning and thinking is widely regarded as being important within all contexts, especially, in higher education (Brockbank & McGill, 1998). Reflective thinking was originally defined by Dewey (1933) as purposeful thinking oriented toward a goal. Reflection in learning involves a process of recording experience and then revisiting the description with the intent of refining learning processes and strategies (Boud, Keogh, & Walker, 1985). Two propositions are important in this context: one, that students find it difficult to engage in reflection over time without external support (Harri-Augstein & Thomas, 1991) and two, that the learner is primarily responsible for identifying important experiences and then linking experiences to learning (Boud et al., 1985). Reflection is governed by both cognitive and affective components and the reflective act is preceded and accompanied by individual feelings and perceptions that could either form barriers to or enhance learning. Understanding the affective components of reflection and their effect on student learning and experiences is essential for identifying appropriate uses of reflection to assist individual learning. In this paper, we identify and explore student feelings and their lived experiences of reflecting on a Weblog (which is a technology supported instantiation of a reflective journal).

The Role of Reflection in Learning

Within a constructivist philosophy of learning, learners are the determinants of the structure and sequence of their knowledge construction. Ultimately, the learner is responsible for his or her own learning and the teacher acts as a facilitator to guide the students learning (Moon, 1999). From a cognitive perspective, learning is made more meaningful when it is integrated—that is assimilated and accommodated—within the learner's prior knowledge (Piaget, 1970). Meaningful learning is also guided by experience and interpretation of experience. Learning can be viewed as a process of revising the interpretation of an experience, which leads to new ways of thinking, valuing, and acting (Mezirow, 1990). The importance of reflection in engendering meaningful learning is addressed by Kolb (1976), who proposed a cyclical four stage model where concrete experiences serve as the basis for observation and reflection, which in turn allows for abstraction and application in new situations. The British Further Education Curriculum and Development Unit (FEU) proposed another model of learning where reflection occupies a central place in learning: specific reflective activities are vital for extracting specific learning of skills and knowledge from an experience (FEU, 1981).

The earlier models clarify cognitive components of reflection: affect is another important influence on the reflective act (Boud et al., 1985). Current and previous experiences affect the perceptions of the learner during the reflective act: positive experiences can enhance learning, while negative experiences can form barriers to learning (Boud et al., 1985). Kelly (1955), as part of his work in personal construct psychology, suggested that objects, events, and constructs are meaningful only when viewed from the perspective of the person construing the meaning. In the context of reflection, Boud, Keogh and Walker (1985) identify the importance of understanding learner intentions and perceptions regarding a specific reflective activity or purpose. Mezirow (1990) identifies the importance of understanding learners' feelings about their perceptions, thinking, action, or habits of engaging in

reflection—that is, understanding learners’ affective reflectivity.

Engaging Students in Reflection

Numerous strategies have been recommended for encouraging reflection, such as Socratic questioning, journal writing, Interpersonal Process Recall (IPR), and reflecting teams (Griffith & Frieden, 2000). Journal writing serves a number of purposes, including allowing a student to externalize his or her reflections on experiences (Stickel & Trimmer, 1994) and then to reframe experiences within the current context (Andrusyszyn & Davie, 1997). Writing about their experiences may allow students to “think critically and develop keener insights into assumptions and beliefs that can interfere with their judgments” (Griffith & Frieden, 2000). For example, Jasper (1999) suggested that journaling might provide a mechanism for nurses to develop analytical and critical skills. Hettich (1990) also suggested that students liked journal writing because it permitted instructors to “monitor” students’ development and journals help them form connection between concepts in class and everyday experiences.

One technology-based instantiation of journaling has emerged in the form of tools and practices surrounding personal Webpublishing. The most common instantiation of personal Webpublishing is a Weblog, which offers mechanisms for learners to publish their thoughts, commentaries, and reflections in the form of individual posts on a Web page. The individual posts are time stamped, archived, and appear in reverse chronological order: that is, the most recent posts appear on the top of the page and older posts are at the bottom of the page. Weblogs allow for personalization and customization by individual Webloggers. Weblogs offer a relatively convenient and easy mechanism for students to journal their learning processes, and if used appropriately this technology has the potential of facilitating reflective learning. Weblogs support the ability of students to record and revisit experience, which is an important part of reflective learning (Boud et al., 1985). Bateson (1973) conceptualized that reflection was a function of distance, “they (processes of reflection) are preconditioned by distance” (Sorensen, 2004). In Bateson’s learning theory, when there is a direct relationship between the learner and the object (to be learned), no reflection happens at this point. However, when there is an indirect relationship (distance) between the learner and the to be learned, “the learner uses reflection as one of the means in his/her learning process...there is a systematic reflection on how to solve a problem, and the learner is conscious about the fact that he/she is learning. He/she is consciously tied to the situated conditions (in a wide sense) and actively using what he/she has learned at other (lower) level” (Sorensen, 2004). Based on Bateson’s theory, Sorensen (2004) concluded that virtual environments are conducive to reflection. Weblog environments can promote reflective activities in learners since they lengthen the distance between learners and the content to be learned.

Reflective journaling stands in contrast to more common forms of online discussion or conversation such as bulletin boards or chats even if they all publish individuals’ thoughts and arguments. They differ in that postings in discussions or conferences are interwoven and build on each other, while Weblogs are more stand-alone and individualized. Moreover, course-based discussion boards are usually open to a limited number of people while Weblogs are, by design, available to anybody on the Web and therefore open to a broader audience. The use of Weblogs in education is relatively recent and our understanding of the impact of this technology in supporting reflection is incomplete.

Weblogs and Reflection

With the relatively recent introduction of Weblogs, very little empirical research has been reported regarding their use in supporting different types of thinking and activities in higher education. One area of research deals with students perceptions of sharing their online journaling practices. For example, Weblogs can be structured to encourage sharing of students’ journals by indexing all students’ Weblogs on the same page. In this sense, a Weblog bears some resemblance to a “team journal” -- where a group of students collaboratively write a common journal for the team-- (Andrusyszyn & Davie, 1997; Graybeal, 1987). Team journals reportedly helped students to make sense of themselves and the world around themselves through a “cooperative shared venture” (Andrusyszyn & Davie, 1997). Another focus of exploration has been the impact of Weblogs on interaction between students and instructors. Grennan (1989) studied the effects of sharing journals of graduate students with their instructors. He reported that the use of a personal tone increased the “warmth of an academic environment”. It was perceived that the sharing of journals narrowed the distance between students and teachers and offered a form of security (Andrusyszyn & Davie, 1997).

However, there is very little reported exploration into learners’ individual perceptions and experiences with the use of Weblogs for reflection. As presented earlier, reflection is a combination of attitudes and skills, of affective and cognitive components, and we believe that an understanding of students’ experiences with and their attitudes towards this technology and practice would offer guidelines or suggestions about how Weblogs could be used best

to enrich students' learning experiences. We hope that the outcomes of this study would serve as a springboard for later research about appropriate uses of Weblogs to support individual reflection and group discourse in educational settings. The research question for this study was: how do graduate students engaged in a course-specific web logging activities describe their experiences of reflecting on the Weblogs and what meanings do they attach to those descriptions?

Research Design

Field research methods were employed because this study aimed to explore the lived experiences of graduate students in their Weblogging activities. Within the family of field research methods, phenomenology was selected as the research method, since phenomenology is concerned with understanding and describing people's lived experiences with a specific phenomenon (Van Manen, 1997). The current study is to explore graduate students' lived experiences of Web-logging. Also, phenomenology aims to gain an in-depth understanding about the phenomenon at issue by searching for its essence and invariant structure (Van Manen, 1997). Likewise, the current study wishes to address the nature of course-specific Weblogging phenomenon.

Participants

Participants of the study were nine doctoral students --four males and five females between 24 and 40 years old-- who enrolled in one graduate level course offered at northeastern land-grant university. The study participants maintained Weblogs for one academic semester, as part of a graduate course requirement. Criterion sampling (Creswell, 1998) was used to select participants from the classes who had maintained Weblogs for at least one semester. In addition, the subjects were "willing to participate in a lengthy interview, and grant the investigator the right to tape-record" (Moustakas, 1994).

Data collection

An interview protocol with several open-ended questions was designed by referring to the guidelines developed by Moustakas (1994) and examples provided by Van Manen (1997) and Creswell (1998). An "interview guide approach" (Rossman & Rallis, 2003) was used to conduct one-hour interviews with each individual participant. Interview questions revolved around the following main themes-- students' feelings toward using Weblogs in class, their approach to reflecting on the Weblogs, and their perceptions of its utility in their learning.

Data triangulation

A second interview of about 20 minutes will be conducted to follow up with additional questions and conduct member checks. The participant Weblogs will also be analyzed to provide an additional level of triangulation.

Data analysis

All interviews were transcribed and N-Vivo was used to analyze data. Free codes and axial codes were created based on the analyses of these interview transcripts. Preliminary categories of students' lived experiences of using Weblogs in a class were found and are presented in the following section. Data analysis comprised a preliminary grouping (also called "horizontalization" (Moustakas, 1994)), thematic labeling, and finally developing a textual-structural description. The aim was to develop a composite description of the meanings and essences of the experience for the whole group of participants and identify different influences on perceptions and use of the Weblogs in contributing to students' reflective thinking and learning.

Initial Themes and Findings

Data analysis is still ongoing, but we present here some of the initial themes that have emerged through analysis. Overall, student experiences can be grouped into positive and negative (or hesitant) feelings about the use of Weblogs. Most students felt positively towards their Weblogging experiences because they felt that Weblogging helped learning and thinking and the environment offered a space outside of the class where they could "meet" and discuss so that a sense of community was created. Being graduate students in instructional systems design, they were excited to be able to explore a new kind of technology themselves and to understand and tap its potential for their own future instructional design.

Positive Perspectives about Weblog Usage

Blogging helped thinking and learning

The first theme in the positive experiences of Weblogging speaks to the utility of Weblogs in aiding thinking and learning. Primarily, participants thought that Weblogs supported their learning by providing different viewpoints, by providing a space where reflection and commentary could be organized and whereby changes in thinking could be charted, and by pushing them to think more critically about reading materials and resources.

Participants suggested that the instructor's and other students' Weblogs were useful for their learning and thinking because they offered different points of view and additional information beyond the class content, and connected the learning content to their own experiences.

"...have others to offer their thoughts and opinions ... and offer another point of view, something else from another point of view. And now you are looking at the whole spectrum, you are not looking at one part of a circle. In fact, you are looking at many arcs in hopes of completing a circle of knowledge toward a particular subject" (Interviewee 2, Paragraph 64).

So if somebody else likes to contribute their experience, I thought that enriched the course, maybe challenged some views I thought the answers have to be this way. But then somebody else does some other way and they get better results. So I let me consider other alternatives (Interviewee 3, Paragraph 75).

The Weblog provided a space where students could organize their thinking and synthesize their learning and students appeared to find it useful to have a structured space where they could construct their learning.

"... it gave me a space I can summarize my thoughts ... I think it's good students have opportunities to sit down and write something, esp. reflective thinking because writing is a process that makes your thinking in a ordered..." (Interviewee 7, Paragraph 138).

"you take learning, bring it into your own context and structure it to make more sense. The process I was going through that I thought was rewarding. I was able to construct these blocks into new blocks of my own. When I came into the class with my own mental model of how the pieces work together, instead of just pieces..." (Interviewee 3, Paragraph 95)

Weblogs seemed to indicate the ability of "charting" students' changes. As students read their own blogs, they could see their own changes and growth in thinking. Being able to see those changes allowed them to better reflect on their learning.

"...Weblogs can provide a discourse for reflection. ... It sort of lays out for you a roadmap of your development in an area..." (Interviewee 2, Paragraph 156)

"...one of the things I did through Weblogs was to reflect on our personal growth in terms of instructional design ideas and so on. So that writing Weblogs help me articulate our ideas and also I could compare ideas. That was what Weblogs are meant to be because like a history of my thoughts. So I could see changing. Maybe if I haven't written those things, even those changes might happen, but when I actually wrote them down, it probably increased the pace those changes were happening." (Interviewee 5, Paragraph 8)

It appeared that Weblog publishing encouraged students to adopt deep approaches to learning. In order to find something to write about in Weblogs, students had to focus their attention on their reading and were "pushed into deep thinking" about the content.

"... for me as a student, it was an opportunity to do something with the material aside from just reading it. So it was educational experience just writing itself... because it keeps me actively interested in what I am reading instead of sometimes when you read, you drift off, you lost your attention. But it keeps my attention." (Interviewee 3, Paragraph 68)

"... it helped me to look at the content even more questioning. Like I have to find questions here 'cause I

need to write something. I want to write something, I need to write something, I must find the question. I would look possibly more critically or try to find places where I would want to know something more or where didn't fit my experiences." (Interviewee 4, Paragraph 68)

Blogging offered a sense of community

A second positive theme was the role of blogging in creating a sense of learning community and extended discussion in and outside of the class.

"My feeling is that you are part of a community. That was nice. You feel you are part of a group, part of an effort. You are actually included something. You don't feel you are alone, because even though you are new to the field, you are still struggling. And it is that feeling of cooperate that we are all struggling to understand this together ... At least it opened up that avenue that I wasn't going through, trying to understand it alone." (Interviewee 2, Paragraph 145)

"... (the instructor) is like connect other people together. She summarized what other people talked about. ... it is good because we normally don't talk about other people, but she talked about other people's log too so we also know what's going on. It brings a feeling that we now know all. We all belong to something, something we can interact with each other." (Interviewee 9, Paragraph 68)

"Sometimes reading what they had written and when I see them in person face to face, that would generate a conversation. Saying, "hey, that thing you wrote on Wednesday, that was very interesting", or maybe I have a counter point or ask them more about what happened to get more details. So maybe that's additional thing it did, was to open a door for additional communication face to face." (Interviewee 4, Paragraph 18)

Blogging offered exploration of new technologies

Students were excited to be able to explore a new technology. Since most of the students were graduate students in instructional systems design, the Weblogging experience itself made the students excited in that it provided them a hands-on opportunity to fully explore an instructional technology.

"Because I never used Weblog before, it's been interesting. I want to use it to see how it is. I was pretty excited about using it because I never heard of it. Actually, I think the instructor told me that it has been pretty widely used for many other people but it's my first exposure to Weblog." (Interviewee 9, Paragraph 5)

"... since the course is an introductory course, most of the students have limited experience with instructional design. Then when we were introduced of this website, I think it's like something new. The Weblog provides space for you to write journals, I think that's good." (Interviewee 7, Paragraph 6)

Hesitancy or Negative Perceptions about Weblog Usage

Apart from the positive feelings associated with the use of Weblogs, participants also expressed some hesitancies. For many, it was their first introduction to such a technology, and they experienced cognitive difficulties, which in turn resulted in stressful experiences for some students. Because of its highly individual and open nature, students had concerns about the environment, people's backgrounds, and the topics they chose to discuss. Main themes were related to uncertainty on Weblog usage and the need for more structure and guidance on their use.

Uncertainty about correct usage of Weblogs

Because most of the students had never used Weblogs before, they mentioned their uncertainty about the usage of the technology. The fact that the Weblogs were a part of class requirement and would be graded at the end of the class exerted some amount of pressure on these students.

"I think there was pressure since it was the first time I was doing it. I was new to it. So there was pressure of doing it right and correct. Because it was new, I started slow and that kind of put some pressure. That kind of affected the course of my Weblogging. I wasn't doing it as early as I should." (Interviewee 5, Paragraph 42, 43)

Being exposed to Weblogs for the first time, some students had not yet understood how they could use Weblogs in their learning and thinking. Thus, they engaged in the activity for only the purpose of meeting the class requirement. For such students, Weblogging became a somewhat stressful experience.

“They can feel this external pressure to make these postings. And they just post something just meet the assignment but not reflecting, or they don’t really feel comfortable... (Interviewee 3, Paragraph 68)

“... if I have something interesting periodically, I can write something in the Weblog. But during a semester you are very busy with other courses, so it’s very stressful for me to figure out something to write there” (Interviewee 8, Paragraph 10)

Since the students had no idea of how to blog at the beginning of the class, they were expecting more “structures or guidelines” from the instructor about how to blog and what to blog.

“(We should be told) “you should post a paper about this topic, you should write about...” It’s a more structural way... One day you can write about schedule of writing, one day you can write about article, then you can write about discussion, then people will have an idea about how to post Weblog.” (Interviewee 9, Paragraph 111)

In absence of such guidelines and exact directions, some students felt lost and frustrated.

“There was no definitive, “this is what you have to do, I want you to write about this topic or tell me your thoughts on this in particular”. It was so open that when you have no limitations, it’s hard to figure out what you write, what should be public knowledge, and what you keep private, and what the instructor feels is meaningful as compared to what is nonsense. It was hard because there were no guidelines. So it was frustrating in that sense”. (Interviewee 6, Paragraph 9)

Role of prior experiences

Students found their own backgrounds mattered in their practice of and ability to engage in blogging. The students in the class came from very different backgrounds and their levels of expertise with the course content varied. Students with relatively more experiences with the content were generally more active with Weblogging. However, those who were new to the field found it hard to create a topic or connect to their prior experiences as the more advanced students did.

“... at that time, I don’t have enough information or knowledge with me, so it’s very hard to find something to write there. Because I am a just a first semester student, it’s very difficult to write some topic in there.” (Interviewee 8, Paragraph 42)

The big differences in students’ background posed some difficulties for some students too because when the other people were writing or connecting with a totally unfamiliar context, they found such the content of such writing difficult to understand and apply to their own situation.

“... the gentleman I worked with was military based, so all of his analogies were based on military. And I am not a military person. I don’t necessarily understand military speak, so some of the things that he made correlations to I don’t understand at all because it’s not even in the realm of experience or understanding.” (Interviewee 6, Paragraph 59)

Concerns about privacy

One student expressed doubts about the environment because of its potential to be viewed by anybody in the world. Theoretically, anyone, anywhere could respond to the writing on the Weblogs, and the student was particularly afraid of attacks on people’s ideas without proper reasoning and factual backup.

“Those who would offer “insights”, I put that in quotes, that was not founded upon anything as you can tell is almost, in one sense, reaction of deeply held personal beliefs which are fine as long as they would have the opportunity to reflect upon themselves, inspired by research, not just something you think is right or

wrong but why do you think is right or wrong. You disagree with me, that's fine, but tell me why. Just don't attach something and offer no reason as to your justification." (Interviewee 2, Paragraph 66)

The student was also concerned about the attention to be given to responses by unknown individuals, since he found it difficult to trust the sources, not knowing the background or expertise of the person.

"... if you don't know the person via the Weblog... to the depth and credibility of their arguments or their thought, then I was skeptical and I was skeptical posting mine 'cause somebody who had no, very limited knowledge would respond something then I don't know how much impact I should take that." (Interviewee 2, Paragraph 146)

Because of the public nature of Weblogs, most students expressed their concerns about the topic they wrote about. They chose not to blog anything personal, anything "too controversial" or too negative.

"... things I thought were going to be personal or group issues didn't go on the Weblog, so that being public forum, my thoughts I wanted it to be kind of profession orientation. If it was personal issues, personal problems, I chose to keep those." (Interviewee 4, Paragraph 60)

"I don't want to name names... I'm not going to make anybody feel bad or make it known to everyone else in the class that he/she was not doing what he's supposed to do. So I don't think it's the right place to do that. You know it's the same thing you air your dirty laundry in public. I don't think it's to be used as a sounding board for negativity in that sense..." (Interviewee 6, Paragraph 34)

Future steps

Data analysis is still on-going and we intend to integrate and structure the emergent themes. Other primary themes were found but are still in need of further refinement and exploration. We present some of these other themes in overview as a precursor to more detailed forthcoming descriptions. These themes include:

- a. students' perceived comparison between Weblog and integrated learning environment such as WebCT, online
- b. discussion board, and listserv postings etc.
- c. students' points of view about the technical aspect of the Weblogging environment
- d. students' Weblog-visiting and -responding patterns
- e. students' interpreted purpose and their own usage of Weblogs
- f. different modes of students' demonstrated motivation types in relation to their emotional experiences of using Weblogs
- g. manifested learning curve of students' use of Weblog

Conclusion and Implications

As a new and potentially powerful technology, the parameters and consequences of Weblog usage within higher education are still unexplored. Understanding graduate students' lived experience of their web logging activities has significant meaning for teachers, practitioners, and instructional designers to use Weblogs in classrooms. Especially, if Weblogs are to be used to support specific types of thinking or collaborative practices in educational settings, students' perceptions are paramount in informing both researchers and practitioners in further educational and exploratory implementations. We have presented some initial themes regarding the positive and negative lived experiences of students' Weblogging activities. This initial data supports the proposition that Weblogs can be used to support reflection individually; however, data also suggest that a more structured and guided introduction to the usage of this technology would be conducive to inculcating early and appropriate usage. Another initial theme suggests that Weblogs allowed students to structure and chart their learning progress. Building on this initial finding, it would be useful to identify additional aids to help students build and further structure their learning and reflective activities. For example, a combination of Weblogs and concept mapping activities might allow students to map their learning in a more concrete fashion, thereby linking individual posts into a more holistic picture of content learning. Although it appeared that Weblogs could potentially offer a sense of community, the threat of privacy invasion also loomed large for some students. Further exploration is need to achieve a balance in fostering community, while avoiding situations that students might find threatening or disengaging.

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Ensuring Quality in Online Education Instruction: What Instructors Should Know?

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Abstract

With a growing number of courses offered online and degrees offered through the Internet, there is a considerable interest in online education, particularly as it relates to the quality of online learning instruction. The major concerns are centering on the following questions: What will be the new role for instructor in online education? How will students' learning outcomes be assured and improved in online learning environment? How will effective communication and interaction be established with students in the absence of face-to-face instruction? and How will instructors motivate students to learn in the online learning environment? This paper will examine new challenges and barriers for online instructors, highlight major themes prevalent in the literature related to "quality control or assurance" in online education, and provide strategies for instructors to design and deliver effective online instruction. Recommendations will be made on how to ensure quality in online instruction, and the role of administrators in ensuring quality online learning will also be described.

With a growing number of courses offered online and degrees offered through the Internet, there is a considerable interest in concerns and problems associated with online education, particularly as it relates to the quality of online education instruction (Allen & Seaman, 2003). According to Twigg (2001) many problems that arise from online education as it relates to quality include, but is not limited to: (a) the requirement of separate quality assurance standards, (b) programs having low (or no) quality standards, and (c) there being no consensus on what constitutes learning quality.

Online education, according to Harasim (1989), is a new domain of learning that combines distance education with the practice of face-to-face instruction utilizing computer-mediated communication. Volery (2000) concluded that online delivery is a form of distributed learning enabled by the Internet. Ascough (2002) suggested that online education has the following features: (a) it provides a learning experience different than in the traditional classroom because learners are different, (b) the communication is via computer and World Wide Web, (c) participation in classroom by learners are different, (d) the social dynamic of the learning environment is changed, and (e) discrimination and prejudice is minimized. More recently, Allen and Seaman (2003) in conducting a survey on online education delivered by higher education institutions in the United States defined an online course as one that had at least 80 % of the course content delivered online. Regardless of the definition, an early indication of the widespread popularity of online education courses can be found in a survey conducted by the U.S. Department of Education, which revealed that more than 54,000 online education courses were being offered in 1998, with over 1.6 million student's enrolled (cited in Lewis, et al., 1999). In this study, Allen and Seaman (2003) reported that: (a) over 1.6 million students took at least one online course during the Fall of 2002, (b) over one-third of these students (578,000) took all of their courses online, (c) among all U.S. higher education students in Fall 2002, 11 percent took at least one online course, and (d) among those students at institutions where online courses were offered, 13 percent took at least one online course (p.1).

Background of the problem

Controversies as to the quality of online education have not diminished over the past decades. Many people are suspicious of online education because courses are often offered by divisions of extended studies or continuing education (Husmann & Miller, 2003) and are taught by adjunct faculty or instructors who have not earned doctoral degrees. Therefore, many individuals have concluded that online education programs are left outside of formal faculty structures that have traditionally had oversight for instructional course quality. Both proponents and opponents have been concerned about online education quality. Opponents view online education as inferior, see it as a substitute for the traditional "brick and mortar" university, and conclude it is rather a profit making venue. This type of delivery is often viewed by "administrators as a "cash cow"-a means of delivering instruction to a large number of paying customers without the expense of providing things such as temperature controlled classrooms and

parking spaces” (Brown & Green, 2003, p. 148-149). Opponents have also suggested that online courses lower the quality of academic standards (Buck, 2001). Some opponents even question the quality of online courses when students do not actually attend a college, and have face-to-face interaction with instructors. Moreover, Weiger (1998) asserted that the quality of instructors who teach online courses cannot be guaranteed since anyone can put a course online.

Concerns regarding the quality of online education are also raised by both students and faculty. Arguments are made that as consumers of online education, students are unlikely to be able to find out information about the quality of the courses that are provided (Twigg, 2001). Schools or universities that offer online education courses typically do not provide comparative information for students e.g., how would a student know which online course meets his/her needs? Moreover, prerequisites that are essential for taking a particular online course are usually not clearly stated on websites for students, and “when students are encountering technical problems, whom they can ask for assistance is not available to them” (Twigg, 2001, p. 15).

From the faculty’s perspective, if they haven’t received the training for teaching online courses, using the technologies, evaluating and assessing online courses, how then can the quality of their online teaching be assured? Moreover, when teaching online, if a majority of the faculty member’s time is spent corresponding with students, how then can faculty balance their traditional teaching, research, and service activities? When faculty are reluctant to teach online classes, how can school administrators to motivate them to do so?

Proponents are in support of online education. They suggest that the lack of face-to-face interaction can be substituted by online discussions in bulletin board systems, online video conferences or on listservs (Blake, 2000). Online education can also promote students’ critical thinking skills, deep learning, collaborative learning, and problem-solving skills (Ascough, 2002; Rosie, 2000). Donlevy (2003) asserted that online education may help schools expand curricula offerings with less cost and can help graduates gain important technology skills to improve their marketability. Proponents also argue that online education can encourage non-discriminatory teaching and learning practices since the teachers and students, as well as students and their classmates typically do not meet face-to-face. Palloff and Pratt (1999) reported that because students cannot tell the race, gender, physical characteristics of each other and their teachers, online education presents a bias-free teaching and learning environment for instructors and students.

Quality Assurance of Online Education

The quality of online education has prompted the attention of higher education accreditation associations. The report of the Council for Higher Education Accreditation (1998, as cited in Weiger, 1998) recommended that accreditors should “establish reliable and valid performance measurements, require evidence of contact between faculty and students, mandate evidence of effective instructional techniques, promote systematic efforts to select and train faculty, and assure that students, faculty, staff and administrators receive adequate training to use electronic resources” (p. 11). Therefore, the need of standards for ensuring quality of online education instruction is paramount.

Paulsen (2002) in defining online education indicated that it separates teachers and learners (which distinguishes it from face-to-face education), influences an educational organization (which distinguishes it from self-study and private tutoring), uses computer network to present or distribute some educational content, and provides two-way communication via a computer network so that students may benefit from communication with each other, teachers, and staff (p.1.). This definition clarifies the difference between online education and traditional education. Consequently, quality indicators should be different as it relates to online education and traditional education.

The higher education community has developed several quality indicators for traditional education that are well accepted by many institutional quality assurance programs (Twigg, 2001). Twigg (2001) has stated, “For traditional education, quality equals a tenured full-time faculty member with a doctoral degree teaching the course. Quality equals courses and degree programs offered by and on a residential campus. Quality equals “students learning by sitting with a professor face-to-face” (Twigg, 2001, p. 3). However, in online education, students will not know if the instructor has earned doctoral degree or not, because there is no way to gain the knowledge of the instructor’s background unless the instructor him/herself indicated on the course website. Online education is usually regarded as time saving and cost effective education since students do not need to drive to a classroom. Face-to-face instruction is often not guaranteed in online class. Therefore, those common quality indicators do not and should not apply to online education.

In the early 1990s, the Western Cooperative for Educational Telecommunications (WECT)) developed “Principles of Good Practice for Electronically Offered Academic Degree and Certificate Programs” (Twigg, 2001). Since then, many other groups have developed similar principles and practices. For example, The American

Distance Education Consortium (ADEC) drafted “ADEC Guiding Principles for Distance Learning”. A joint task force of the American Council of Education and the Alliance: An Association for Alternative Programs for Adults developed “Guiding Principles for Distance Learning in a Learning Society.” The Instructional Telecommunications Council provided “Quality Enhancing Practices in Distance Education.” The American Federation of Teachers (AFT) developed “Distance Education: Guidelines for Good Practice.” The Council of Regional Accrediting Commissions updated and explained WECT’s statement, and published “Guidelines for the Evaluation of Electronically Offered Degree and Certificate Programs” (Twigg, 2001).

In 2000, The Institute for Higher Education Policy (IHEP) first reviewed all of the existing principles or guidelines, and proposed 24 benchmarks for measuring quality Internet-based learning, which were grouped into seven categories: (a) institutional support, (b) course development, (c) teaching/learning, (d) course structure, (e) student support, (f) faculty support, and (g) evaluation and assessment (IHEP, 2000). Yeung (2001) also carried out a study among academic staff in Hong Kong higher education institutions on their perceptions of a quality assurance model. He concluded that the benchmarks for quality assurance of web-based learning were considered important. The institutions that participated in the study attempted to incorporate those benchmarks into their policies, practices, and procedures. Yeung (2001) further asserted that academic staff and students are the two key stakeholders in an educational setting. Therefore, to ensure the quality of online education, controlling the quality of academic faculty who teach online courses is vital.

The team approach has also been suggested by organizations and researchers as a method to ensure the quality of online education instruction. The Southern Regional Education Board (2001) encourages institutions and states to build an instructional design team for a quality online environment. Such a team might consist of the instructional designer, graphic/interface designer, technical support personnel, content expert, direct instructor, information resource personnel, mentors/tutors, and assessor. The instructor, however, remains at the center of the team to guarantee academic integrity, with the assistance from other partners. Levy (2003) suggested an organizational structure change in online educational program. This change should involve different people who do different jobs. For example, in this scenario, a content specialist would decide the teaching material, an instructional designer would be responsible for the visual presentation of this material, and a technical specialist would actually create the online course and the instructor then interacts with the online learners. Care and Scanlan (2001) have also advocated another team approach, which is the Interdisciplinary Team Model. In this model, various participants meet as a team on a regular basis to develop the course, solve problems, and discuss issues as course development unfolded. The participants are content specialist, instructional designer, student representative, media specialist, program director, and external faculty member.

Ensuring Effective Online Instruction

Challenges and Barriers for Online Education Instructors

Some of the challenges and barriers for online learning that have been identified by researchers are the change of roles and responsibilities for instructors (Zheng & Smaldino, 2003; Murihead, 2000), use of technology (Valentine, 2002; Palloff & Pratt, 2000; Berge, 1998; Volery, 2000), interaction with students and the changes in interpersonal relations (Bower 2001), and academic dishonesty of online learners (Muirhead, 2000). O’Quinn & Corry’s (2002) in conducting a study on online education pointed out several factors that may deter faculty from teaching online. The factors the authors identified include a lack of professional prestige, delivery method used, change in faculty role, and lack of monetary support.

New roles of instructor.

Instructors have many concerns about online education. Their primary concern is how online education changes their roles and responsibilities, and how they can adapt to this change. Online education is widely accepted as student-centered education, and the traditional education is regarded as professor-centered education. Due to a shift to online education, the instructor’s role has become more of a facilitator than a traditional lecturer. Therefore, the traditional professor-centered educational environment and student-centered online educational environment will have many differences. Besides the role shifting, the role of the virtual instructor is to select and filter information for student consideration, to provide thought-provoking questions, and to facilitate well-considered discussion (Kettner-Polley, 1999).

Wu & Hiltz (2004) conducted a study of 116 students enrolled in two undergraduate courses and one graduate course at the New Jersey Institute of Technology. Their study concluded that variations among instructors or courses are associated with differences in perceptions of student motivation, enjoyment and learning. Wu and Hiltz also found that in traditional professor-centered education, the roles of professor and student are regimented;

the professor disseminates knowledge, and the student reflects that information. However, as Knowton (2000) has argued, in the student-centered online education course, the professor and students are a community of learners. The professor serves as coach, counselor and mentor; the students become active participants in learning. During the processes of learning, in teacher-centered classroom, professor lectures while students take notes. In online student-centered education, the professor serves as facilitator, while students collaborate with each other and the professor to develop personal understanding of content.

Murihead (2000) indicated three areas considered to be changed when the education courses are put online: (a) the provision of instructional and emotional support to students, (b) the expectations associated with authoring online courses while maintaining a full teaching load, and (c) the requirement to provide ongoing technological support to students and parents (p. 322). According to Ascough (2002), the role of instructor in an online learning environment should be more of a facilitator or moderator due to less control of the class environment. He noted that because most instructors are more likely to have been trained in traditional instruction, it is a somewhat foreign practice for them to plan interactive strategies in course delivery, and adjusting their change in role from the leading speaker to that of a facilitator. Volery (2000) also suggested that the academic role of instructor should be shifted from intellect-on-stage and mentor towards a learning catalyst because the level of interaction has changed in online delivery. Therefore, besides being a facilitator, the instructor should also be an instructional designer (Zheng & Smaldino, 2003).

New roles of online learners.

Because the online environment is different from the traditional classroom, it is important for the instructor to motivate students to adjust their roles when becoming an online learner. In online education, the interaction between students and their instructors have been changed from synchronous in face to face (F2F) instruction to an asynchronous virtual community. Thus, a significant role adjustment for students may be required if they are to experience success. Students must move from being a more traditional passive classroom learner into a more active online inquirer. Hughes (2004) has suggested that online learners should ask themselves, “Am I ready for university (or college)?” “Am I ready for online learning?” “What is my preferred learning style?” “Do I have the skills to be successful in my chosen program?” (p. 369-370).

Garrison, Cleveland-Innes, and Fung (2004) conducted a study to validate an instrument regarding online students’ role adjustment. Their findings suggest that students do see a difference in the learning process and a need for their role adjustment. The online learning should be viewed as more cognitive or internally oriented. Online learners must take more responsibility, adjust to a new climate, adjust to new context, synthesize ideas, know how to participate, synthesize ideas, apply ideas or concepts, and stimulate their own curiosity. In addition, Palloff & Pratt (2003) have suggested that online learners should be “open” about personal details of his or her life, work and other educational experiences; should be “flexible” and “humor” to create a warm, inviting course environment; should be “honest”; should be willing to take “responsibility” for online community formation; and should be willing to work “collaboratively” (p. 17-28).

New technologies

Technology, as the inter-medium for instructors to delivery courses becomes more important when the level of face-to-face communication is decreased in online education courses. Consequently, how to appropriately use technology to serve an instructional purpose tends to be another challenge for online education instructors. Muirhead (2000) reported teachers’ frustration with the reliability of computer technology, working with multiple versions of a software package, providing technology support to students using multiple operating systems, and the absence of mature integrated content development tools. Palloff and Pratt (2000) also noted that the instructor must be trained “not only to use technology, but also to shift the way in which they organize and deliver material” (p. 3). Valentine (2002) indicated that misuse of technology could also be a problem for the instructor, although this problem may arise from lack of training, instructor’s attitudes, or hardware problems. Faculty should learn how to use technology, but not completely rely on the technologies. Instead, they should be able to identify and recognize the strength and weakness of technologies, and select the most appropriate delivery mechanism for their lessons (Gunawardena, 1992, as cited in O’Quinn & Corry, 2002).

McGreal and Elliott (2004) summarized the technologies being used in today’s online instructional environment as multimedia, streaming audio, streaming video, instant messaging, and web whiteboarding. The authors also indicated some of the new technologies may be used in tomorrow’s online instruction are push technologies and data channels, audio chat and voice over Internet protocol, hand-held and wireless technologies, and peer-to-peer file sharing.

New interaction and communication with online learners

How to interact with online learners is always a challenge for instructors. Muirhead (2000) reported that the teachers he interviewed in his study regarding online education in schools noted their perplexity on how to initiate interactions with students to build relationship while doing their online teaching job. Because most faculty are trained in “hand to hand” teaching, they have to face the challenge of lack of direct interpersonal contact with students, and they have little contact or feedback to gauge the clarity of their communications (Bower, 2001). Also, because managing electronic course materials, student participation, student achievement, and course evaluations can be problematic (Schott et al., 2003), interaction with students appears to be more important for online education instructors on encouraging students self-directed, disciplined, and self-motivated. Moreover, because of the needs of different interaction methods to be employed, changes are also needed in the interpersonal relations between the instructor and students (Bower, 2001).

New way of learning and testing

Since the face to face instruction is usually eliminated in online classes, instructors may lack sufficient information on how well learners actually perform. Thus, ensuring the academic honesty and integrity is another challenge for online instructors. Muirhead (2000) reported that all online teachers in his study worried if the completed assignments received through the Internet have been completed by students themselves. The concerns expressed by those teachers Muirhead interviewed may also partially relate to other online educators’ complaints, relative to the lack of direct teacher supervision of online learning and testing. McAlister, Rivera, & Hallam (2001) raised another concern about the difficulty of ascertaining the students’ identity when communicating over the Internet. Cheating, plagiarism, and integrity in taking test are also other issues in ensuring quality online instruction (Hanson, 2001; Simonson et al, 2003). While many critics have suggested that there is no sure way to hold students accountable for academic dishonesty, Heberling (2002) concluded that while maintaining academic integrity in the online instructional setting may be a challenging, he asserts that many strategies may be employed to detect and prevent plagiarism, such as reversing an Internet search, tracking back to an original source.

Berge, Muilenburg, & Haneghan (2002) grouped identified barriers to quality online instruction into 10 clusters. Those are technical expertise, administrative structure, evaluation and effectiveness, organization change, social interaction and quality, student support services, threatened by technology, access to technology, faculty compensation and time, and legal issues. Understanding these challenges and barriers will help instructors know how their roles have been changed, what qualifications they need, and how to ensure the quality of online education instruction with the help of various strategies.

Facing the Challenge

As the primary key to ensuring the quality of online education instruction, instructors need to adjust their attitudes to teach online, understand what qualifications are needed, and know what they could do ensure the quality of online education instruction. As Deubel (2003) has argued an instructor’s attitude, motivation, and true commitment affect much of the quality of online education instruction. High quality online education instruction encourages discovery, integration, application, and practices. Instructors need to discover students’ learning preferences, integrate technology tools, apply appropriate instructional techniques, put them all into practices, and generate the most suitable method for individuals. Furthermore, Cooper (2000) stated:

Online instruction can offer new challenges and opportunities to both students and instructors. Most students do not view online instruction as a replacement for traditional classroom instruction. However, with the right subject matter, with the right instructor and facilitator, and for the right student, Internet or online courses can provide an effective educational environment that is a viable alternative to traditional classroom instruction. (p. 54)

Since the role of instructors has been changed in online education courses to facilitator, mentor and coach, the instructors will need to adjust their attitudes towards technology and new teaching styles to meet the challenge. Attitudes towards technology, teaching styles, and control of technology are the three instructor characteristics that influence learning outcomes (Webster and Hackley, 1997 as cited in Volery, 2000). Therefore, students are likely to experience more positive learning outcomes when their instructors hold positive attitudes toward online delivery of course content (Volery, 2000). Contributing factors on faculty’s positive attitudes are the instructor’s prior experience of teaching online, intellectual change, monetary support or promotion/tenure, availability of online courseware, improved training and facilities, feedback from students, and flexibility of teaching schedule (Clay, 1999). To become an online teacher, Deubel (2003) suggested that instructors could read literature about online learning environments first, and then get trained to use required technology, and finally seek assistance from experienced instructors when needed.

In order to design and deliver effective online instruction, instructors should know what qualifications they must have. First, they need to upgrade their technical skills in order to keep abreast of technological developments (Volery, 2000). Second, instructors need to know how to design interactive activities and course syllabi, how to operate the learning platform, and troubleshoot with problems online learners may encounter (Cuellar, 2002). Therefore, faculty receiving training before actually delivering online education courses is crucial.

Many researchers have reported the importance of faculty training (McKenzie, Mims, Bennett & Waugh, 2000; Levy, 2003). The question is what training instructors should receive to qualify them to deliver online courses. The instructor must be trained in using the designated software, managing online course, integrating web sources, and interacting with students through the web (Ko & Rossen, 1998). Some online facilitation skills, such as giving negative feedback, encouraging students to become actively involve in online learning, and dealing with disruptive students, could be offered in training programs to prepare qualified online instructors (Hitch & Hirsch, 2001). This training is best offered online, since it provides the instructors the same learning experiences as their students (Ko & Rossen, 1998; Hitch & Hirsch, 2001).

Strategies for Designing and Delivering Effective Online Instruction

The promise for effective online instruction is not guaranteed when instructors adjust their attitudes to new teaching methods, nor when they receive training in the use of technology. The key is how to put theory into practice, and bring them both. Instructors should understand that online education is not merely uploading teaching materials, receiving and sending e-mail messages, and posting discussion topics onto the Internet. More importantly, it provides an arena for an interactive, deep, collaborative, and multidimensional thinking and learning environment (Ascough, 2002).

McAlister et al. (2001) suggested that a self-evaluation process in the online courses that instructor's teach should help them better prepare, design and deliver online courses. The self-evaluation questions might contain: what are the congruence between the web-curriculum and the institution's mission and strategy, how available is the administrative support, what are the chances of institutional obstacles, what are issues of intellectual property, will any compensation from institution be given, how to select the courses, how available is assistance of facilities and capabilities on preparation and delivery of the course material, what are the choices of instructional methods, how to assess student's progress, how to adopt a delivery platform, and maintain the class materials online.

Designing an Effective Online Learning Environment

To ensure the quality of online instruction, the online learning environment must be designed first before the instructor embarks on the online course delivery. Wu & Hiltz (2004) asserted in their study that examined students' learning from asynchronous online discussion that the instructor plays an important role in motivating effective online discussion. Therefore, more online guidance, more structured discussion topics and considerate time devotion are required for instructors.

The online learning environment also embraces pedagogical use of technology (Ascough, 2002; Yeung, 2001), integration of instructional design elements (Zheng & Smaldino, 2003), various types of medium and media (Deubel, 2003; Palloff & Pratt, 1999; McAlister et al., 2001), and diversified learning methods include deep learning, critical thinking, collaborative learning, and problem-based learning (Ronteltap & Eurelings, 2002; Rosie, 2000; Wheeler, Waite & Bromfield, 2002; Ascough, 2002).

Several researchers (Ascough, 2002; Ronteltap & Eurelings, 2002; Rosie, 2000) have reported that online education can encourage students' deep learning and critical thinking skills when learned collaboratively or under problem-based scenarios. Ronteltap and Eureling's (2002) experimental study revealed that when students are learning in a problem-based practical learning, more interaction of students were caused, and students learn more actively. Therefore, integrating deep learning, critical thinking, collaborative learning, and problem-based learning methods into instruction is critical to instructors in improving the quality of online education. How to promote students' deep learning via online education is a critical factor for online education instructors to consider. This requires the instructor to design collaborative and problem-based projects which will involve students to think critically, actively, and deeply.

To ensure the effectiveness of the online learning environment, a detailed course plan is required. The course plan should include doing an analysis on both students' and instructor needs, class objective, selecting course materials for students' knowledge construction, designing activities, discussion topics, projects, and tests, envisioning any potential problems technically or academically, and testing the feasibility of the online course.

In developing the course plan, instructors must analyze their own teaching styles first, and then analyze learner's characteristics (Ascough 2002). Who are the online learners and how fluently can they use computers and the Internet? The students' learning styles should also be examined. Are they visual, print, aural, interactive, haptic,

kinesthetic, or olfactory learners? It might not be possible to gather all the information before the online course begins, but a simple online survey or questionnaire can help the instructor know more about his students' learning styles. One type of questionnaire could be a course experience questionnaire, which not only can help the instructor to gain information about students, but can also improve the students' perception on the academic quality of the course (Richardson & Price, 2003). Paulsen (1995, as cited in Palloff & Pratt, 2003) have also suggested that incorporating various activities can successfully address all learning styles of the virtual student. Those activities could be one-alone, one-to-one, one-to-many, and many-to-many.

When organizing the content for online education courses, the learner's needs must be taken into account. The amount students learn, their ability to apply learned skills into practice, and their satisfaction with the learning experience should be considered. Evaluation is also an important component when implementing instructional design principles into online course design, because it is the way to gauge students' learning outcome and the quality of course instruction (Zheng & Smaldino, 2003).

Instructors should keep in mind that online learners need program orientation and course orientation before getting started. The program orientation should be offered by the institution, and the course orientation should be provided during the course, as well as by the institution. Palloff & Pratt (2003) recommended that the program orientation should include orientation to the courseware, basics of Internet use, how and where to get help when needed, technology requirements for online courses and programs, and information about any course or program policies. The authors also contended that course orientation should provide course descriptions, syllabus, faculty bios, specific information on course expectations, course requirements, assignments, grades. A "Frequent Asked Questions" file about the course and how to complete it, as well as course or program policies should be made available.

Several strategies may be used by instructors to help them to build the effective learning environment. The strategies include, but are not limited to: (a) providing background information for the course, topics on the unit, key concepts and readings for the course; (b) incorporating PowerPoint presentations, video lectures and demonstrations (this is especially important for application classes); (c) designing some activities or discussion questions which can trigger students' interest to explore the answer, which will ultimately foster students' critical thinking and deep learning; (d) requiring students to play roles in certain scenarios in online discussion or virtual classroom. Successful implementation of those strategies should enormously improve the quality of online education instruction.

Allen et al. (cited in Allen, 2001) have also identified 10 keys to quality online learning. The authors suggested that online courses will be high quality when they are student-centered and when:

1. Knowledge is constructed, not transmitted.
2. Students can take full responsibility for their own learning.
3. Students are motivated to want to learn.
4. The course provides "mental white space" for reflection.
5. Learning activities appropriately match student learning styles.
6. Experiential, active learning augments the Web site learning environment.
7. Solitary and interpersonal learning activities are interspersed.
8. Inaccurate prior learning is identified and corrected.
9. "Spiral learning" provides for revisiting and expanding prior lessons.
10. The master teacher is able to guide the overall learning process. (¶1)

Developing an Interactive Online Teaching-Learning Community

To ensure the quality of online education, an interactive online teaching-learning community should be developed by the instructor. Unlike instruction in the traditional classroom, in online courses, greater attention must be paid to the development of a sense of community within the virtual classroom in order for students' learning to be successful (Palloff & Pratt, 2000). This online community will augment the interaction between instructor-to-student, student-to-student, and student-to-content. Brown (2001) concluded there are three levels of community from his qualitative study on a graduate educational administration offered by a midwestern university. The three levels are: (a) making on-line acquaintances or friends; (b) building community conferment, which is like a membership card for the community of learners. This level requires online learners to be part of a long, thoughtful, threaded discussion on a subject, (c) camaraderie, which was achieved after long-term and/or intense association with others involving personal communication (p. 24).

According to Edelstein & Edwards (2002), developing an effective system for students' ongoing interaction is one of the chief tenets for a successful and engaging online course. The characteristics of e-learning community are learner centered, active learning, instructor guided and greater participated by all students (Palloff & Pratt, 1999). Ascough (2002) suggested that the online interaction can be done through exploration, reflection, and

discussion, which ultimately should lead to students' deeper learning.

The e-mail, listserv, threaded discussion, and chat room provide an efficient communication tool to build an effective online community. Threaded discussions could be a means of generating or promoting interaction. Threaded discussions can be constructed and created a home-like atmosphere by instructor whereby students can visit and embrace the joy of learning (Edelstein & Edwards, 2002). In this environment, the interaction between instructor-to-students predominantly consists of email interactions about assignments, questions about a particular aspect of a lesson, and general messages about the lesson. The student-to-student interaction is mainly discussing the group project, or discussion questions posted by the instructor. Setting online office hours may be a good option for the instructor to bridge the gap between instructor and student interaction, since students can get immediate answers to questions when the teacher is online (Serwatka, 1999).

Brown (2002) presented several tips for instructors to improve the impact of their online discussions, including: (a) maintaining an informal tone in the online community built by online discussion, (b) relating online discussions to issues raised and happened in class, (c) structuring discussion topic, stay focused around a being solved problem, (d) defining roles for various discussants, such as "original proposer", "idea extender", "constructive critic", "responder to critic", or "consolidator", (e) providing incentive for active participant in discussion by enhancing grade, (f) requesting backup for the points student have raised, and (g) keeping the discussion board to be a open and free speech platform (p. 9.).

Establishing Performance Assessments

Reliable and valid performance assessments should be established by instructors for quality online education instruction. The assessment should be aligned with course objectives and subject aims, and should enhance students' vocational and disciplinary skills (Morgan & O'Reilly, 1999 as cited in Zheng & Smaldino, 2003). An assignment is one of the major assessment tools used to measure students' performance. To ensure the quality of assignments in the online learning environment, the instructor could design collaborative assignments, also include exemplary student work, permit revision of students' work, and encourage students to initiate course-related discussion topic (Deubel, 2003).

Testing is another assessment tool used in online education courses. However, due to the special features of online education, teacher and students might not meet face to face. Therefore, academic integrity of the testing process is a crucial issue. One way to ensure quality instruction is to require students come to school to take the test, or give an essay-type test alternatively (Serwaktak, 1999). Other ways to prevent the cheating in tests, according to Olt (2002), would be to disseminate a special username and password to students prior to the assessment being made available, make all assessments open-book, set time limits and number of permissible accesses, randomized questions from question pool, and use courseware, such as WebCT to track the time, duration, and number of attempts that a student accesses the tests. It is clear that the quality of online instruction can be ensured from the instructors' perceptive when they hold positive attitudes towards teaching online, design an effective learning environment, develop an interactive online teaching-learning community, and establish reliable and valid performance assessments.

Assisting Students to Achieve Learning Outcomes

To ensure the quality of online education, the instructor must ensure that the students' learning outcomes can be achieved. However, this does not seem as easy as the teaching in traditional face-to-face classroom. Several researchers have expressed their concern about how students' learning outcome could be achieved through online education (Wu & Hiltz, 2004; Koory, 2003). Does asynchronous online discussion improve students' perceived learning

(Wu & Hiltz, 2004)? Does online teaching and learning have particular strength in ensuring students' learning outcome (Simonson, Smaldino, Albright & Zvacek, 2000)?

As early as in 1997, Althaus examined 142 undergraduate students' learning outcomes through comparing the blended (face-to-face and computer-mediated) discussion and the traditional classroom discussion. The author found that this combination provides a superior learning environment compared to the traditional classroom alone. Koorey (2003) taught two years of "An introduction to Shakespeare" at the University of California Berkley. One course was offered online, and the other was in a traditional face to face (F2F) class. Through two years' teaching and observation, the author found that her online students achieved dramatic higher learning performance than her traditional lecture class. The author's conclusion was determined by whether course objectives have been fulfilled, and measures of course grade distribution. Koorey reported that fifty-eight percent (58%) of her online students received an A or A⁻, as opposed to the more usual 15% of students making similar grades in the face to face course.

Learning outcomes should not be only measured through students' grades, but also through their deep

learning, higher order thinking, critical thinking, or problem-solving skills. Online discussion is usually regarded as the major communication tool between the online instructor and learners, and is regarded as the major vehicle to promote deep learning, and high quality learning outcomes. Larkin -Hein (2001, as cited in Wu & Hiltz, 2004) reported a research study addressing the role of students' understanding in physics using an online discussion group format. The author found that: (a) online discussion provided an additional learning and teaching vehicle, (b) online discussion facilitated the acquisition of higher-order thinking skills, and (c) students became more adept at transferring and applying information learned in class to novel situations (p.141).

In addition to ensuring the online students' learning outcomes with effective online teaching, the instructor should be able to accommodate the students' learning styles. Koorey (2003) concluded from her two year field study that students who possess the following learning styles are more likely to be successful in online class: experienced, self-directive, task-oriented, independent, value composed, textual communication, less social, but values some give-and-take, interested in problem-solving and immediate application.

Clark (2002) pointed out that the online learner must be a constructivist learner. This suggests that the learner must be active in the process, cognitively complex and motivated. According to Clark, motivating factors in the learning process include self-reference, personal goals, control and autonomy. Howland & Moore's (2002) study examined 48 students' experiences in online environments. Their results confirmed that the students who were the most positive in their perceptions of online learning were those with attributes consistent with constructivist learners. The most positive students were more independent, proactive and responsible for their learning.

The Role of Administrators in Ensuring the Quality of Online Instruction

The administrator should be a planner, motivator, promoter, and supporter in the process to ensure quality online education. To ensure the quality of online education instruction, administrators should plan and manage online educational programs, and support faculty balance between their research and teaching of online classes. Moreover, Alley (2001) asserted that administrators have a distinctive role and obligation in facilitating quality learning. He encourages administrators to examine and evaluate online education programs using techniques that are aligned with quality online learning. According to Alley (2001) this review will ensure that faculty design web courses for construct knowledge, not just transmission of information; develop more detailed course syllabuses to include timetables, learning tasks, and learning outcomes; plan for online and remote assessment sites for formative and summative assessments; motivate students; accommodate learning and teaching styles in online environments; and promote social interaction. Levy (2003) also suggested six areas to consider when planning online program in higher education. The areas are: visions and plans; curriculum, staff training and support; student services; student training and support; and copyright and intellectual property.

The administrator should motivate faculty, especially senior faculty to teach online courses through intrinsic or personal rewards, such as tenure and promotion, workload adjustment, or reduction in duties and increase in pay (Giannoni & Tesone, 2003). Cuellar (2002) also suggested that faculty who are willing to teach online should be provided faculty development opportunities to order for them to learn not only the "technological know how's, but also education on how to develop courses on strategies to promote interactive online learning" (p. 11). The administrator should also provide and arrange administrative and technical support for instructors who teach online (Levy, 2003). In a study conducted by Giannoni and Tesone (2003) to determine motivational factors that might influence participation of senior faculty in online learning programs, they found that faculty rated release time, personal satisfaction, e-teaching development, technical support, and professional prestige as motivational factors that influenced their participation in an online learning program. A consideration of these factors should assist administrators in making decisions relative to the involvement of faculty in online education programs.

McKenzie et al. (2000) also surveyed faculty needs and concerns at State University of West Georgia. The authors found that faculty preferred receiving the assistance from the university and administrators in delivering online courses on more and varied training sessions (i.e., Authorware, online course development), technical support as needed by instructors and students, more time to design and deliver on-line class, more incentives (i.e., laptop, student assistants, merit pays), helpful support services, upgrading WebCT, limiting the online class enrollments, fixing WebCT problems in a timely manner, more detailed, understandable instructional material, respecting their wishes to teach online, making WebCT more user friendly, and mentoring for novice or less experienced online instructors, and more time to adapt using WebCT after training).

Husmann and Miller (2001) in a study of the perceptions of program administrators on improving distance learning found that administrators viewed their role as facilitators of program quality. The findings revealed that administrator's perception on the quality of an online program is based almost exclusively on the performance of faculty. Therefore, the recruitment of qualified faculty to teach online courses becomes extremely important. Rahman (2001) suggested a model that administrator may use in recruiting faculty to teach online courses. Within

the model, he recommends that administrators should convince the prospective candidate about the principles, practices, and values of the online education, and the online programs to be offered.

Providing supports (training, administrative, monetary, and promotional) and hiring qualified instructor is essential for administrators to ensure the quality of online education instruction (McKenzie et al, 2000; Husmann & Miller, 2001; Levy, 2003; Giannoni & Tesone, 2003). Berge (1998) has argued that online teaching and learning will definitely fail without the strong support of administrators on programs, trainings, concerns of faculty and students, and overcoming barriers. However, Bowers (2003) contended that in faculty perspectives must be considered in order for quality learning to occur in distance education technology programs. She states, “administrators must ‘move beyond the build it and they will come mentality” (p. 4) in order to promote greater faculty participation in such programs. Therefore, administrators should recognize their roles in educational institutions and determine how they may motivate faculty to teach online courses and in the process help them to ensure the quality of these programs. After all, a 2003 Sloan Survey of Online Learning conducted by Allen & Seaman (2003) revealed that academic leaders (59.6%) from degree-granting institutions of higher education agreed that their faculty accepted the value and legitimacy of online education, while over 40% of those leaders in the institutions surveyed were either neutral or disagreed that faculty embraced online education as a delivery method. However, the findings of this survey also showed that the overall attitudes of faculty at all institutions surveyed remained more conservative with regard to the quality of online education and its ability to equal face-to-face learning.

Conclusion and Recommendations

The transition from the traditional face-to-face classroom to on line learning can be successfully achieved and quality can be ensured if several key factors closely examined. According to Palloff and Pratt (2000), those key areas are: ensuring the access to and familiarity with the technology used, establishing relatively loose and free-flowing guidelines and procedures, striving to active maximum participation of participants, promoting collaborative learning, and enabling online participants to reflect their learning. Levy (2003) also suggested that when planning, developing, and implementing online learning programs in higher education six factors should be considered, which are: visions and plans, curriculum, staff training and support, student training and support, and copyright and intellectual property (p. 1). Levy concluded that if institutions want to have effective online learning programs they must analyze all of these areas and make changes as necessary in order to successfully implement online learning programs.

What is considered a good online course? According to Kearsley (2000) there are at least ten critical elements for a good quality online course: They are content, pedagogy, motivation, feedback, coordination/organization, usability, assistance, assessment, workload, and flexibility. The Institute for Higher Education Policy (IHEP 2000) has also proposed 24 benchmarks for measuring quality Internet-based learning which should be considered by institutions planning, developing, and assessing the quality of their online learning programs.

Some studies have suggested that a team approach be used as a method to ensure the quality of online education instruction (Care & Scanlan, 2001; Levy, 2003; Southern Regional Education Board, 2001). Such a team might consist of the instructional designer, graphic/interface designer, technical support personnel, content expert, direct instructor, information resource personnel, mentors/tutors, and assessor. The instructor, however, remains at the center of the team to guarantee academic integrity, with the assistance from other partners.

To ensure the quality of online education instruction, the qualification of instructors should be the first consideration for quality assurance. Instructors who conduct online education courses should understand what their roles are and adjust their attitudes for this role change. Second, it is important for instructors to master design and delivery strategies, techniques, and methods for teaching online courses. Third, the institution should provide technical and financial support for faculty. Fourth, school administrators should also realize what their role and responsibilities are in ensuring quality online instruction. Critical to this process, administrators should recruit qualified faculty or instructors for their online education programs. Moore (2001) also noted that to effectively deliver online courses, faculty must promote student to student interaction with minimal faculty intervention, engage students in regular assignments, promoting students’ self-direct ability, and providing specialized attention to students who are lack of self-directedness.

The increasing diversity of the nation’s student population and advancements in the development of educational technology has encouraged the popularity of online education instruction (Bi, 2000). However, academic institutions that offer courses online still face many challenges. Therefore, administrative support is crucial if programs are to be successful. Administrators must consider issues related to intellectual property, pedagogical rigor and methods, course management, and instructional compensation of faculty (McAlister, Rivera,

& Hallman, 2003). In essence, successful online education instruction does not happen by magic. It is a collaboration of instructors, administrators, students, and the community at large. The courseware development industries should also keep the instructors tuned in about their product updates and provide training and technical service support to instructors. The government, community, and parents should also help the school to ensure the quality of online education.

Moving from traditional methods of teaching to online methods of instruction often create dramatic shifts in the perspectives of instructors and their students (Dringus, 2000). Moreover, many issues have been raised about the quality of online education. To resolve some of the problems and concerns associated with online education instruction, Dringus (2000) suggested that administrators and faculty should prepare students for the online learning experience. Included in her considerations are:

1. Develop a valid and reliable pre-assessment process to determine the educational and technical skills background of the learners before allowing them to register for an online class.
2. Study learners' attitudes and perceptions about online learning. Determine the extent of learners' fears, anxieties, and the capacity for self-motivation as learners begin their online courses.
3. Determine the extensive stream of requirements, roles, and responsibilities that must be supported and maintained in online classes by faculty, students, and administrative staff.
4. Demonstrate to potential online learners how unique online learning is compared to traditional campus-based learning.
5. Devise learning or study strategies that students can adopt to maximize their online learning experience. (p. 194).

Based on findings in this review of the literature and conclusions in this paper, the following recommendations are made for ensuring quality online education instruction:

1. Administrators should not force faculty to teach online courses who do not wish to do so.
2. Training in WebCT should be made more user friendly.
3. Mentors should be available in each department or college who can answer questions that come up from faculty who have limited experience in teaching online courses.
4. Departments should limit the enrollment in online courses.
5. Teachers need to take courses to better understand technology; specific classes need to be taken in order to design websites for online courses.
6. Teachers must have the support of other teachers who have taught online courses before, as well as administrative and technical support.

Specific recommendations on course design and delivery (Bi, 2000, p. 42, Bower, 2003)

1. Limit the size of an online class because timeliness of online feedback and grading suffers when there are larger numbers.
2. Determine what kind of learning will online instruction assist and how that will shape student learning?
3. Consider carefully the type of instructional design to be used to increase student interaction for the objectives of the course.
4. Determine the influence of multimedia upon the instructional process, and the new roles of the professor, Web developer, site facilitator, and non-traditional students in the distance learning process.
5. Provide continuous and periodic student and program evaluation to assess quality indicators.
6. Faculty should be encouraged to explore the online environment and make well informed decisions regarding its appropriateness for their courses that they teach.
7. Faculty and students must learn how to use the online tools that ensure that teaching and learning is appropriate for academic success.

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Students' Perceptions towards the Quality of Online Education: A Qualitative Approach

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Abstract

How to ensure the quality of online learning in institutions of higher education has been a growing concern during the past several years. While several studies have focused on the perceptions of faculty and administrators, there has been a paucity of research conducted on students' perceptions toward the quality of online education. This study utilized qualitative methods to investigate the perceptions of students from two universities and one community college regarding the quality of online education based on their own online learning experiences. Interviews and observations were conducted with three students. Various documents were collected, digital and printed. Positive and negative experiences of students were examined. Factors that contribute to those experiences were also identified. The findings of this research revealed that flexibility, cost-effectiveness, electronic research availability, ease of connection to the Internet, and well-designed class interface were students' positive experiences. The students' negative experiences were caused by delayed feedback from instructors, unavailable technical support from instructors, lack of self-regulation and self-motivation, the sense of isolation, monotonous instructional methods, and poorly-designed course content. The findings can be used by instructors to understand students' perceptions regarding online learning, and ultimately improve their online instructional practices.

Introduction

With the fast development of the Internet, many colleges and universities have offered online courses as a viable alternative to traditional face-to-face instruction. However, considerable concerns and problems have developed, particularly as it relates to the quality of online education. Online education, according to Harasim (1989), is a new domain of learning that combines distance education with the practice of face-to-face instruction utilizing computer-mediated communication. Ascough (2002) suggested that online education has the following features: (a) it provides a learning experience different than in the traditional classroom because learners are different, (b) the communication is via computer and World Wide Web, (c) participation in classroom by learners are different, (d) the social dynamic of the learning environment is changed, and (e) discrimination and prejudice is minimized (p.1).

New technologies, the Internet, streaming video, net-meeting etc. now makes higher education more accessible and affordable for many students, and for those who would have been unable to pursue higher education in a traditional in-class setting (Bianco & Carr-Chellman, 2002). Consequently, online learning has now become an integral part of higher education institutions' expanding curriculum.

The term online education is often associated with Internet education, virtual education, cyber-learning, and asynchronous learning (Office of Sustainable Development, 2000). Kearsly (2000) reported the following themes that shape online education: collaboration, connectivity, student-centeredness, unboundedness, community, exploration, shared knowledge, multisensory experience, and authenticity (p. 4-10).

Volery (2000) also concluded that online delivery is a form of distributed learning enabled by the Internet.

According to Paulsen (2002), online education is characterized by:

- the separation of teachers and learners (which distinguishes it from face-to-face education),
- the influence of an educational organization (which distinguishes it from self-study and private tutoring),
- the use of a computer network to present or distribute some educational content
- the provision of two-way communication via a computer network so that students may benefit from communication with each other, teachers, and staff. (p.1)

Online courses and degrees have been widely adopted by higher education institutions as another method to substitute traditional classroom instruction. Allen and Seaman's (2003) recent survey on online education delivered by higher education institutions in the United States, found that at least 80% of the course content delivered by those institutions were delivered online. Regardless of the definition, an early indication of the widespread popularity of

online education courses can be found in a survey conducted by the U.S. Department of Education, which revealed that more than 54,000 online education courses were being offered in 1998, with over 1.6 million student's enrolled (cited in Lewis, et al., 1999). In a more recent study, Allen and Seaman (2003) reported that: (a) over 1.6 million students took at least one online course during the Fall of 2002, (b) over one-third of these students (578,000) took all of their courses online, (c) among all U.S. higher education students in Fall 2002, 11 percent took at least one online course, and (d) among those students at institutions where online courses were offered, 13 percent took at least one online course (p.1).

Statement of the problem

Although it has been reported in a recent study that 80% of course content offered in institutions of higher learning are being delivered online (Allen & Seaman, 2003), students in this study were still reluctant to take online courses and complained about the online classes they had taken. One participant noted, "Not only does the courses costs more, but they made me feel lost all the time" (Personal communication, November 11, 2003). Another participant stated, "The online class was very boring, and I don't feel the instructor helped me a lot"(Personal communication, November 11, 2003). It appeared that these students held unpleasant experiences from their prior online learning experiences. What caused their negative experiences? Was it the learner themselves? Was it the program? Or was it because of the instructor? How do students perceive the quality of online education based upon their own online learning experiences? Are they satisfied or dissatisfied with the online education they have received? What are the factors that shape students' online learning experiences? All of those questions prompted the present study and its investigation to explore students' perceptions towards the quality of online education.

Rationale for study

As the number of online education courses in higher education has increased, concerns and issues have arisen about the quality of these courses (Yang & Cornelious, 2003). Many problems that have arisen in online education regarding its quality are often related, but not limited to: (a) the requirement of separate quality assurance standards, (b), programs having low (or no) quality standards, and (c) there is no consensus on what constitutes learning quality (Twigg, 2001).

Carnevale (2000) reported that Nick Smith (D, Michigan), the chairman of the House of Representatives science subcommittee on basic research expressed deep concerns about the quality of internet-based courses during a hearing in May of year 2000. Representative Smith stated that he remained skeptical of the quality of online learning, "... students who take courses online don't interact as much as their peers in traditional courses, and that they may walk away with knowledge but not with an understanding of how to think for themselves (p. 51.)" Concerns have also arisen as to the use of technology as a panacea to correct financial problems of institutions rather than serve as a valid teaching method (Hensrud, 2001). Brown & Green (2003) have also argued that online course delivery is often viewed by "administrators as a 'cash cow' venue – a means of delivering instruction to a large number of paying customers without the expense of providing things such as temperature controlled classroom and parking spaces" (p. 148).

Many opponents of online education question whether or not online learning can provide the same interaction between instructor-students and students-students as traditional classrooms offered (Roblyer & Ekhaml, 2000). Some opponents also question the quality of online education since the quality of instructors who teach online courses cannot be guaranteed (Weiger, 1998). Arguments are made that as consumers of online education, students are unlikely to be able to find out information about the quality of the courses that are provided (Twigg, 2001). Schools or universities that offer online education courses typically do not provide comparative information for students e.g., how would a student know which online course meets his/her needs? Moreover, prerequisites that are essential for taking a particular online course are usually not clearly stated on websites for students, and when students are encountering technical problems, who will they be able to ask for assistance if it is not available to them (Twigg, 2001, p. 15). Thus, additional research is needed to examine the quality of online education.

Proponents are in support of online education. They have suggested that the lack of face-to-face interaction can be substituted by online discussions in bulletin board systems, online video conferences or on listservs (Blake, 2000). Online education can also promote students' critical thinking skills, deep learning, collaborative learning, and problem-solving skills (Ascough, 2002; Rosie, 2000 & Briggs, 1999). Donlevy (2003) asserted that online education may help schools expand curricula offerings with less cost and can help graduates gain important technology skills to improve their marketability. Proponents also argue that online education can encourage non-discriminatory teaching and learning practices since the teachers and students, as well as students and their

classmates typically do not meet face-to-face. Palloff and Pratt (1999) reported that because students cannot tell the race, gender, physical characteristics of each other and their teachers, online education presents a bias-free teaching and learning environment for instructors and students.

Quality, as used in this study is the extent to which an internet-based distance education program meets the benchmark criteria established by the Institute of Higher Education Policy in 2000 (IHEP 2000). In order for a distance education program to be recognized as a quality program it should meet these specific criteria (Hensrud, 2001). According to Kearsley (2000), to be considered as good-quality online course, ten most critical elements must be incorporated. They are “content, pedagogy, motivation, feedback, coordination/organization, usability, assistance, workload, and flexibility” (p.105). Numerous research projects have been conducted from the perspectives of faculty (Bennett & Bennett, 2002; Bower, 2001; O’Quinn & Corry, 2002; Yueng, 2001) and administrators (Alley, 2001; Giannoni & Tesone, 2003; Husman & Miller, 2001) toward the quality of distance education, where the Internet was used as the major delivery method, based upon the IHEP’s quality benchmarks. However, there is a lack of research to measure the quality of online education from the students’ perspective. Little is known about the quality of programs that offer online education, especially those programs based on the Internet. Faculty, administrators, and policy makers need to know how their “customers” view the quality of online education programs based upon their own learning experiences.

Purpose of the Study

Although the literature regarding online education is expanding, studies related to the quality of online education are limited. Among those examined, few researchers have examined the quality of online education from the students’ perspective. Therefore, there is a need to investigate students’ perceptions towards the quality of online education. The purpose of this study was to examine the quality of existing online education courses that utilize the Internet as the primary instructional delivery method. The focus of this study was to examine students’ perceptions of the quality of online education. The findings of this study may contribute to the literature of online education in terms of quality assurance. The results should hopefully enable institutions offering online education to evaluate their programs based on the findings and the recommendations in this study.

Research Questions

Answers to the following research questions were sought in this study.

1. What is the experience of students who are receiving online education? How do they perceive the quality of online education from their experiences?
2. What are factors that have shaped students’ online education experience? How do those factors contribute to the quality of online education?

Limitations

There are several limitations of this study which need to be addressed. First, the three students who participated in this study were taking three different classes offered at only two universities and one community college. Each instructor in the study had his/her own characteristic in regard to how he/she presented course content and communicated with students. Therefore, the characteristics of the instructor may have had an influence on students’ perceptions of their online education.

Second, there were different types of formats utilized to present the online courses. Two classes used WebCT as courseware technology, and one class used Blackboard. Although there are many similarities for the two courseware technology, the layout, the design of the class, and interface were all different.

Third, the classes were across disciplines and were taught at different levels. One was a graduate course in Educational Psychology. One was an undergraduate course in Music Appreciation, and the third was a social development class, which was taught at the undergraduate level.

Definition of Terms

This study adopted the term of *online education* identified by Paulsen (2002). According to Paulsen, online education is characterized by

- the separation of teachers and learners (which distinguishes it from face-to-face education),
- the influence of an educational organization (which distinguishes it from self-study and private tutoring),
- the use of a computer network to present or distribute some educational content

- the provision of two-way communication via a computer network so that students may benefit from communication with each other, teachers, and staff. (p.1.)

Review of Literature

Many quantitative studies (Bennett & Bennett, 2002; Goodwin, 1993; Hara & Kling, 1999) have been conducted in an effort to determine the effectiveness of on-line learning. However, there has been little research that has sought to control for student variables that could provide answers to the following questions such as: How do students' computer skills affect perceptions of on-line quality? Do students' computer skills also affect students' learning outcomes? How does the communication within the on-line environment affect student's perception and learning outcome? According to Thurmond, Wambach, Connors & Frey (2002) these are just a few of the questions that are often ignored or under investigated in research that has assessed the quality of on-line learning.

Quality assurance guidelines and principles

The quality of online education has also prompted the attention of higher education accreditation associations. Many organizations published and proposed their guidelines or principles to ensure the quality of online education. In the early 1990s, the Western Cooperative for Educational Telecommunications (WECT) developed "Principles of Good Practice for Electronically Offered Academic Degree and Certificate Programs" (Twigg, 2001). Since then, many other groups have developed similar principles and practices. For example, The American Distance Education Consortium (ADEC) drafted "ADEC Guiding Principles for Distance Learning". A joint task force of the American Council of Education and the Alliance: An Association for Alternative Programs for Adults developed "Guiding Principles for Distance Learning in a Learning Society." The Instructional Telecommunications Council provided "Quality Enhancing Practices in Distance Education." The American Federation of Teachers (AFT) developed "Distance Education: Guidelines for Good Practice." The Council of Regional Accrediting Commissions updated and explained WECT's statement, and published "Guidelines for the Evaluation of Electronically Offered Degree and Certificate Programs" (Twigg, 2001).

In 2000, The Institute for Higher Education Policy (IHEP) first reviewed all of the existing principles or guidelines, and proposed 24 benchmarks for measuring quality Internet-based learning, which were grouped into seven categories: (a) institutional support, (b) course development, (c) teaching/learning, (d) course structure, (e) student support, (f) faculty support, and (g) evaluation and assessment (IHEP, 2000). Among the seven categories, three categories are related to students. They are teaching/learning, course structure, and student support. The IHEP student Benchmark scales are adopted as theoretic framework of this study to see if students' perceived good quality of online education is congruent with IHEP Benchmarks.

Students' perceived strengths of online learning

Petrides (2002) conducted a qualitative study to determine learners' perspectives on web-based learning. The research was conducted in a blended university online class, which means the class was a one-semester regularly scheduled class with web-based technology (LearningSpace) as a supplement. When interviewed, some participants indicated that they tended to think more deeply about the subject areas when responding in writing as compared to giving verbal responses. They explained that they were able to continually reflect upon each other's reflections because of the public and permanent display of the discussion postings on the Web. As stated by one participant, "There is something that forces you to think more deeply about subject areas when you have to respond in writing" (Petrides, 2002, p. 72). Another participant reiterated this opinion, indicating that the online technology allowed more reflection than in face-to-face classroom discussion.

Vonderwell (2003) interviewed 22 students in regards to their perceptions of their asynchronous online learning experiences. Some participants expressed that the asynchronous environment allowed them to write carefully about their ideas. For example, Vonderwell revealed that one participant stated, "The discussion questions were not just for writing the answers; they required reflection" (p. 86).

Flexibility is an area of strength of the online learning environment that has been identified by researchers (Petrides, 2002; Schrum, 2002). In Petride's (2002) study, he reported that participants revealed that it was easier to work in collaborative groups in an online course, since there was no less needs to rearrange everyone's schedule. In addition to flexibility with time, choices related to the learning experience were also reported as positive. Participants in Chizmar and Walber's (1999) study on web-based learning environments guided by principles of good teaching practice also indicated that the ability to freely pick and choose from the menu of diverse learning experiences enabled them to find the approaches that best fit the way they learn.

Convenience is also an advantage reported in the online learning literature. For example, in Poole's (2000)

study of student participation in a discussion-oriented online course, the findings indicated that students participated in online discussions at the times which is most convenient to them, such as on weekends. Poole also found that students mostly accessed the online course from their home computers, which was the place most convenient to them. Other researchers have also found similar results that online learners read and respond to instructor's comments in online discussions at times convenient to them e.g. early morning, late evening (Murphy & Collins, 1997).

Students' perceived weakness of online learning

Delay communication is one weakness of online learning that is reported by many researchers (Howland & Moore, 2002; Petride, 2002; Hara & Kling, 1999; Vonderwell, 2003). According to the study by Howland & Moore (2002), the communication between students and between students and instructor was a critical issue. The absence of face-to-face interaction between student and instructor contributed to negative perceptions of many students. Students felt unconfident in guidance when the feedback from instructor was delayed. In addition, in Howland & Moore's study (2002), they found that many students reported that it was difficult to get clarification on assignments, etc. due to lack of communication between student and instructor. The general impression of communication between students was also negative. The message board was the main communication gateway between students and instructor. Each student was required to make a posting on message board each week. The students often reported that the message board posting was ineffective and they were disappointed in the level and quality of communication (Howland & Moore, 2002).

Petride's (2002) study on learners' perspectives on web-based learning also reported that some participants felt a lack of immediacy in responses in the online context in comparison to what could typically occur in a structured face-to-face class discussion. This appears to be especially obvious in asynchronous online discussions, when students have to wait for others to read and respond back to their postings or e-mail messages.

Hara and Kling (1999) did a qualitative case study of a web-based distance education course at a major U.S. university. Their participants reported the lack of immediacy in getting responses back from the instructor, and as a result they felt frustrated. Recent studies indicate similar results. For example, in Vonderwell's (2003) study, one reported disadvantage of an online course was the delay of immediate feedback from the instructor. One participant stated, "It might take hours, maybe a day or so before you get an answer back for the question" (Vonderwell, 2003, p. 84).

Lack of a sense of online community and the feelings of isolation were other weakness that learners have reported in their online learning experiences. Vonderwell (2003) reported that online learning participants indicated a lack of connection with the instructor, especially "one-on-one" relationship with the instructor. Vonderwell revealed that one participant stated, "I still feel like I know a little bit about my instructor, but not the same way that I would if I was in a class. I don't know much about her personality at all" (p.83). Other studies have found similar results. For example, Woods (2002) in his study on the online communication between instructor and learner reported that online learners reported feeling isolated from faculty as well as other learners in the online courses they had taken.

Factors that influenced students' online learning experiences

There are many factors that will influence students' online learning experiences. Song, Singleton, Hill and Koh's (2004) survey study on 76 graduate students' perceptions of useful and challenging components in learning online reported that lack of community, difficulty understanding instructional goals, and technical problems were challenges in their online learning experiences. Some other factors identified by other researchers are learner characteristics (Howland & Moore, 2002) and design of the learning environment (Clark, 2002; Dwyer, 2003; Song et al., 2004).

Learner characteristics that influenced students' experiences

Learner characteristics influence the way online learners learn and their online learning experiences. Howland & Moore's (2002) study on students' perception as distance learners in Internet-based courses revealed that students who were the most positive in their perceptions of on-line learning were those with attributes consistent with constructivist learners. The most positive students were more independent, proactive and responsible for their learning. In contrast, the students who reported more negative perceptions of their on-line learning experience had the same expectations for structure and information as they did for an in-class format. Those students with negative perceptions expressed the need for more feedback from the instructor as well as more structure. These students reported the lack of feedback and communication from the instructor as abandonment (Howland & Moore, 2002).

Another study conducted by Garrison, Cleveland-Innes, and Fung (2004) on online students' role

adjustment suggested that students do see a difference in the learning process and a need for their role adjustment and the online learning should be viewed as more cognitive or internally oriented. Garrison et. al (2004) also pointed out that online learners must take more responsibility, adjust to a new climate, adjust to new context, synthesize ideas, learn how to participate, synthesize ideas, apply ideas or concepts, and stimulate their own curiosity to be successful in online class.

Learning Environment that influenced students' experiences

Another important aspect of the on-line experience is the design of the on-line environment itself. Clark (2002) stated in *Myths in E-learning* that the effectiveness of e-learning “all depends on the quality of the designed content” (p. 599). He also suggested that the content of e-learning should be more “meaningful, distinct, vivid, organized and personal” (p.601) to increase students’ retention.

In current online education practices, the text is the primary means of communication. Text is found in traditional paper based format, multi-media and on-line mediums. These texts exist not in isolation but within a specific context. The learning style and learning objectives are part of the context in which the text is experienced. According to Dwyer (2003) the use of text alone has been shown to be unreliable for the most effective communication between individuals lacking shared concrete experiences. However, the level of effectiveness of textual communication is enhanced when incorporated with feedback, analogies, questions and visuals.

Images can convey the meaning better than words. As Clark (2002) stated, “A picture really is worth a thousand words and the on-line environment can take advantage of the ability to include animation, photographs, video and other graphics” (p. 601). Dwyer’s (2003) meta-analysis study on examining the effectiveness of text based internet learning environment revealed that the inclusion of visual images in the learning environment can be extremely effective but the inclusion of visual images should be based on specific educational objectives. He also found that visualizations are effective according to the type of visualization and the type of learning objective and some visual aids are highly effective in achieving specific learning objectives.

When the learning environment is varied rather than text communication only, students feel more satisfied with their learning. Thurmond et al.’s (2002) study of evaluating 120 students’ satisfaction in a web-based learning environment asserted that the virtual learning environment including emails, computer conferences, chat groups, and online discussions has a greater impact on student satisfaction than does student characteristics. Song et al.’s (2004) survey study also asserted that design of the course is one of the helpful components in their online learning. Other helpful components included comfort with online technologies, time management and motivation of the learner.

Methodology

Research design The design selected for this research study was qualitative in nature using interviews, observations, and documents. Qualitative research provides an understanding of a situation or phenomenon that tells the story rather than determining cause and effect (Fraenkel & Wallen, 2003; Glesne, 1999).

Techniques for conducting qualitative research include observations, interview, and document analysis. Triangulation—putting together various types and pieces of information—can lead to a better analysis or interpretation of a situation. According to Patton (1990), “Studies that use only one method are more vulnerable to errors linked to that particular method than studies that use multiple methods in which different types of data provide cross-data validity checks” (p. 18). Interviews and observations are only two parts of that process. Strengthening the information collected from observations and interviews with other data is not essential, but desirable (Stake, 1995). The data collection techniques used in this study consisted of the structured and unstructured interviews, observations, and documentations.

Data Collection Data were collected using the following methods: interviews, observations, and documents. Multiple sources for data collection will allow the researchers to use different data sources to validate and crosscheck findings (Patton, 1990). Documents were collected and evaluated as additional resources for the study. Each participant in this study engaged in two interviews. One of the interviews was structured and the other was unstructured. Two observations were conducted in an effort to gain more qualitative data. The observations were approximately 60-minute sessions. The observations were conducted in the setting that participants usually completed their online coursework. Documents were collected from all participants. These documents were printouts and other information to substantiate information that was already collected and witnessed during the observations and interviews process. Data were analyzed to answer the research questions and to cross reference similarities and differences among participants.

Interviews Fraenkl & Wallen (2003) have suggested that interviewing is an essential method for checking the accuracy of the impressions that a researcher has gained through observations (p. 455). Interviews can be conducted in several ways—with prepared questions, a protocol or interview guide, or as an unplanned event. Patton (1990) described six different types of questions that all contribute valuable information to the research study: (a) experience/behavior questions—what the individual does in this situation or has previously done; (b) opinion/value questions—what the individual thinks or believes about a situation or issue; (c) feeling questions—what the individual's natural emotional responses would be to a situation or issue; (d) knowledge questions—what facts the individual knows about the situation or issue; (e) sensory questions—what sensory response the individual would have to the situation or issue; and (f) background or demographic questions—what characteristics describe the individual. Each of these questions guides the researcher in developing an understanding of the phenomenon. This study employed a variety of questioning techniques (see Appendix A) to encourage the participants to describe their perceptions of the quality of online education based on their own experiences.

Formal structured interviews were conducted for each participant at the beginning of the study. Each participant's interview lasted approximately 60 minutes each. The interviews were conducted at the convenience of the participants, such as in their dorm room, office, or the campus library. Unstructured interviews were conducted with each participant. The unstructured interviews lasted approximately 45-60 minutes. Each participant had an unstructured and a structured interview. Sample questions asked during the formal interviews included: As a student, how does your experience of online educational programs compare with traditional in-class instruction? How do you like or dislike it? As a student, how would you rate the overall quality of the online instruction you receive? Very good, good, moderate, or not good? Why? In what ways could online education programs serve your educational needs? As a student, how do you feel about the communication between yourself and the instructor? Between you and other students?

Questions for the unstructured interviews were based on things that were observed or were not seen during observations. Also, much room was allowed for spontaneous questions and responses from both the participants and the researchers.

Observations Observations were conducted from February to May during the spring semester of 2004. An integral part of qualitative research, observations allow the researcher to determine if what the participant has said in the interview is transferred into action during the online learning experience. Participant observation “gives a firsthand account of the situation under study and, when combined with interviewing and document analysis, allowed for a holistic interpretation of the phenomenon being investigated (Merriam, 1998, p. 102). During the observation process, field notes were made and transcribed. Pictures about the setting of the environment where the participants normally work for online classes were also taken.

Participants were given the opportunity to schedule their observations at their convenience and in settings conducive for them. Each participant was observed twice. Some of the observations took place in the participant's homes, dorm rooms, offices, or the campus library. During the process of observation, extensive field notes were taken. Those notes included participants' study habits, description of the physical environment where the participants were studying, and how the participants were actively or inactively involved in his/her online learning.

Documentation Fraenkel and Wallen (2003) indicated that documents refers to any kind of information that exists in some type of written or printed form intended for private or public consumption public and are available to the researcher for analysis. Thus, photographs, participants' email messages, printed version of the class layout, and participants' submitted assignments along with class syllabus were collected as data sources.

Documents concerning online education were collected from all participants. These documents included syllabus, course information, tests, study notes, discussion board postings, emails, etc. The majority of the documents received from the participants were printouts from each participant's course site. The purpose of implementing observations, interviews, and documents was to provide trustworthiness and accountability to the data. The researchers were attempting to determine whether the participants' actions and interview responses were the same. The researchers examined how closely what the participants said in the interview, and observations were aligned with what actually happened in the typical online learning settings.

Participants The sample for this research study were three students enrolled in online learning courses. The participants received online instruction from two different universities (University of Southern Mississippi, and Mississippi State University) and one community college (East Mississippi Community College) in Mississippi.

Fraenkel & Wallen (2003) have concluded that purposive sampling is based on the assumption that one needs to “select a sample from which they feel will yield the best understanding of whatever it is they wish to study”

(p. 440). However, convenience sampling was used in this study. Two males and one female student participated in this study. Among the three, one was Caucasian, and two were African American. These participants were all enrolled in online classes. Their exams and other assessments were completed online. Two of the participants received instruction delivery via WebCT and the other participant received instruction via Blackboard. Two of these participants were non-traditional students. One was a housewife of approximately 42 years old, and the other participant was almost 40 years old and held a full time job. Both participants took undergraduate courses offered online. The third participant was a traditional student of 25 years of age, who took graduate online course.

Procedures The initial step in the procedure was the selection of study participants. Convenience sampling was done because the participants were known to the researchers. Participants' interviews and observations were then conducted during the spring semester of 2004. Structured interviews with the participants were first conducted separately. Conversations were recorded during the entire interview processes. Following, the participants engaged in unstructured interviews two weeks later. The interviews were conducted in different places to accommodate the needs and convenience of the participants. One participant was interviewed twice in his dormitory room. The second participant was interviewed twice in her home. The third participant was interviewed in his office once and once at the campus library.

After the completion of interviews, data were organized and preliminarily analyzed. The first observation was then scheduled upon the participants' consent to see how he/she worked for the online class. A week later, the second observation was scheduled with participants to confirm whether or not there had been any change in participants' behaviors when the participants became familiar with the research process.

During the process of the first and second observations, various documents were collected. Photographs were taken for the physical setting of the online environment of the participants. The online class design and layout were also printed as archival data. Some other documents such as syllabus, discussion posting messages were also collected during this stage of the process.

Data Analysis Data analysis is a key component of qualitative research. Transcripts made of audiotaped interviews were checked for accuracy against the original recordings. Data analysis was also conducted simultaneously with data collection. Extensive coding of the interview and observation transcripts was conducted by researchers. The constant comparative method (Glaser & Strauss, 1967) was used to analyze the qualitative data from different sources over time. Data were organized around each research questions, which related to experiences of students who were taking online classes and the factors that shaped those experiences. The researchers examined the interviews, observations, and archival data for similarities and differences. This information was then compiled around two major areas. These areas were positive experiences and negative experiences of online education.

The positive experiences included: flexibility, cost-effectiveness, convenience, self-paced, availability of technical support, and ease of connection. The negative experiences included: delayed instructor feedback, unavailable technical support from instructor, self-regulation and self-motivation, and a sense of isolation. The factors that attributed to participants' positive experiences were: easy access to computers and Internet, well-designed course layout, available technical support from the university and library, spontaneous grade postings after assessments, and flexible class participation time. The factors that attributed to participants' negative experiences were: untimely or lack of feedback from instructor; monotonous instructional methods, lack of technical support, lack of interpersonal communication, and poorly-designed course interface. Limitations of the analysis is reported and discussed in the findings section of this paper.

Data collection and analysis provided answers to the following research questions: (1) What is the experience of students who are receiving online education? (2) How do students perceive the quality of online education from their experiences? (3) What factors shaped the students' online education experience? (4) How do those factors contribute to the quality of online education?

Findings and Discussion

The purpose of this study was to examine students' perceptions towards the online education based upon the online learning experiences they had. Students perceptions toward online education based on their own experiences have been examined. The factors which shaped those students' online education experiences have also been investigated.

The findings of this research will be grouped in two clusters: students' positive experiences and negative experiences. The students' positive experiences were: flexibility, cost-effectiveness, electronic research availability, and ease of connection to the Internet. The students' negative experiences were identified as: delayed feedback from instructors, unavailable technical support from instructor, lack of self-regulation and self-

motivation, and the sense of isolation. Factors that contributed to students' positive experiences were: flexibility of class participation time and self-paced study, cost-effectiveness of online class, electronic research availability, well-designed course layout, ease connection of the Internet, easy navigation of the online class interface, and familiarity with the instructor. Factors that contributed to student' negative experiences were: delayed feedback from instructor; unavailable technical support from instructor, lack of self-regulation and self-motivation, sense of isolation, monotonous instructional methods, and poorly-designed course content.

Positive experiences and contributed factors

1. Flexibility

The flexibility of online education has been widely recognized as one advantage. The most important factor that contributed to participants' positive experience was the flexible class participation time. All three participants in this study emphasized the convenience they enjoyed from not being required to drive to campus, and plan their work and study at their own time. Flexibility with time was one positive experience found in this study. Students could log in to the online course at any time when they are available. "It allows me to take to log on at will and view my courses and assignments at will." "I don't have to worry about trying to find time to come to campus or a pointed pace to meet with the instructor." "One benefit of online course is that you don't have to worry about trying to find time to meet as a whole class". "I have very little time to dedicate to coming to a campus to pursue my education because I am a full time mom." "There is no hassle in trying to rush to get to class." "You're never late for class." One of the non-traditional students reported that he had a full-time job that was extremely demanding and the only option he had at that time was the online class. This student had strong emotions about the sacrifices that he perceived his family had made due to his pursuit of a higher education degree. He expressed anger towards the educational system for not making it easier to attend college. "More online courses would have been a huge benefit...less time away from my family."

Flexibility with self-paced study is another positive experience found in this study. The participants had full control of when to study the required knowledge content by instructor. It was considered as one remarkable advantage for the fulltime employee and the full time mother. "You can pace your work at your own time and you don't have to listen to lectures by the instructor." "Basically, I get to work around my own time schedule." "It helps me to manage my time." "You have time to sit back and reflect your initial reactions to the discussion topics."

Participants also perceived online education as an enjoyable experience when studying with no pressure from the instructor and the other students. The participants felt convenience was also important because "There is no distraction from your classmates", and "There is no one looking over your shoulder or checking your homework or forcing you to read." "You can pace your work at your own time and you don't have to listen to lectures by the instructor."

2. Cost-effectiveness

All the three participants agreed to the cost-effectiveness of online education. Although they have to pay extra for a fee so-called "Special class fee", compared to the automobile, gas, textbook, and meal cost, they would rather take online classes to save those extra expenses. "I think online courses save me money. I have less automobile cost because I don't drive come back and forth to campus." "I spend less on class materials, because I fell online courses require fewer books if any. I don't spend extra money on backpacks, notebook papers, parking decals or fines. I feel that I make more efficient use of my money while taking online courses."

3. Electronic research availability

Electronic research availability was the third positive experience had by the participants. When the graduate student was required to do some research work, the digital library was his first choice. The student perceived that the library provided a good support on the research activities in the online class. "As far as research support, our library did a good job. We can use online databases. If we have any questions, we can call the librarian, the librarian can help us to answer the questions." "If the book or article in not available in the library, we can use the library loan." "The online indexes and databases are open to all students."

4. Ease of connection to the Internet

The ease of connection to the Internet is the fourth positive experience found in this study. The easy access to computer and Internet stimulates students' interests to access their online courses quite often. Since they have access at home or at the dorm, they didn't need to drive to campus or school to access their online class. Some could receive discounts on Internet access due to the enrollment of online class. "With this online program available through internet, getting a degree is possible." "I have Internet access at dorm, I can access my course at any time, and it's so easy for me." "I am able to get dial-up Internet access cheap from university."

5. Easy navigation of the online class interface

The well-designed online course made it easy for students to navigate and find the information they were

seeking. Two kinds of courseware technology were utilized by different participant. Two participants' online courses utilized WebCT, and one participant who took the undergraduate course used Blackboard. Therefore, there were two different kinds of interfaces being used in this study. Two students stated the easy navigation for the whole class design. "The menus on the screen on the Blackboard are very easy to use. I can easily navigate my way around the screen." "The amount of links, information and navigation bar, everything is very simple and laid out on the homepage."

Automatic grading for tests by the courseware was perceived as a good experience by one participant. "I can receive the results for the tests immediately after I took it." A second participant also reported automatic grading by the courseware as a positive of the course. Stating that it was great to see not only your grade for a specific quiz or test, but to have a list of all grades received. Another participant did not receive automatic grading and reported long delays in reporting. The participant stated, "We've already taken three exams, but I still haven't gotten the result from my first test yet."

6. Familiarity with the instructor

One interesting phenomenon found in this study was the comfort level or familiarity with the instructor. One participant indicated that, "I feel good about this class, because I know the instructor pretty well." When asked if this familiarity brought any effect on his perceptions towards the quality of the online class, the participant answer, "I believe this familiarity make me feel more comfortable since I already knew how the instructor behaved and his way of teaching."

Negative experiences and contributed factors

1. Delayed feedback from instructor

The delayed feedback from the instructor was conceived as the main factor which shaped students' negative experience on the quality of online education. Students expect to receive timely feedback from instructors on discussion postings, exam or tests, and submitted assignments. "The feedback from the instructor is not immediate. So far, I haven't received any feedback yet. I think there is a huge need for improvements as regards to the feedback from the instructor". "You must have feedback on exams, discussion postings, and main sources of communication on the regular basis." Students also expect the instructor to reply to email messages or voice mail messages promptly. "She (the instructor) didn't reply to my calls, or my email. I had no way to contact her." It normally took students a day, or several days to wait for feedback from the instructor. "I have to wait for his responses, it normally takes a day or so." The document of discussion postings of one class showed that the instructor only replied to students' messages during the first and second weeks of the semester. The earliest posted answer by students was Jan. 19th. The earliest response posted by the instructor was Jan. 19th. The next response posted by the instructor was Jan. 29th. By that this time the total amount of messages that had been posted were 33, almost one third of Chapter 1 (89 messages). Among the 33 messages, the messages posted by the instructor were ZERO. No wonder the student complained that no feedback had been given to him.

When students did not receive feedback from the instructor, they felt frustrated, depressed, and less motivated. "This miscommunication killed my motivation and I almost cancelled the class." "Sometimes it was very easy for me to get frustrated when I encounter something that I don't understand." "He is probably busy, spending his day teaching traditional classes. Therefore, he doesn't have to read and respond to emails until after hours." Participants then perceived "Time and response time is a drawback in all aspects of online education." During the conversation, the interviewee mentioned several times about the frustration he experienced because of delayed or lack of feedback from the instructor, such as "I hate this class, no feedback, no response." He shook his head, and sighed deeply when giving the above comment.

2. Unavailable technical support from instructor

When students have technical problems, they need someone to help them. The person that came to their mind first was the instructor. Thus, when the technical support from the instructor was not available, negative experiences will be brought up. One participant mentioned that she and her classmates had no technology background, "Many students have little technical background knowledge of computers". It was even difficult for her to explain the problems she experienced with modern technology. "Some problems or gray areas are hard to sum up in words. It is also difficult for the instructor to always know what the student is trying to say or describe." Thus, she said "I have to seek advice from friends, who were computer literate about how to send and compose messages." They suggested that "A how-to-mini lesson would be ideal.", or "... some type of training or workshop on WebCT before class will be beneficial to us."

3. Lack of self-regulation and self-motivation

While online learners enjoyed the flexibility and convenience of online education, they also needed to keep in mind that they had to take some responsibility for their own learning. Due to the freedom and convenient nature

of online courses, self-regulation and self-motivation are highly expected for students to be successful. When students can't control him/herself, he/she might miss the due date for the assignments, or even the dates for the tests. One participant missed the deadline for one of his tests. He had to keep contacting the instructor for an opportunity to make up the test. However, he couldn't contact the instructor through any means, which also caused his negative experience due to this lack of connection. The participants stated, "You must be really self-motivated and focused". "I am easily distracted and I put off things until the last minute". Sometimes they even complained about the freedom and independence they had enjoyed, "Independence and freedom can get you in trouble." "It is so easy to not to complete an assignment." "You don't have a specific time to do your work, so it's very easy to get off track and lose focus." "If I were in a traditional class, at least I can talk to classmates, and we may remind each other about the due dates for assignments and tests."

Participants in this study spent their time on housework, babysitting, other coursework, or activities. Because the class didn't meet, sometimes they forgot that they were taking online courses. "Sometimes I will forget my assignments." However, the participant realized that he needed to control himself, and motivate himself, "If I could have spent some time in preparing for the test, I wouldn't have gotten such a bad score." He also realized that he spent too much time on other things, such as talking on the phone, and traveling. "Sorry, I talked too long (he spent 30 or more minutes talking on the phone." "I had too much travel this year, because I had to go for an interview."

4. Sense of isolation

There are a variety reasons that caused a sense of isolation for online learners in this study. One reason was the lack of interpersonal communication or interaction between instructor/student, and student/students. "You can't talk to teacher face to face on a regularly basis if at all." "You miss out hands-on experiences done in class, and you won't be able to interact with other students." The participant felt a strong isolation in the online class he was taking because he kept saying "I feel I am nowhere and live in a lonely island." Especially when there is no group work for online learners, they won't even have chance to talk to their group members. Consequently, students don't know the instructor, and don't know his/her classmates. "So far I don't know how many classmates I have, and who they are." "Although the instructor listed her number on the class page, but I can never reach her."

5. Monotonous instructional methods

Another reason that caused the feeling of isolation was the monotonous instructional methods used in the online class. Two participants in this study indicated that the message board was the only communication and interaction method used by their instructor. "We only communicated through discussion boarding. She (the instructor) won't reply to our email message. As far as the chatting room, we never used it in this class. If we can meet in the chatting room, it will be so much better." The monotonous instructional methods also included class materials the instructor prepared for students. Printed materials were solely used in the graduate level class. In the music appreciation undergraduate level class, sound files and graphics are also utilized as supplementary teaching materials. Comparing those two, the participant in the monotonous learning environment expressed his feeling and suggestion, "Everything is printed. If we could have different material, such as audio, video, or even let us rent some video and write a report on it, I will feel better for my learning."

6. Poorly-designed online course content

A well-designed course interface can improve students' use of class pages. But a poorly designed course interface will make students lose in seeking information. "I don't know where she (the instructor) put the page for... (a certain assignment), it was there two days, but now it is gone." The structure of one course design was not logic. They were the detailed syllabus and the extended syllabus. Under the extended syllabus, there are two links, one is the detailed syllabus, and the other one is the chapter outlines. But the chapter outlines were not linked. The interviewer also noticed the inconsistent design of the course from the archival data documents. This inconsistency caused students' confusion and frustration in finding information they need.

Participants' overall rating of the quality of online education indicated that they did not believe that they had received a good quality online education. In addition, from their experiences, the online courses they had taken did not meet the IHEP benchmark criteria. IHEP benchmarks states:

Feedback to student assignments and questions is constructive and provided in a timely manner. Proper orientation is advised to students before starting an online program. Students are provided with supplemental course information about course objectives, concepts, etc. Students have access to sufficient library resources that may include "virtual library". Students are provided with support services, such as information programs, technical and proctoring requirements, training, technical assistance, student service personnel, and a structured system to address student complaint. (p. 2-3).

One positive thing indicated by all participants was that they all had access to electronic library resources.

However, they all expressed their dissatisfaction on the delayed feedback, frustration of helplessness, and no orientation before the online classes were given. Therefore, the participants did not perceive their online education to be of high quality.

Conclusions and Recommendations

The purpose of this study was to gain an understanding of students' perception of online learning. Qualitative research methods used in this study were well suited to achieve this goal. The depth of information gained through the analysis of interviews, observations and archival data have provided a level of understanding that quantitative methodology could not have.

While receiving online education, participants gained both positive and negative experiences, although their experiences tended to be more positive. Flexibility of class participation time and self-paced study, cost-effectiveness of online class, electronic research availability, well-designed course layout, ease connection of the Internet, easy navigation of the online class interface, and familiarity with the instructor contributed to participants' positive experiences. Factors that contributed to student' negative experiences were: delayed feedback from instructor; unavailable technical support from instructor, lack of self-regulation and self-motivation, sense of isolation, monotonous instructional methods, and poorly-designed course content.

These findings were supported by the majority of the research literature that was reviewed in this study. Reflection, flexibility, and convenience are reported as strengths of online education by several researchers (Petrides, 2002; Vonderwell, 2003; Poole, 2000; & Murphy and Collins, 1997). Some contributing factors as regards to participants' negative experiences could also be found in similar studies found in the literature. As Howland & Moore (2002) pointed out the level and quality of communication between students and between students and instructor was a critical issue. Petride (2002) revealed the immediacy in responses affected learners' experiences. Vonderwell (2003) and Song et al. (2004) also reported the lack of a sense of community in students' online learning experiences.

This study also found the feeling of familiarity with the instructor influenced students' learning experiences. When the online learner knows the online instructor, he/she may feel more comfortable while taking the instructor's online class. Based on this finding, a question may be raised as to whether or not an online class should be taught by first-year faculty? Further research may be conducted to examine the effectiveness of online teaching by first-year faculty and senior faculty.

When participants were asked to evaluate the overall quality of online education they received, their answers were moderate. Moderate quality of online education implies that they were not very satisfied with the education received, or they did not perceive that the online education they received as of high quality. The participants' personality may have some bearing on how responsible they felt for their own learning. Online learner may need to change their own behaviors such as lack of self-motivation, spending too much time on the phone, or not being an active and constructive learner. However, when their negative experiences were examined, all of the factors except the one related to learner characteristics (lack of self-regulation or self-motivation) are related to the online instructor.

Participant's in this study felt lost, frustrated, and isolated because there was lack of immediate response or no feedback from the instructor. When the course content was not organized, it increased the level of perplexity and nervousness of online learners. When participants encountered any technical problems, the instructors were not able to assist them. Even when the instructor could not help them, no other technical person could help the online learners either. When the instructional methods were only through textbooks, or discussion postings, students' learning was not effective. The learners just completed assignment and turned them in without transferring and assimilating the knowledge from textbook to their own.

The authors concluded that in the process of ensuring the quality of online education, the instructor plays a key role. Not only because the instructor "faces" the students directly, but also because more responsibility has been put on the instructor's shoulder. However, this does not mean that the administrator should be set aside in the quality assurance of online education. More importantly, the administrator should provide sufficient supports (training, administrative, monetary, and promotional), hire qualified faculty, and motivate faculty to provide effective online teaching.

This study was conducted with students from two universities and one community college in the south. Convenience sampling, rather than another sampling technique was used. If a different sampling technique had been chosen, the results could be different. Therefore, future research could be done with a homogeneous group of students, using a larger sample size; including more universities and colleges in the study.

This study has contributed to the literature in the area of on-line education. It has also provided valuable information from students that can serve both online instructors and administrators in providing more effective on-

line education. This study suggests that IHEP benchmarks should be adopted by every institution of higher education as a measure of the online programs each institution offers. When the online education programs do not meet the benchmarks, students won't perceive their online education to be of high quality. This study has also shown that more research need to be conducted in the area of improving communications and utilizing multi-media to enhance the on-line educational experiences of students in regard to both course content and social connectedness.

Appendix A
Interview Questions

1. As a student, how does your experience of online educational programs compare with traditional in-class instruction? How do you like or dislike it?
2. In what ways could online education programs serve your educational needs?
3. As a student, how do you feel about the communication between yourself and the instructor? Between you and other students?
4. As a student, do you think your learning outcomes could be achieved through online education? Why? How?
5. As a student, how do you view the feedback from instructor? Is it in a timely manner? Constructive? Please give some examples.
6. As a student, how do you think the technical support provided from university? Do you receive any other type of support, such as enrolling in online class, electronic database, and written information about the program? If you have any complain, is there anyone you can address to and solve your problem?
7. How do you view your online educational environment? E.g. Quality of graphics, layout, user friendly, navigation, etc.?
8. How does the amount of course work in your online education program compare with traditional in-class instruction?
9. As a student, what could you do to improve the quality of your online education?
10. What do you think are the important factors determining the quality of the online instruction you receive?
11. What factors would lead you to choose online educational programs rather than traditional in-class instruction?
12. As a student, how would you rate the overall quality of the online education you receive? Very good, good, moderate, not good? Why?

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The Value of Modularity in Instructional Design: Implications for Improved Validity in the Evaluation of New Techniques in Distance Learning

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In the development of distance learning, advances in cognitive science merge with new technology to deliver instruction worldwide. However, one major difficulty in evaluating the efficacy of these tools is determining which elements of instruction truly lead to observed changes in student performance. As content, pedagogical methods, and media are intertwined, identifying the “active ingredients” is an essential element of facilitating training that is of high quality and minimizes development costs (Clark & Estes, 2000). To accurately evaluate applications in the field, researchers must be able to identify specific instructional components, make decisions on who and what will be subject to treatment, and accurately draw inferences regarding causal interactions without the control offered by a laboratory. The purpose of this paper is to briefly review current use of various research methods for evaluating instructional technologies, discuss previous solutions to balancing the conflicting demands of internal and external validity, and then to propose a new research design that achieves this goal in a manner compatible with many instructional technology applications.

Current Methodologies in Instructional Technology Research

As educational researchers have grappled with the challenges of obtaining robust findings that successfully transfer from the laboratory to the field, use of experimental and quasi-experimental designs has decreased in favor of contextually embedded case studies that are descriptive in nature (Winn, 2002). Emphasizing the post hoc measurement of past learning outcomes or present conditions, it has been asserted that descriptive research may often be the only feasible way to study relationships between educationally relevant variables. Describing and interpreting “what is” makes descriptive research particularly appropriate to study questions, where significant variables cannot be manipulated in an authentic setting without being detrimental or threatening to human subjects (Best & Kahn, 2003).

The movement toward qualitative studies can be examined from the perspective of new entrants to research in instructional technology. Caffarella (2000), analyzed the content of doctoral dissertations in educational technology from 1977 through 1998 and found a clear shift in the selection of research methodologies. Over that time span, he observed a reduction in the number of experimental studies and an increase in the number of qualitative studies. Noting that his selection method most likely underestimated the actual percentages and that doctoral studies tend to be concentrated in a few institutions and professors, he concluded that “the balance between experimental and qualitative studies will most likely continue to show a change” (p. 20).

In their review of distance education research from 1990 to 1999, Berge and Mrozowski (2001) evaluated 890 research articles and dissertations and concluded that approximately 75% involved descriptive research, while only 6% employed a valid experimental approach. Further, their analysis of the data indicated that pedagogical methods dominated the research and that the trend continues to increase. Similarly, Ross and Morrison’s (2003) analysis of 424 articles published by *Educational Technology Research & Development*, and its predecessor publications from 1953 through 2001, found a decline in the use of true-experimental studies from their height (77%) during the period 1983-1992, to 53% during 1993-2001, while descriptive studies increased from 13% to 45% during the same time periods. They suggested that this demonstrates the growing influence of alternative designs, such as case studies.

Their analysis of the types of stimuli and assessment used in these studies was also noteworthy, because it revealed a significant decrease in the use of materials that were developed only for the purposes of conducting the reported study, such as nonsense words and fictitious content, in favor of authentic curricular materials from 1993-2001. They suggest that this trend is due to the increased interest in external validity and an increased concern about the applicability (generalizability) of laboratory-controlled findings for real-world settings.

An Examination of Internal and External Validity Considerations

Ironically, the pursuit of external validity through non-experimental methods inherently limits the generalizability of the findings. While case studies and other qualitative methods are very helpful for identifying potential pivotal variables for further study and capturing the experiential elements of individual experiences

regarding the technology in question, they are inherently not generalizable beyond the time - and activity-specific setting in which the data was gathered (Stake, 1998). Likewise, the limitations of descriptive studies that utilize quantitative correlational methods prevent researchers from validly concluding that use of a particular technology of interest caused any reported outcome (Pedhazur & Schmelkin, 1991).

Addressing the relationship between external validity and generalizability, Banaji and Crowder (1989) caution against conflating the two:

No one would deny that, other things being equal...ecologically valid methods...used to achieve generalizable results is the best situation in which to find oneself. Nor could it possibly be denied that the combination of contrived, artificial methods and conclusions with no external validity produces a sorry state.... The multiplicity of uncontrolled factors in naturalistic contexts actually prohibits generalizability to other situations with different parameters. The implication that tests in the real world permit greater generalizability is false once the immense variability from one real-world situation to another is recognized. (pp. 1188-1189).

In fact, they suggest that when a tradeoff must be made between ecological validity and generalizability, it is generalizability that ought to win out, in order to advance our understanding of causal mechanisms that can be harnessed to develop technologies. Ecological factors, they reason, can validate the generalizability of a causal mechanism, but the uniquenesses of particular settings can obscure the accurate identification of causal principles. As Morton (1991) noted in his commentary on their article, “generalizations that do not extend outside the restricted environment in which they were bred are not of much use, irrespective of their beauty” (p. 33).

Especially in educational technology research, investigators must be cautious of sacrificing internal validity, because such a strategy can lead to confounded results, such as those identified by Clark (1983; 1985) in his discussion of media selection and instructional strategies. Clark’s analysis of effect sizes in media research revealed that the most common sources of invalid causal inference in technology studies were the uncontrolled effects of the differences in the method or content compared and the novelty effect for the use of a newer media. Because the demands of authentic settings often require the use of imperfectly matched instructional materials (e.g. lecture vs. interactive simulation) or blatant introduction of new apparatus, it is often extraordinarily difficult to design research that meets the demands of Banaji and Crowder’s (1991, p. 78) “best possible situation.”

Campbell and Stanley (1963) identified eight common threats to internal validity that manifest as a design’s inability to control the influence of extraneous variables (see Table 1). These threats are best controlled in the laboratory, where “true experiments” provide equivalence of the subject groups and tight controls over variables that cannot be managed in the field. However, to a great extent, carefully considered quasi-experimental designs can also control these potential confounds. As discussed above, the traditional disadvantage is that the controlled laboratory environment often reduces the robustness of findings by limiting external validity. However, the tension between laboratory-based internal validity and field-based external validity can be alleviated by creatively combining research designs to measure the effects of instructional technology innovations (Clark & Snow, 1975).

Table 1: *Campbell & Stanley’s (1963) Threats to Internal Validity*

| | |
|-------------------------|---|
| History | Events, other than the experimental treatments, influence results. |
| Maturation | During the study, psychological changes occur within subjects |
| Testing | Exposure to a pretest or intervening assessment influences performance on a posttest. |
| Instrumentation | Testing instruments or conditions are inconsistent; or pretest and posttest are not equivalent, creating an illusory change in performance. |
| Statistical Regression | Scores of subjects that are very high or very low tend to regress towards the mean during retesting. |
| Selection | Systematic differences exist in subjects’ characteristics between treatment groups. |
| Experimental Mortality | Subject attrition may bias the results. |
| Diffusion of Treatments | Implementation of one condition influences subjects in another condition. |

Past Attempts to Satisfy Both Types of Validity

Building upon classic research methodology, Clark and Snow (1975) offered one of the original treatises in proposing alternative research designs specifically for instructional technology. Common design problems in the studies they reviewed included reliance on pre-experimental research designs, which lacked random assignments to conditions, control groups, and/or equivalence among the subjects. Consequently, it was impossible to draw valid conclusions regarding the causal relationships between subjects’ characteristics, technology design, and observed

outcomes.

Unfortunately these shortcomings are still in evidence today (Clark & Estes, 1998, 1999). Much of the activity in educational technology, Clark argues, has been the practice of craft, not technology. Whereas technology is the application of scientific principles to solving real-world problems and the generalizability of solutions, craft is characterized more by situated trial and error and solutions that are indeterminate, non-transferable, and unconnected to a systematic knowledge base. Further, the result of this confusion in the practice of educational technology is reflected in research studies that report “no significant difference,” that fail to isolate the “active ingredient” for effect attribution, and that are not generalizable to different contexts.

Various alternative design solutions for balancing the conflicting demands of internal and external validity have been proposed. Two designs that have recently come to the forefront are the randomized field experiment and the design experiment. The randomized field experiment (Ross & Morrison, 2003) requires that subjects in the treatment group be randomly selected to eliminate selection as a threat to internal validity. The advantage of this type of experiment is its high external validity; however, internal validity with respect to history and the overall complexity of the experiment allows for confounding variables.

Design experiments (Winn, 2003) are also conducted mostly in field environments. In this design, the treatment, such as an instructional tool or strategy, is applied in an educational setting, and data is gathered. Based on an analysis of the data, the treatment is revised and applied with additional data collection. This iterative intervention continues over time until the treatment is proved consistently effective. It is the iterative nature of design experiments that controls for spurious variables, in that the intervention can be adapted to correct a problem that the analysis of the data reveals. Design experiments should be replicated to establish validity; however, “the techniques for gathering and analyzing data in design experiments are typically less prescribed and less procedural than those used in experimental studies” (p. 370).

A New Design

Although conducted in real world settings, randomized field experiments and design experiments radically tip the balance of the evidence collected in favor of external validity. Due to the threats to internal validity inherent in both designs through history, maturation, and diffusion of treatment, the results of studies using these and similar designs may only be useful to generally interpret learning outcomes, rather than assist researchers to understand the specific mechanisms underlying and supporting student learning. It is critical, therefore, to continue to refine experimental designs in educational technology research to improve the yield of experiments in complex field settings, the causal inferences they provide, and the generalizability of these inferences to constructs over a variety of populations, settings, treatments, and outcomes (Shadish, Cook, & Campbell, 2002).

In the case of distance learning, the balance between internal and external validity must be informed by the realities of its implementation. In addition to taking place over a geographically distributed area at varying times, course designs are often modular in nature. That is, instructional content is divided into sequential modules that deliver the curricular content in a logical order (Khan, 2001). Because some content is often dependent on the mastery of material presented in a previous module, consideration of such features is vital during the experimental design process to preserve both internal validity (i.e. eliminate history and maturation threats) and external validity (i.e. maintain authentic delivery).

Built specifically with sequential module-based courses in mind, the Strand of Pearls (SOP; see Figure 1) design consists of four conditions into which distance education subjects are randomly placed. Each condition presents the course material in the same sequence and with the same timing. What differs among the conditions for each module is solely the inclusion or exclusion of the targeted feature to be tested. The first condition entails a standard sequence of instructional modules that do not include the feature to be tested as an equivalent control group against which treatment modules are compared (Group A in Figure 1). As with a conventional untreated control group design, the second condition into which subjects may be assigned delivers each module in the same sequence as the first group, though every module includes the experimental feature to be evaluated (Group D in Figure 1). The third and fourth conditions represent systematic alternating sequences of the experimental and the control versions of the modules (Groups B and C in Figure 1). The difference between the third and fourth conditions lies in the sequencing of the experimental and control modules. In Group B, the first quarter of the modules in the course are control versions, the second quarter are experimental versions, and so on. The order for Group C is a reverse of the B, so that the first quarter of the modules use the experimental version, the second quarter use the control modules, etc. In this way, half of the subjects across all conditions are using the experimental modules at any point in the course.

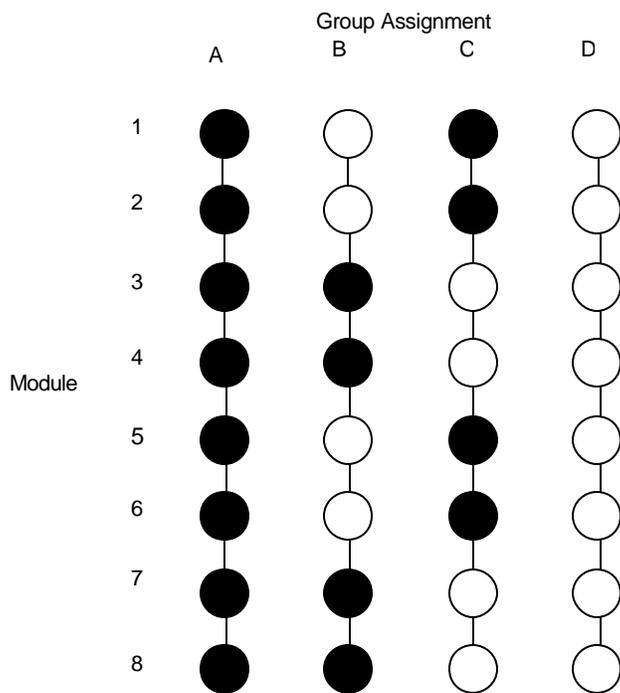


Figure 1.

In each module where it is present, the feature is implemented in precisely the same way in order to maintain the comparability of effects both longitudinally within groups and cross-sectionally across modules. By alternating the availability of the feature across two of the four groups, it becomes possible to detect any confounds or threats to internal validity due to time enrolled in the course (history, maturation), widespread environmental influences (history), and aberrant results due to an interaction between the feature tested and module-specific content.

In order to achieve external validity, the features of instructional delivery must be consistent between actual and experimental use. Such elements include the settings in which subjects participate in the course, the technological impediments that might impact the use of technological features, the presentation sequence and content of the curriculum, and the assessment mechanisms. Additionally, subjects' attention and actions must not be unduly influenced by awareness of the fact that they are participating in an experiment (i.e. the Hawthorne effect). Each of these elements is satisfied, because the study occurs through the vehicle of the course delivery itself. As such, all of the user experiences are authentic and limit the visibility of the research being conducted.

Further, generalizability is also preserved, because the sole consistent difference between a particular module used by the experimental groups and control groups is the availability of the instructional tool being tested. Thus, the findings will predominantly reflect only that manipulation. Typically, one of the major confounds in field studies is the environment in which each subject is participating. In classrooms during live instruction or in other scenarios in which subjects are in a particular physical setting, there are many uncontrolled commonalities (e.g. culture, socio-economic status, teacher bias, etc.). However, in distance learning scenarios, such environmental influences are limited, because the variance introduced by environmental effects on a single subject will not have a statistically significant impact on the overall results, if sample sizes are sufficient to provide appropriate statistical power. Further, it can be argued that those environmental variables consistent enough across users to generate an overall effect are common to the larger population of distance learners.

An additional evaluative approach to enhancing generalizability leverages the sequential and modular design of most distance learning courses. By transparently evaluating subjects' knowledge levels at frequent intervals, using pre- and post-test assessments between each module, longitudinal data is acquired for each subject that can be used to detect statistical outliers within individuals over time, in addition to particular subjects relative to the sample population. Thus, if a subject generates aberrant data for a particular module (possibly for reasons of environmental interference that would not be representative of the general population), that data can be withheld from overall analyses to increase the generalizability of the findings.

The advantage of this design over other research paradigms is that it combines the external validity of a staged innovation design (Clark & Snow, 1975) with the internal validity of an equivalent time samples design (Best & Kahn, 2003). The strength of the staged innovation design is that the “control” and “experimental” groups are created by time -shifting the treatment; however, this is also its weakness for internal validity, especially with respect to history. The traditional equivalent time samples designs, on the other hand, minimize the effect of history; however, they increase the strength of potential confounds, such as maturation, unstable instrumentation, testing, and experimental mortality. In the proposed design, the four conditions, considered collectively, serve as counter-balanced controls to evaluate not only the net effect of the experimental feature, but also the intraindividual effects on the rate and outcome of skill development related to the module design being tested.

An Example of Application

To illustrate the advantages of the Strand of Pearls design, we will consider the case of a distance learning course in U.S. law for foreign students taken in their home country. Historically, such students have either received conversational English language instruction prior to the course or enroll in a conversational English language course concurrent with the law course. However, recent studies have indicated that these approaches do not adequately prepare these students to succeed in advanced courses (Brostoff, Sinsheimer, & Ford, 2001; Feak & Reinhart, 2002; Hanigsberg, 1994). As the language of law and legal studies is complex and difficult, these students might benefit from language instruction embedded in their law courses to master the content objectives and language learning goals simultaneously.

In such courses, students must be able to read, summarize, and analyze previously adjudicated cases from the U.S. Supreme Court and various Courts of Appeal to learn how to identify the legal principle at issue, the facts of the case under consideration, and the reasoning the court used to reach its finding. Both the density of the language, often comprised of long sentences containing multiple conditional clauses and the organizational intricacy of the case often defeat students’ attempts to extract the necessary information.

One method to enhance the readability, comprehension, and retention of complex text is the use of textual cues (Kerper, 2001). Textual cues are added to the reading text by reformatting the page to create additional white space, allowing the placement of “textual cues” in the form of headings or questions. These cues direct the reader’s attention to a particularly important fact or issue that is essential for understanding the reading assignment. In our example, the purpose of our study is to determine the effect of the treatment, in this case, the use of textual cues in reading assignments, on students’ achievement of the course objectives, with the corresponding null hypothesis that the treatment has no effect on student achievement. As each course module contains the text of one complete case taken from the body of U.S. case law, the achievement of the individual module’s learning objectives, and thus the overall course goals, is dependent on the understanding of each module’s case. As such, the course is an ideal mechanism for measuring the effectiveness of this proposal and for testing our hypothesis by helping to isolate the respective influences of language and skill proficiency on outcome assessments.

The course consists of 8 ordered modules of computer-based instruction. Each module incorporates multimedia, the court case, exercises, and self-assessments. Two versions of each court case are prepared, one version that incorporates textual cues, and another version in which the text remains in its original form. The study’s control and experimental conditions are solely determined by which version of the case text is present in the module. Except for this intervention, all other module components are identical in content, method, and instructional sequence in the control and experimental conditions.

The course is delivered to students via an Internet Web site. Prior to commencing the course, participants complete a questionnaire to collect background data with respect to age, level of education, experience, and English language fluency. In addition, pretests to measure knowledge of U.S. law and to assess English language skills are administered to the participants.

Following the SOP design, participants in the study are randomly assigned to one of the four conditions. The control condition (Group A in Figure 1) provides instruction in law only and does not include the textual treatment, and the experimental condition (Group D in Figure 1) includes the textual treatment. As described above, the third and fourth conditions (Groups B and C in Figure 1) alternate between the language treatment-included (TI) and treatment-excluded (TX) modules in two -module segments (i.e., TI-TX-TI-TX and TX-TI-TX-TI sequences). After each module, a combined posttest of the previous module and pre-test of the subsequent model is completed by each participant. With the use of module-specific and overall pre- and posttests, a rich data pool can be analyzed with great confidence in both internal and external validity.

Longitudinal Analyses Across Modules. For instance, it is conceivable that a direct comparison of the achievement data for Group A and Group D following completion of all 8 modules might reveal no significant difference in the effect of the experimental treatment, initially indicating a failure to reject the null hypothesis.

However, a longitudinal analysis of the posttest data for each module might demonstrate a significant effect early in the course sequence that diminished as the course progressed. As initial successes could be expected to beneficially impact academic motivation and early course attrition, such data could be used to justify the use of the treatment only in initial modules—a finding that would have been overlooked in a conventional summative comparison.

An inter-module analysis of the data for Groups B and C is also of interest. Following completion of Modules 1 and 2, Groups B and C might demonstrate significant effect differences. If the differences in these same groups following completion of Modules 3 and 4 were *similar* but *reversed*, and this trend continued in an alternating dyad sequence, the strength of the hypothesis in favor of a positive treatment effect would be increased.

Another inter-module analysis might examine the data within any of the four conditions following the completion of each module. This analysis would focus on the trends established by the data. For example, the slope of a graph representing post-module achievement scores for Group A might be compared with the slope for Group B to examine the achievement rate over time and any possible cumulative effects of the treatment, whether positive or negative.

Cross-Sectional Analyses Within Modules. Controlling for variables resulting from the background data, the SOP design enables cross-sectional analyses within modules to detect indications of threats to internal validity and anomalous results. Modular anomalies can be isolated and examined further to determine possible causes. For example, if the treatment were to be effective only with certain modules and not others, additional qualitative analyses could be performed to develop possible explanations, such as unforeseen interactions between the content specific to those modules and the treatment (e.g. assessment for a particular module emphasizes non-linguistic information, thereby reducing the effectiveness of the language-oriented treatment). Further, other threats to internal validity, such as maturation or interference from history, might be identified.

Because the course serves both instructional and experimental purposes, external validity is maximized, in that the content, modular sequence, technology, and assessments are consistent in both actual and experimental use. Additionally, participants take part in the course on an individual basis at a distance via the Internet and therefore, have no contact with one another, which protects against the diffusion of treatment threat. Further, subjects need not be aware of, or influenced by, the experimental nature of the course.

Conclusion

Distance learning courses provide a unique opportunity for research, where the internal validity of the laboratory and the external validity and generalizability of the field can be called upon to support the conclusions of instructional treatment studies. The inherently useful state of modularity common to these courses provides a practical tool for isolating treatments under randomized and controlled conditions. In particular, the Strand of Pearls design facilitates a variety of cross-sectional and longitudinal analyses that aid researchers in establishing robust convergent evidence for the effectiveness of particular treatments. Through such efforts, it is our hope that the “active ingredients” of effective learning can be identified and leveraged to improve both the scientific understanding of human learning and the quality of instruction available to learners across the globe.

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Novice Learners in Cyberspace

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Since the Internet was introduced in the field of Educational Technology, it has predominantly been seen as an instructional tool. A number of educational technologists point out that the Internet can be a powerful instructional tool that encourages learners to be involved in problem-solving by using a great deal of information and to enlarge and deepen their knowledge by sharing their opinions through a variety of communication tools such as emails, threaded discussions and chat rooms (Harasim, Calvert, & Groeneboer, 1997; Herrington & Oliver, 2000; Jonassen & Hernandez-Serrano, 2002; Khan, 1997; McCormack & Jones, 1998; Ritchie & Hoffman, 1997; Romiszowski, 1997). These researchers have studied how teachers can use the Internet to help learners construct meaningful learning for problem-solving in real life context and to allow them to be engaged in learning. In addition, they have done research on how to create useful and effective learning environments including design of specific contents, development of instructional strategy, and educational evaluation using the Internet. The popularization of the term web-based instruction shows how many researchers and educators think of the Internet by as tool for teaching and learning.

This paper, however, raises another perspective on the Internet in the field of Educational Technology, considering it as a cultural space. Cyberspace, first discussed in a science fiction novel by Gibson (1984), is an appropriate term to describe the space of this perspective. In general, cyberspace refers to the interactive digital space created by computer networks, in particular the Internet (Mann & Stewart, 2000). Many researchers and scholars argue that beyond an instructional tool, the Internet provides a cultural space where people have interactions, communicate with each other, and build online communities (Bell, 2001; Bell & Kennedy, 2001; Correll, 1995; Hine, 2000; Markham, 1998; Turkle, 1995). These researchers assert that cyberspace has an influence on the way people think, behave, feel, and communicate with others in terms of race, gender, class, religion, etc. In addition, they point out that people in cyberspace represent themselves in certain ways that might not resemble how they represent themselves in physical spaces². In this light, Turkle (1995) states that cyberspace is part of people's everyday life. Thus, in this perspective on the Internet, cyberspace as a cultural space, human interaction, recognition of selves and others, and people's experiences can be centered in cyberspace

Given that cyberspace is a cultural space, it is obvious that learning occurs in cyberspace and that it is embedded in social and cultural contexts in which learning occurs. While there are many studies on cyberspace as a cultural space, a majority of these studies have concerned online identity or online community, not educational environments. Little research on learning in cyberspace has been conducted. As large numbers of students come to be involved in learning in cyberspace at university and K-12 levels, it is necessary to understand how students learn in cyberspace when they cannot see their teachers and other students face-to-face.

As many social theorists argue for physical space, we need to take a social theory of learning for examining learning in cyberspace. Situated learning, a well-known social theory of learning by Lave and Wenger (1991), can be an appropriate theoretical lens for this examination. According to Lave and Wenger, social, cultural, and historical interactions always bring about situated activities or situated learning. Given that cyberspace is a cultural space based on communities and cultures, I argue that learning in cyberspace is situated learning that leads novice learners to participate fully in the community of practice through the legitimate peripheral participation. In this light, it is of importance to understand how novice learners become part of the community in cyberspace.

Since situated learning in cyberspace occurs in social and cultural space, a cultural studies approach focusing on discourse, subjectivity, and agency is useful for understanding learning, knowledge, and power in cyberspace. As Lave and Wegner (1991) argue, learning and knowledge, whether in physical spaces or in cyberspace, is always related with power relationship between novice learners and experts (eg. teachers). In other words, discourses of both novice learners and experts, novice learners' multiple and fluid subjectivities, and the way novice learners exercise their agency in a certain extent and condition can influence the negotiations and constructions of meaning in cyberspace learning contexts.

Thus, the purpose of this qualitative study is to investigate how novice learners become part of a cyber community through the legitimate peripheral participation in cyberspace in terms of discourse, subjectivity, and agency. This paper addresses an issue of situated learning in cyberspace using a cultural studies approach that will include the data collection process and a preliminary analysis of data.

Conceptualization of Cyberspace as a Cultural Space

The term cyberspace is not an easy word to define in that it describes a virtual world that is mediated by a computer network. Due to this uniqueness, cyberspace is conceptualized in a variety of ways. Benedikt (2000) defines cyberspace as “a world in which the global traffic of knowledge, secrets, measurements, indicators, entertainments, and alter-human agency takes on form: sights, sounds, presences never seen on the surface of the earth blossoming in a vast electronic light” (p.29). On the other hand, he also describes cyberspace as “a common mental geography, built, in turn, by consensus and revolution, canon, experiment; a territory swarming with data and lies, with mind stuff and memories of nature, with a million voices and two million eyes in a silent, invisible concert to enquiry, deal-making, dream sharing, and simple beholding” (p.29). His conceptualization of cyberspace implies that cyberspace is not only a simple space created by machine, computer network, but also a concrete place where millions of people exist, stay for a while, and live for a certain time of their lives with active human interactions.

Bell (2001) makes this broad and complicated conceptualization of cyberspace much clearer. He conceptualizes cyberspace as a cultural space that is lived and made from people, machine, and stories in everyday life. He defines cyberspace by using three modes of story-telling. First, he defines cyberspace in terms of hardware that facilitates a form of interaction between remote actors, which calls material stories. As an alternative definition, he defines cyberspace as an imagined space between computers in which people might build new selves and new worlds, which he calls symbolic stories. According to Bell, cyberspace is all this and more. In other words, cyberspace is hardware and software and “image and ideas” (p.7). In this light, these two stories are inseparable. Moreover, Bell argues that the ways we experience cyberspace represent a negotiation of material and symbolic elements, which he calls experiential stories. In Bell’s definition, human interaction, recognition of selves and others, and people’s experiences are centered in cyberspace. In this light, he emphasizes that cyberspace is always cyberculture in that any and every thing around us is the product of culture.

Turkle (1995) has a similar point of view to Bell. She sees cyberspace as a cultural space of simulation in that even though they might not see others, people have the opportunity to build new kinds of communities in which they participate with others from all over the world, others with whom they have conversations everyday, or others with whom they may have deeply intimate relationships. In this regard, like Bell, she focuses on people’s interaction and experiences in cyberspace and believes that cyberspace provides people with a new environment for social and cultural interaction. Differing from Bell, however, she emphasizes specific local contexts in cyberspace. In the explanation of constructing identity in cyberspace, she argues that experiences in cyberspace can only be understood in the larger cultural context.

In sum, cyberspace is not only a virtual space mediated by computer networks but also is conceptualized as a cultural space in which human interaction takes place, social and cultural communities are built, and human experiences are situated in the social and cultural context in which they work.

Situated Learning in Cyberspace

Situated learning is based on an assumption that learning is constructed by the individual’s negotiation of meaning in a specific social and cultural context (Lave & Wenger, 1991; Wenger, 1998). Since cyberspace is a cultural space, I argue that learning in cyberspace is situated learning and conceptualize cyberspace as the site of situatedness. In other words, borrowing from Lave and Wenger’s (1991) argument on situated learning, I argue that there is no activity in cyberspace that is not situated. Through negotiation of meaning, learning in cyberspace is an integral part of generative social practice in the lived-in world. Consequently, novice learners in cyberspace will become experts through legitimate peripheral participation through the community of practice in cyberspace. Thus, the assumption of situated learning fits into learning in cyberspace in that any novice learners’ activity in cyberspace is situated in a given context and thus, needs to negotiate meaning with their experts through written text.

As the findings of many studies show (Hine, 2000; Markham, 1998; Turkle, 1995), cyberspace provides people with online communities in which they spend a great deal of time, they see what is happening, they exchange their ideas, they learn, and they practice what they learn. In this light, it can be said that online communities are communities of practice for situated learning (Hung & Chen, 2002). While many studies on communities of practice in cyberspace have begun, almost all communities of practice in the studies are non-educational communities.

Although Lave and Wenger (1991) contend that schooling cannot be exactly situated learning because its characteristic is institutional, many scholars seem to consider that schooling is situated learning in that every activity is situated (Brown, Collins, & Duguid, 1989; Hung, 2001). They see classroom environments as communities of practice that allow learners to become part of communities in terms of learning topics or issues. Consistent with this view, it is possible to think of teaching and learning processes in cyberspace as constructing communities of

practice.

Online middle and high schools can be a good example of an educational community in cyberspace. In general, online schools provide students with qualified teachers and state-wide approved learning content. Teachers and students at online schools have a continuous bond and interactions for an academic year in an online community even though they do not need to meet each other face-to-face. Like novices in physical places, novice students who start going to online schools for the first time need to negotiate both the meaning of learning and the online community culture where they belong to in a situated context. When they negotiate these with their teachers as experts in cyberspace, as Lave and Wenger (1991) argue, there are always power relationships between novice learners and teachers that affects learners' meaningful learning. These power relationships should be understood and analyzed in a specific local and cultural context.

A Cultural Studies Approach to Situated Learning in Cyberspace

Cultural studies differs from traditional academic disciplines having definite areas for investigation and its own particular methodology in that a variety of disciplines such as philosophy, psychoanalysis, sociology, anthropology, history, language, semiotics, poststructuralism, postmodernism, and feminism have had a great deal of influence on cultural studies (During, 1993; Grossberg, Nelson, & Treichler, 1992). While some researchers call cultural studies interdisciplinary, other theorists consider cultural studies anti-disciplinary in that it is hardly easy to define it in terms of academic disciplines. Rather than finding its simple origin, cultural studies tends to be understood as "a discursive formation" (Hall, 1993, p.98). Cultural studies has focused on a political perspective in order to articulate how dominant groups manipulate subordinate ones within culture. Most cultural studies theorists believe that every social meaning and knowledge production is based on power relationships.

In the field of cultural studies, discourse, subjectivity, and agency can be core concepts for understanding the connection between social relations and meanings. Discourse is defined as not only language-in-use in everyday life but also a system that has its own rules and constraints, produces meaning through practice in social, cultural, and historical contexts (Foucault, 1972, 1978). Language creates a perspective by which human subjects make sense of the world. Each perspective imposed by language requires human subjects to negotiate meanings in social and cultural contexts, which is always political (Gee, 1999). This political characteristic of language leads cultural studies theorists to pay attention to discourse in terms of learning, knowledge, and power. Subjectivity refers to the positions of the individuals (subjects) within a particular discourse. In other words, subjectivity can be defined as locating one in a particular social position. Subjectivity is crucial in cultural studies in that it connects identity existing in individual's mind with social and cultural contexts. Agency means capability of people to think, determine, and act autonomously. Some forms of agency can be the finding of new directions while others can be resistance and struggle. Agency can be considered as the most important issue in cultural studies because the most critical concerns of cultural studies is the ways in which culture shapes human action (Smith, 2001). The three concepts of discourse, subjectivity, and agency are interrelated with each other rather than discrete.

Taking the heavy reliance on written texts in cyberspace into account, it can be said that discourse has more effect on situated learning in cyberspace than that in physical spaces in that novice learners and experts must represent their every activity as written texts. This unique type of discourse in cyberspace can have different influences on people and their situated learning. Some people may feel comfortable in using written texts for their learning and some other people may not. In addition, the written discourse in cyberspace allows people to observe and learn how to write, how to behave, how to respond, etc. In this light, it can be said that discourse in cyberspace has similar characteristics to that in physical spaces. Thus, it is necessary to investigate how novice learners and experts have an influence on the learners' negotiation for meaningfulness in cyberspace learning contexts.

Like that in physical spaces, discourse in cyberspace has an influence on subjectivity. In addition to this issue, cyberspace can allow people to posit their subject position falsely on purpose because of invisibility. This situation can frequently happen in online communities. However, in a school-based online community, it is expected that students and teachers tend to expose their subjectivity without deception. Since there are few studies on subjectivity in situated learning in cyberspace, it is necessary to examine how novice learners' multiple and fluid subjectivities influence negotiation for meaningfulness in cyberspace learning contexts.

Regarding agency, due to the characteristics of invisibility and heavy reliance on written texts, cyberspace can allow people to act, determine, and represent in different ways from physical spaces. Novice learners' agency in negotiating meaning in cyberspace can differ from that in physical spaces. In this light, it can be important to do an inquiry on how novice learners become agents overcoming experts' dominant power through legitimate peripheral participation in cyberspace learning contexts.

Method

The Interpretive Paradigm

This study is based on the interpretive paradigm because I focus on the understanding how novice learners negotiate meaning in terms of their discourse, subjectivity, and agency. Unlike positivism, the interpretive paradigm assumes that there are multiple realities that are socially and experientially constructed in specific and local contexts (Guba & Lincoln, 1994). These realities come from human interactions for meaning making. Consistent with this, the interpretive paradigm assumes that knowledge consists of “the reconstruction of intersubjective meanings” (Greene, 1990, p.235). Knowledge of a topic or an issue is not unique but plural because multiple reconstructions of meaning are possible. In addition, knowledge is value-added rather than neutral since a viewpoint on knowledge can be different based on race, gender, class, ethnicity, sexuality, or religion as well as individual’s belief or value. Thus, the findings of investigations are created (Lincoln & Guba, 2000) rather than discovered. In consequence, the interpretive paradigm pursues the interpretive understanding of the meanings people construct in a local and specific context and how these meanings interrelated with each other for making them integrated.

The ontology and epistemology of the interpretive paradigm lead interpretive researchers to pay attention to a cultural space embedded in power relations such as cyberspace as well as physical space because they believe that “social reality is defined by the nature and distribution of domination, power, and influence” (Mezirow, 1996, p.161). With attention to culture, the interpretive paradigm tends to focus on discourse that has an effect on people’s subjectivity and agency in everyday life in terms of social, cultural, and historical aspects. In this light, it argues that one must gain an access to culture and participate in it for an in-depth understanding of nature of reality and knowledge. This argument can provide an ethnographic qualitative approach in terms of methodology of the interpretive paradigm.

An Ethnographic Qualitative Research

My study on situated learning in cyberspace is based on culture. Even though it does not allow novice learners and experts to see each other face-to-face, in general, cyberspace provides them with social and cultural interactions, allows them to build communities, and has an influence on the way they think and behave through written text-based communication (Bell, 2001; Hine, 2000; Markham, 1998; Turkle, 1995). Each community of practice in cyberspace has its own particular language, norms, beliefs, values, and local histories. Thus, an ethnographic qualitative approach was useful for conducting this study focusing on understanding how novice learners become part of the community of practice in cyberspace.

In the interpretive paradigm, people’s actions are inherently meaningful and are understood in social and cultural contexts that constitute the action (Schwandt, 2000). Based on this approach, the interpretive paradigm researchers select a natural place where the participants live in everyday life instead of experimental settings for understanding how people make a sense of their life toward the world. In the natural site, researchers play a role in interpreting the participants’ actions embedded in social, cultural, economical, historical, and political aspects as ethnography researchers.

Cyberspace has a great number of natural places as research sites for an interpretive paradigm inquiry. Any websites that provide dynamic interactions using communication tools such as email, discussion boards, chat room, or instant messenger without any control to people who go to the websites can be viewed as natural sites. Online communities are the most well-known research sites for ethnography researchers (Baym, 1995; Denzin, 1999; Hine, 2000).

Online community has different purposes and diverse forms using different communication tools. Despite these differences, online communities commonly allow people to post their opinion or idea, to read others message, and to reply to them without any limit of time and place. Some people may only read others’ postings as lurkers without any response. Other people may go to an online community irregularly or stop going there suddenly. In general, online communities are open to anyone from the world and cannot control people and their message. In addition, while they are involved in these online communities, people think, feel, change, and learn naturally (Markham, 1998; Turkle, 1995). Thus, it can be said that all activities that occur in online communities are natural. Whereas many studies on online communities have been conducted, there are few studies on online communities related with education, especially schooling. Like other online communities, online communities for schooling can have common ties such as academic topics or subjects and social interactions between teachers (experts) and learners (novice learners).

Research Site

The research site of this study was a virtual community school that is a non-profit public school for

students in a mid-west state. This school offers a statewide, comprehensive educational program for students in grades K-12, is established under The Charter School Law of the state, and is governed by the School Board of the state. This school runs all courses on cyberspace during a whole academic year. Students are provided a computer and all kinds of technologies they need for learning such as a scanner, a printer, the Internet service, etc. Students are required to take an introductory computer literacy class before their classes start. After classes begin, students will have access to the virtual classroom, the learning website, for twenty four hours per day and seven days per week. In order to access the website, they need a user ID and password. This website allows only students and teachers at this school to access it.

The learning website was created specifically for this school by a business company, instead of using a platform such as Blackboard or WebCT. Each subject, regardless of grade, has a consistent structure in the website and has the same items: Teachers' Homepage, Meet the teacher, Class help, Timeline, Syllabus, Get started, Go to school, Email, Forum, Chat, Office Hours. Students can use email or telephone for communicating with their teachers. Forum enables students to communicate with their teachers and other students for asking a question about their learning or assignments and to post messages related with content area and reply to other students' messages for active discussion. In addition, teachers provide students with synchronous communication tools, chat rooms and Elluminate, once a week. Any students who have some questions about their learning or assignments can attend teachers' chat session. They can leave chat rooms early before the chat session is over if they get answers from their teachers. Elluminate is a virtual classroom where teachers and students gather together and talk to each other by using a headset with a microphone in cyberspace. This school started using Elluminate in every subject of the middle school at the second semester of 2003-2004. I conducted this study during the entire second semester of 2003-2004 in this school.

Participants

In the interpretive paradigm focusing on an in-depth understanding, an ethnographic researcher relies on small samples in order to learn a great number of issues of central importance to the purpose of the research. In this light, unlike quantitative research, selecting samples in qualitative research tends to be purposive rather than random (Patton, 1990). Thus, the participant selection for my study was based on a purposeful sampling.

The participants were a Language Arts (LA) teacher and seventeen students in 8th grade at the virtual community school. For recruitment of the teacher, a school director at this school made a connection between the teacher who was willing to participate in this study voluntarily and me. Since teachers at this school worked at their home around the state, I could not meet any teachers at the school building when I met the director. I was informed about the teacher by email a few days later and then, sent her the first email introducing myself and this study. She replied to me right away and also introduced herself a little bit. She has eighteen years of teaching experience in physical schools and it was her first year to work at this school. Even though we did not meet each other face-to-face at that moment, I felt that she was comfortable with me and excited about being part of this study. I had a few chances to meet her face-to-face during this study but in general, she and I met in cyberspace by email.

For recruitment of students, I asked the teacher to announce this study on her homepage where every LA student visited for their learning. A few days later, she emailed me that three girls out of around ninety students wanted to work with me and gave me their names for me to contact them. In order to recruit more students, I decided to send each 8th grade student an email introducing myself and this study. I also attached a recruitment letter for parents to each email. It took a few hours to finish sending all 8th grade students an email. Surprisingly, I had several emails from some students who were interested in being part of this study while I was sending emails to every student. Finally, I had eight more students, six girls and two boys, before the second semester started. However, I lost a girl a few weeks later after the second semester began because I could not get any emails from her. Just in case to lost more students as time went by, I asked the teacher to keep announcing this study on her homepage. As the second semester went by, I had seven more students at different times. Some of them started working with me at the beginning of the second semester and other students joined this study in the middle of the second semester. The reason why I decided to work with them was because I thought that each student had his/her own valuable experiences of going to this school and then, their experiences could contribute to this study.

All of the participants participated in this research voluntarily. As for informed consent, I sent each participant (and parents) an informed consent form by mail and received all informed consents by mail.

In order to create rapport with my participants, I sent them emails right away after they had sent me an email telling me that they wanted to be part of this study. All of my participants were willing to introduce themselves to me and felt comfortable with me from the beginning of our communications even though we had never meet together face-to-face before. I did not have any chances to meet any of my participants during my data collection.

Data Collection Procedure

Data was collected by Interviews, participant observation, and document analysis. These are described in detail in the following section.

Interview

For ethnographic research based on the interpretive paradigm, interviews are “the most common and powerful ways” (Fontana & Frey, 2000, p. 645) in which we can understand other people. Interviews attempt to understand the world from the participants’ points of view, to unfold the meaning of people’s experiences, and to uncover their lived world (Kvale, 1996). Kvale (1996) states that interviews have strength in that researchers can see participants’ inner view instead of simply getting answers to their questions. Based on its characteristics, interviews are selected as a main research method for data collection in cyberspace (Correll, 1995; Markham, 1998).

Researchers can use email or chat rooms for having an interview. Email has strength in that participants can take enough time to answer to interviews questions and then, can provide a researcher with rich data (Correll, 1995; Ferri, 2000; Hine, 2000). However, it lacks in the flexibility of an “in person” interview because participants tend to answer all questions without communicating with a researcher. Chat rooms provide the flexibility of face-to-face interviews in cyberspace in that it is conducted synchronously in real time (O’Connor & Madge, 2000, cited in Mann & Stewart, 2000). In this light, I used chat for conducting interviews with my participants.

The interviews with my participants were conducted once a week. I met each participant at a chat room of Language Arts class for an hour. In order to make sure all of my participants felt comfortable with having an interview at this chat room, I had two informal chats with each of them before the first interview. My participants and I used email the virtual community school provided to make an appointment for an interview or to change their interview schedule. At the beginning of the first interview, I told my participants some instructions they needed to remember for having an interview. One of the instructions I gave them was to write down “done” or “next”. Because I could not see them face-to-face, it was hard for me to know whether they finished telling me their stories to an interview question. Another important instruction was that they did not have to answer some questions that made them feel uncomfortable. Fortunately, there were no interview questions that made them feel uncomfortable. In general, my participants were pretty open-minded and willing to talk to me about their experiences at the school.

In addition to one-on-one interviews, I conducted group interviews for three weeks. Since my participants were diverse in terms of gender, race, and previous schools background before going to the virtual community school, I decided to have three group interviews for three weeks. I made each group have three or four participants and let them talk to each other about some broad interview questions. It took around one hour or one and half hours. From these group interviews, I found that my participants were so excited about talking to other students and got to know each other quickly in cyberspace even though they had never met together face-to-face. After three group interviews, I resumed one-on-one interviews for the last two weeks.

Participant Observation

Participant observation is considered as central to most of ethnographic research (Wolcott, 1999). While observation allows researchers to see the participants’ actions objectively as the stance of the “fly on the wall” (Roman, 1993, cited in Proweller (1998)), participant observation makes researchers involve in active interactions such as participation in classroom discussion or group activities with participants within the research site. This participant observation provides researchers with better understanding the context.

It is participant observation that many researchers strongly suggest for an ethnographic research in cyberspace (Mann & Stewart, 2000). What researchers can observe in cyberspace is not participants’ visible actions but written texts they write in email or chat room or on discussion boards. Since people cannot have face-to-face interactions in cyberspace, all interactions, in general, depend on written texts. Even though we need to admit that cyberspace provides more than text, it can be said that written text is a unique form of interaction in terms of online communication (Mitra & Cohen, 1999).

I conducted both observation and participant observation. For observation, I observed the school announcement that was the first webpage after students logged in in daily basis in order to understand what was going on at the school. I also observed the Language Arts teachers’ homepage in daily basis. Observing the LA teacher’s homepage helped me understand what was going on in her classroom and how she communicated with her students in cyberspace.

I observed chat rooms of Language Arts once a week. Since the LA teacher used chat rooms for students asking a question about their learning content or assignments/projects instead of discussion, participant observation was not needed. The LA teacher used chat room for communicating with her students until in the middle of the

second semester. After the middle of the second semester, she used only Elluminate.

I also observed Elluminate of Language Arts once a week from the beginning of the second semester. Unlike chat rooms, Elluminate allowed only nine students to attend at a time. Thus, the LA teacher announced the day and time of Elluminate at the first day of the week on her homepage and encouraged students to attend it. In order to attend Elluminate, students needed to have ID and password and needed to have new ones for every time. Since there were not many students who attended Elluminate every week, I was able to observe every Elluminate session during the whole second semester. At the beginning of the each Elluminate session, the LA teacher asked students to introduce themselves to the class since they could not see each other face-to-face. All students and the teacher could see in the Elluminate was their ID instead of real name. In Elluminate, the LA teacher encouraged students to be more engaged in their learning. When she explained part of the learning content, for instance, she wanted to check if students understood her well. For doing this, she frequently asked students if they had any questions so far while explaining. Each student answered to her whether they had a question or not by speaking to her directly or by clicking on "Smile" button. In addition, students were allowed to click on "Raise hand" button whenever they had a question. Even though Elluminate was a virtual classroom in cyberspace, interactions between the teacher and students were active and dynamic. While I observed Elluminate, I wrote field notes as ethnographic qualitative researchers in physical spaces do.

For participant observation, I observed Forum of Language Arts and participated in it. Around a month after the second semester started, the LA teacher wanted to encourage students to be involved in discussion on some learning contents in Forum. Since she used Forum for the first time at the school, she wanted me to participate in making some discussion questions and replying to students' postings. I read the learning contents for discussion and read and replied to all of students' postings in Forum.

I also conducted participant observation by reading some students' projects. A couple of students wanted me to take a look at their projects and to give them some feedback on it before they submitted them. They sent me their projects as an attached file by email and then, they and I exchanged our opinions on them by email.

Document Analysis

In an ethnographic qualitative approach, documents analysis is important as much as interviews and observation in that documents reflect historical situations as a stable source and are embedded in individual's social and cultural contexts in everyday life (Hodder, 2000; Lincoln & Guba, 1985). While some researchers distinguish documents and records on the basis of whether the texts are personal or private (Lincoln & Guba, 1985), any kinds of documents can be counted for document analysis according to research purposes. In this respect, documents include public records such as government reports or media accounts, private documents such as diaries, reflection journal, or letters, books, photographs, video, etc. (Schwandt, 2001).

With the advent of the Internet, cyberspace produces another kinds of documents that have never existed before in physical spaces. Web pages, emails, postings on discussion boards, and messages on chat rooms or instant messengers are related with people's day-to-day lives. Thus, researchers who conduct an ethnographic qualitative inquiry in cyberspace may need to analyze some of these new kinds of documents for an in-depth understanding of participants' actions.

For this study, web pages of school announcements, web pages of the LA teachers' announcements, learning content of Language Arts, emails my participants exchanged with each other, and messages my participants posted in Forum were collected for document analysis. Since all of these documents were on the Internet, I did not have to print them all. Instead, I was able to copy and paste hundreds of emails and many postings in Forum into a Microsoft Word file. For collecting the two kinds of web pages, I saved them as image files using "PrintScreen" on the keyboard. I printed out only learning content of Language Arts because it was hard to copy and paste them.

Preliminary Analysis of Data

In this section, I briefly present three emerging findings I have found and these findings will be elaborated in further analysis.

Perception of Online School

Some of my participants seemed to think that the reason for going to their online school was to have flexibility of studying. A boy told me that it was easier to learn at his own space in his online school. A girl told me that she liked that she could make her own hours to study. Another boy said that he got to do his work at his own space and anytime during day pretty much. For this boy, he liked to study during afternoon or night instead of morning. But, there was a negative case of this. A girl told me that she could go more at her own speed in homeshool.

Other my participants seemed to think that going to their online school would make them enjoy going to school. Several students told me that it was pretty cool to work on the computer and a kind of fun because they liked being on the Internet itself and because schoolwork was a little easier than public schools or homeschool.

A few students seem to think that going to their online school was to go to an actual school. A girl said to me “I mean we have homework that is due at a certain time and if it isn't done than there are consequences. WE have teachers, who grade your papers and correct what you need to be corrected. We have administration. A principal.” Another girl also told me that she felt going to “a school” because she had an actual teachers.

Learning in Cyberspace: Email as a Communication Tool

Even though the school email was a main communication tool between teachers and my participants, all of my participants told me that no one at the school taught them how to use it. Thus, it was interesting to understand both how my participants learned how to use the school email and how they practiced for fully participation in communication with their teachers and other students in the school. Some of my participants who already experienced using regular email seemed to feel comfortable with the school email at first. They were a little familiar with a basic structure of email. Based on their previous experiences of a regular email, they tried clicking on every button in the school email system. They had some problems of sending an email or replying to an email at the beginning of their trial. In this case, some of my participants asked their parents to help them out. One boy told me that his neighbor showed him how to use the school email and that he observed what she had done.

Other participants who had never used a regular email before their online school had a little different experience of learning how to use the school email. They seemed to try to find some information from the online school first. One girl told me that she took a look at a section “getting started” at one of the teachers’ homepage first. She read all of the information about using email in the section and then, tried to follow the direction. Even though she needed to practice for using the school email for a while, she was satisfied with the way the school provided information.

Teachers/Students Power Disparity

Almost all my participants tended to think that teachers at the school were nicer, understanding, and friendly. They seemed to think that the relationship between their teachers and themselves were more equal, in general. A girl told me that she was very surprised when one of her teachers always replied to her and talked to her about her daughter once. She said to me that she was very happy because the teacher really “talked” to her. However, I also found different interaction between teachers and students in communicating by email. A girl told me that she was frustrated and finally stopped emailing one of her teachers when she argued with the teacher about some wrong answers from quiz. Since this was a preliminary analysis on power disparity between teachers and students, I need to analyze this in detail.

Further Analysis

With an elaboration of above findings, I am going to analyze data on online identity of students, online school activities, novice students’ practice in online school community, and discourse, subjectivity, and agency of students and teachers in online school community.

¹This paper is based on part of the author’s dissertation research at The Ohio State University, Suzanne Damarin, advisor.

²In this paper, I use the term physical space instead of “real environments” or “reality” because these two words tend to signify dualism – physical space is real and cyberspace is not real.

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Development of a Computer-based Test of Creative Thinking

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Introduction

Despite the fact that creativity has long been a topic of interest to educators, artists, and scientists, it has not been a subject of serious study among experimental psychologists (Finke, Ward, & Smith, 1992). This lack of scientific studies on creativity appears to relate to the difficulty of conceptualizing or defining exactly what creativity or creative behavior is. While there are many definitions of creativity, no one definition is universally accepted (Treffinger, Young, Selby, & Shepardson, 2002).

Creativity Definitions

In early research, creative ability was not separated from traditional intelligence; often they were treated as one capacity or ability (Runco, 2002). A more recent trend has resulted in a somewhat extreme contrast between creativity and intelligence. For example, a general view developed that considered creativity to involve divergent thinking while traditional intelligence involves convergent thinking. More recently, an integrated view has evolved that views creativity as a process which involves the combination of both divergent and convergent thinking (Runco, 2002).

According to Runco (2002) studies of creativity are typically categorized in terms of personality, product, process, and press. Personality studies generally identify the personal characteristics that distinguish creative persons from less creative persons. Creative personality has been suggested to include traits such as courage, openness, curiosity, autonomy, playfulness, risk-taking, tolerance for ambiguity and so forth. In contrast, studies of creative products examine artifacts such as works of art, or publications. Such products are evaluated on the basis of preset criteria involving factors such as novelty and usability. Studies that focus on process examine the underlying progression or development of creative performances or products. Runco used the term press to describe the studies that examine the interaction between creative behaviors and environments.

Among these varied approaches to studying creativity, the process approach is considered here to provide a more functional, integrated view of creativity. Process includes many aspects of the other approaches. The processes involved while examining creativity performance include components such as the individual's sequence of responses, spatial elements of product development, temporal elements of product development, underlying thinking processes, and final products. These process factors will provide a means of investigating differences in response patterns among individuals to provide a more complete understanding of the nature of creativity. Further, the study of the process approach may help to explain the ways divergent and convergent thinking operate to complete the creative performances.

A creative performance involves a dynamic process including interaction with problems, prior knowledge, and social contexts. However, when reviewing the literature, it is apparent that there is a lack of research or sound methodologies for examining the dynamic process components of creativity. At minimum, there is mismatch between proposed definitions and methods used to investigate them. Furthermore, current instruments used to assess creativity (e.g. Torrance Tests of Creative Thinking (1974) have focused primarily on examining final products and have been limited in providing information about the underlying processes of creative production.

Measuring Process in Creative Productions

The development of new methodologies or techniques that provide for the measurement of the process elements associated in a creative performance may be instrumental in furthering our understanding of the nature of creativity. In fact, the introduction of such methodologies may not only provide a better picture of creativity but may allow for new functional definitions of creativity itself. Similarly, such development may apply to monitoring processes or thinking patterns of participants who are engaged in creative problem solving activities. In the past it has been*** to examine the mental processes a person goes through while endeavoring to solve a problem creatively, resulting in mostly relying on anecdotal or introspective accounts. Current computer technologies have produced environments and resources that offer much promise to research on creativity and it's underlying

processes. Not only can we develop more efficient and convenient ways to gather, store and distribute creative products for evaluation, but we can now gather a vast amount of information about the processes used in producing those products. Computer technology now makes it possible to provide unobtrusive, automatic recording of multiple, concurrent components of examinee performance. The purpose of this presentation is to illustrate computerized methodologies that monitor and record process components such as response patterns, temporal elements, and sequential stages of creative products. In addition, local and internet-based resources will be discussed in relation to storage of data and products, as well as efficient distribution for analysis and evaluation.

Defining Creativity as a Thinking Process

Creative performances require a person to be involved in a task for a while and to execute his individual resources to complete it. In dealing with a task demanding creative ability, individuals may utilize different types of thinking processes to respond or adapt to the constraints that the task presents. The underlying thinking patterns required for creative performance should be studied in relation to their similarities to, and differences from those needed for other types of cognitive performance. A number of approaches to the study of creativity and related processes have emerged over the years.

According to Graham Wallas (1926) the creative problem solving process goes through a sequence of stages: preparation, incubation, illumination, and verification. The preparation stage involves the process of investigating a problem in all directions and accumulating knowledge. Incubation is the process of consciously focusing on problems other than the proposed one. It is "voluntary abstention from conscious thought on any particular problem." (p.86). The illumination stage involves the moment when an inspiration emerges as the result of unconscious work. At the verification stage the validity of the idea is tested.

In studying creativity as a process, some researchers have attempted to explain creativity in the same context as problem solving processes. Torrance (1974) defined creativity as a process for a person to endeavor to find a solution to a problem. Accordingly, creative thinking is a process in which individuals sense problems, form hypotheses, communicate the results, and modify and embellish the hypotheses. Based on this definition, Torrance created a divergent thinking test, the Torrance Tests of Creative Thinking (date), which focused on measurement of originality, fluency, flexibility, and elaboration.

Guilford (1950) was also interested in the types of thinking involved in creative performances. He proposed two general types of thinking, divergent thinking and convergent thinking. In convergent thinking, the individual is expected to 'converge' on the appropriate answer to a problem, while divergent thinking involves producing a range of novel solutions to a problem (Robertson, 1999). Treffinger et al (2002) reviewed Guilford's approach and emphasized his view that problem solving and creative thinking are closely related and his position that the definitions for the two types of thinking have a logical connection. "Creative thinking produces novel outcomes, and problem solving involves producing a new response to a new situation, which is a novel outcome" (Guilford, 1977, p.161, cited by Treffinger et al, 2002).

Similarly, Treffinger et al. (2002) defined creativity from the combined perspective of convergent and divergent thinking. They substitute 'generating ideas' for divergent thinking. Generating ideas includes fluency, flexibility, originality, elaboration and metaphorical thinking. Convergent thinking, in their view, is replaced by 'digging deeper into ideas' which includes analyzing, synthesizing, reorganizing or redefining, evaluating, seeing relationships, desiring to resolve ambiguity or bringing order to disorder, and preferring complexity or understanding complexity.

Ebert (1994) also viewed creative thinking to include cognitive, convergent thinking. In his cognitive spiral model he argued a conceptualized creative thinking is an integral component of all cognitive processing. The spiral model adopted the sequential nature of the information-processing model by delineating five components: perceptual thought, creative thought, inventive thought, metacognitive thought, and performance thought. Ebert arranged these components in a spiral continuum rather than the cycle typical of the information-processing model. The dynamic aspect of a creative mind interrelating prior knowledge or stimuli is an important component.

Amabile's (1983) definition provided a broader view for creative thinking by including an interaction component between individuals and their environments. He argued that creativity is

best conceptualized not as a personality trait or a general ability but as a behavior resulting from particular constellations of personal characteristics, cognitive abilities, and social environments. This behavior, which is evidenced in products or responses, can only be completely explained by a model that encompasses all three sets of factors. (p.358).

Similarly, Treffinger et al. (2002) argued that creative productivity arises from the dynamic interactions among four essential components: personal characteristics, operations, context, and outcomes. According to the authors, operations are the strategies and techniques that people employ to generate and analyze ideas, solve

problems, make decisions, and manage their thinking.

In summarizing, there is no universal definition of creativity and, consequently, no agreement on the best way to measure it. Creativity is described here as a dynamic thinking process that interacts with problems, prior knowledge, and social contexts. Creativity as a dynamic process entails both divergent and convergent thinking processes. The components associated with creativity and creativity research are grouped into the following categories: Personality, Press, Process and Product. Process and product are the major elements of any creativity production and are mediated or influenced by personality and press factors. All four work in combination and have influence over each other as the individual develops and matures over time.

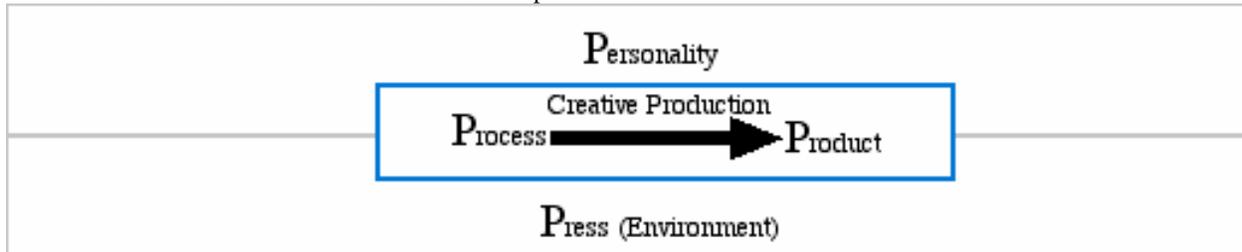


Figure 1. Creative production consists of a process and a resulting product which are influenced by past and present personality and environment components.

The measurement techniques presented here will focus on the process and product components of any creative production. Some elements of personality and press components (especially the testing setting) will be addressed where appropriate.

Measuring creative thinking

When measuring creativity, focus in the past has often been only placed on examining creative end products. However, when creativity is defined and measured in this manner, the observation of the dynamic aspect of the creative process is missed. Even though some efforts to illuminate the creative process have been made, most of the studies have focused on anecdotal and introspective accounts (Finke et al., 1992; Kwon, 1996). This informal, descriptive approach to the construct of creativity makes it difficult to study creativity within the context of controlled scientific experiments (Finke et al., 1992). More objective measurement techniques are necessary for a complete analysis of creative abilities.

In addition, most of the attempts to assess the creativity used pencil-paper tests that add little to the ability to observe the underlying process. For example, the Torrance Tests of Creativity Thinking (1974), one of the most widely used creativity tests in paper-pencil format (Cooper, 1991), has been used extensively to examine the creative thinking process. The research on creativity using this test has therefore focused on the test's scoring of final outcomes. As Erdos argued (1990), this approach would yield little information about the processes involved in creative thinking and it is necessary to move to a more dynamic approach.

Developing an instrument to support a dynamic approach for creativity is essential because the derived information through such instruments can reveal a more complete understanding of creativity. The data obtained by using tools which provide observation of process will bring us more in-depth information about how individuals go about creative performances, what their patterns of creative behaviors are, and, consequently, what types of thinking accompanies creative behaviors. In addition, the increased understanding obtained by employing such tools will help our conceptual reframing of the construct of creativity. Given the current situation in which researchers have no universal definition of creativity, such tools should be of great benefit in comparing, refining, and combining the competing theoretical views. While it is typically not desirable to create theories based primarily on the tools available (e.g. everything becomes a nail when you have a hammer), the reliance on advances in measurement and observation technologies does provide a legitimate influence for expanding the definition of creativity. We are no longer bound by paper and pencil resources and the consequent distribution of only final products for evaluators to score. We can now take advantage of computer technologies that make it possible to monitor and record a wide range of components of an examinee's production activities and make them available for research or testing purposes..

Proposed creativity measurement method

Based on the above views, creativity should be measured not only by final products. Consequently, it

would be important to develop methodologies that not only evaluate creative products, but also enable evaluation of patterns and actions used to generate those products. Such measurement has become possible using computer-administered testing formats that provide methods to readily enable the tracking and recording of such response patterns. Computers can automate monitoring of quantitative variables such as: response latencies, speed, accuracy, numbers of attempts, confidence levels, and a record of self-correction activities (Johnson, 1982; Kwon, Goetz & Zellner, 1998).

This presentation will demonstrate a computer-based methodology that automates monitoring and recording of examinees' responses while they are involved in creative activities. Resources and techniques have been developed that use both local and internet components to present testing materials, monitor both overt and underlying responses, and then store/manage the performance data and final products. In addition, the collected data can be distributed via the internet to evaluators at various locations or placed on servers for analyses. This distribution capability will enhance both the opportunities for creativity research as well as the accessibility of any resulting tests.

These resources will have multiple advantages over traditional paper-pencil tests. Overall testing would be more efficient due to ease of replicating and accessing the testing materials. Cost would be reduced since replication of the test material would require no additional physical resources. This computer-based method would allow more careful qualitative observation of the examinees by the test administrators because it frees them from other responsibilities that paper-pencil testing would require, e.g. distributing/managing testing material and giving instructions. All timing and sequencing of events and management of associated materials would be under the control of the computer and would serve to increase standardization of the administration procedures. For example, such functions would eliminate the need for examiners using stop watches to monitor particular activities thereby reducing potential social pressure as an influence on performance. In addition, with this programmed testing material, it is possible to automate keeping track of quantitative variables such as response latencies, speed, numbers of attempts, and self-correction activities. This method also enables the automatic, unobtrusive recording of responses on a repeated basis giving a more complete picture of examinee performance. For example, the method proposed here was programmed to record the stages of the examinee's drawing product by grabbing snapshots every 10 seconds providing the opportunity to analyze temporal and spatial development patterns. Temporal patterns within and between performance tasks can also be measured more accurately. In addition, other tendencies of creative approaches can be examined through the recorded sequence of drawings. For example, some responders might prefer to move from whole to details, while others tend to go from details to whole. Some might keep the original idea intact through the whole activity; others may change part or all of their work before deciding on the final product. How and when they enter or edit a title for their products can also be recorded. Parallel data collection could be introduced such as embedded means for the examinees to rate their comfort with a task, self-confidence in performance, satisfaction with their production, etc. These ratings would also provide patterns with respect to timing and change patterns.

Further, this method is advantageous in that it facilitates the process of delivering the collected data and analyses. Automatically recorded data will be delivered via Internet and arranged as database files in individual profiles. This process would make the administration and analyses more efficient. In addition, this data storage format would make it possible for evaluators to access the data from remote locations for the analyses that must be done by human observation. Consequently, in exploring the behavior patterns of creative performances, this method should increase testing validity. Blind raters and trained experts, who do not know about the study hypotheses, subjects, etc., could be selected from distant places and asked to conduct independent analyses of the data. Having raters from different settings would make the evaluation of drawings more objective but the evaluations could still be easily acquired and managed.

When the creativity test material is completed, a pilot test of the proposed test material will be conducted to evaluate the presentation resources, interactivity, examinees' reactions to the experience, and the data collection processes. The materials will be refined or redeveloped based on these findings. The intent is to first explore the mechanics of measurement and evaluation and then examine the data to determine the relative value of the types of measurements based on the nature of the patterns observed. Refinement of the techniques and types of data collected would follow according to the initial findings. This ongoing evolution of measurement techniques and determination of appropriate responses to observe will facilitate our understanding of the relation between the creative thinking process and other variables, such as personality traits, motivation, and attitudes. Such understanding should eventually influence our definitions of creativity and lead to further development.

Examples: Original Testing Format

The following test items were originally developed in HyperCard and have been converted in Revolution, a

development environment that provides additional display and data collection components, cross-platform delivery, and internet transfer/accessibility.

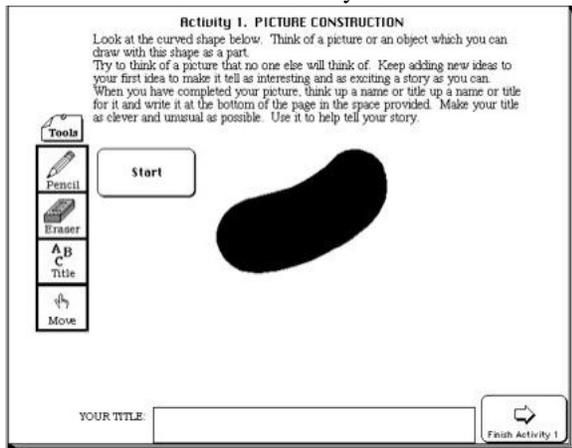


Figure 2. Picture Construction- Examinee constructs drawing ("think of a picture or an object which you can draw with this shape as a part") and adds a title for the drawing. All time and choice patterns are recorded. The instructions are removed during the drawing on all tasks.

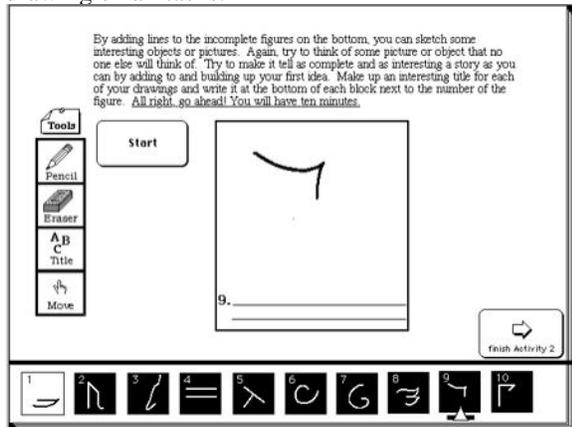


Figure 3. Picture Completion: Examinee completes ("sketch some interesting objects or pictures") and labels a series of drawings using specific starting elements. Examinees can move among the various drawing tasks, all choices, sequences, tool choices and labeling and their timings are recorded

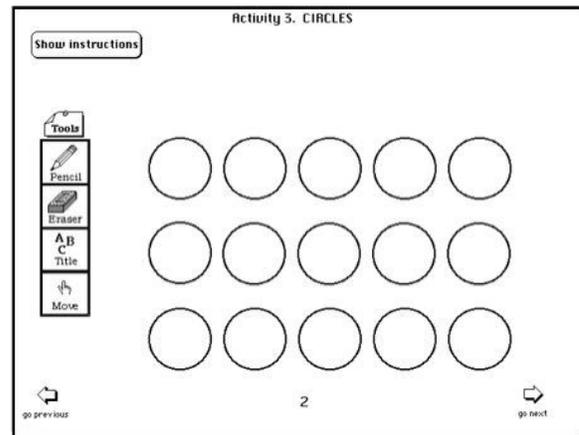


Figure 4. Circles how many objects or pictures can be made from the circles. Can draw inside and/or outside the circles. Followed by a second large screen of additional circles.

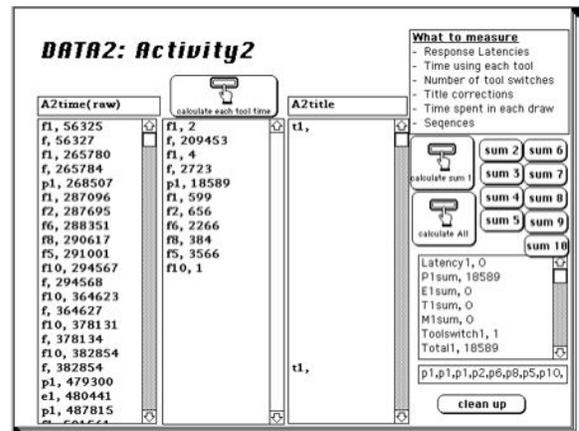


Figure 6. All the data for the series of drawings in activity two are collected and summarized on one card.

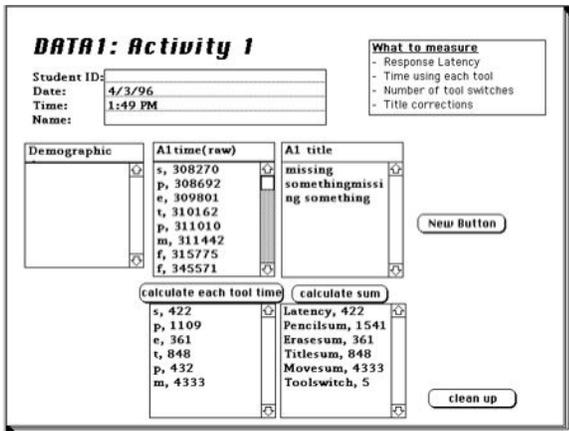


Figure 5. Data collection card for activity one: all timing and sequences are recorded in fields and summarized.

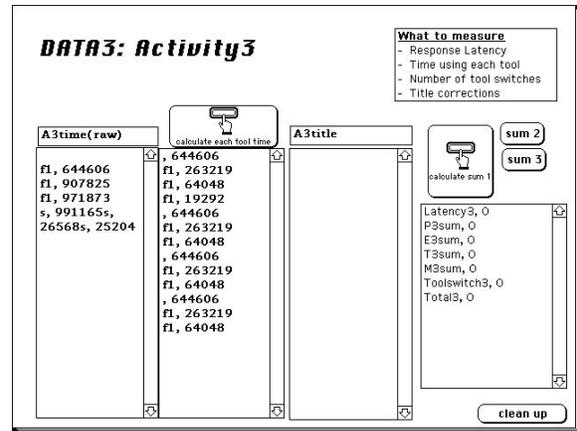


Figure 7. Similarly, the data for activity three are stored and summarized

Expanded Drawing Resource

The following format was developed to provide a means of monitoring the progression of the examinees' drawing at regular intervals. This illustration is a general prototype that can be applied to any test item format to create permanent recordings of the stages of completion.

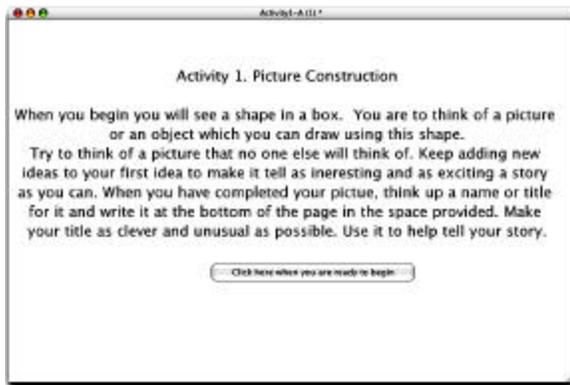


Figure 8. The task begins with instructions on what the task is and how to complete it. When the examinee is ready to begin a click on the begin button removes the text and reveals the drawing interface. This also starts a timer to record the current times and to begin the screen capture sequence.

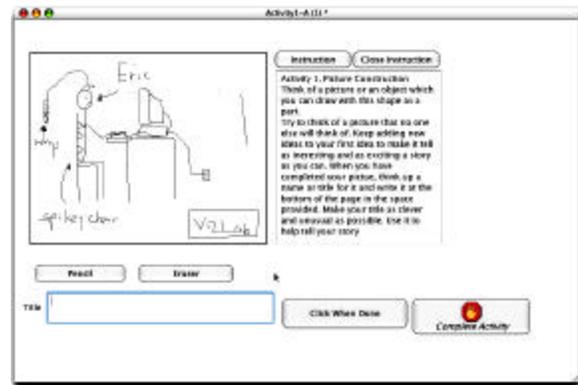


Figure 9. The drawing instructions are repeated. The examinee is presented a button for drawing and erasing. There is a box for entering a title for the drawing. All actions are recorded and timed and snapshots of the drawing area are taken at ten second intervals until the 'Done' button is clicked.

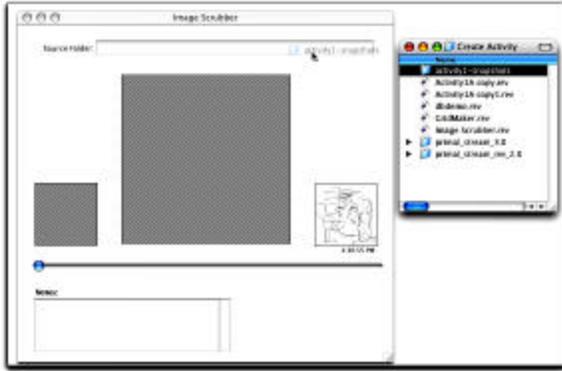


Figure 10. Viewing the screen captures. The sequence of screen captures is loaded into the viewer by simply dragging the folder from the desktop onto the file window of the viewing utility.

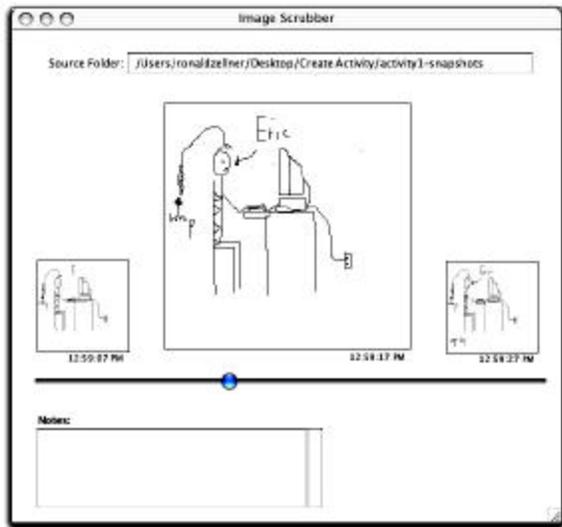


Figure 11. The sequence of captured screens are then accessed using the scrubbing control. The current screen is shown in the center with its time stamp. The previous and next graphic in the sequence are displayed to the right and left. A text area is provided for entering notes or annotations for each drawing sequence. The text can be consolidated for a final report.

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Credit: Eric Peden for developmental support in creation of the testing resources.

The Effects of Various Animation Strategies in Facilitating the Achievement of Students on Tests Measuring Different Educational Objectives

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Abstract

The purpose of this quantitative study was to investigate the instructional effects of various animation strategies. Three treatment groups involved include static graphic, animation used as an attention-gaining strategy, and animation used as an attention-gaining and elaboration strategy. Participants were 115 college student volunteers. Two-way multiple analysis of variance (MANOVA) was used to analyze the data. Important findings indicate equivalent, non significant difference in performance between high and low prior knowledge participants. This was so regardless of animation strategies. The effects of the animation strategies on the achievement of students with low prior knowledge are discussed in detail.

Introduction

The advancement of technologies make it possible to present computer-based multimedia instruction that includes motion, voice, data, text, graphics, and still images (Moore, Burton & Myers, 1996). One important combination of media is animation, that is, images in motion (Dwyer & Dwyer, 2003). Animation has been the focus of recent attention and interest and become more and more popular. Although animation seems to attract learners' attention and increase their motivation to learn, whether or not instructions using animation strategies can facilitate learning still remains a question. This study attempted to examine the effects of two specific animation strategies on student achievement.

Related Literature

Information Processing & Dual Coding

Many early information processing theories described a human brain as being similar to a computer, and human learning as being similar to how computer processes information. There are three main storage structures in the memory system: sensory register, which registers stimuli in the memory system; short-term memory (STM), which serves as temporary storage; and long-term memory (LTM) where information is permanently stored. Short-term memory can only hold five to nine chunks of information (Miller, 1956) before it is processed in LTM. Not all the information stored in the LTM can be retrieved. Retrieval is more likely when appropriate cues are provided in the encoding process (Driscoll, 1994).

Pavio's (1986) dual coding theory further stated that there are two separate information processing systems: a visual system which processes visual knowledge and a verbal system for processing verbal knowledge. Animation, because of its unique dynamic function, is more likely to be coded as both visual and verbal knowledge and stored into long-term memory. Therefore, animation strategies should facilitate encoding and retrieval process (Paivio, 1986; Rieber, 1994).

Dual coding theory also suggests there are three distinctive levels of processing that can occur between the verbal and visual system: representational, associative and referential (Rieber 1996). Representational processing connects the incoming stimuli from the environment to either the verbal or visual system. Associative processing constructs connections within either of the verbal or visual systems, and referential processing builds connections between the verbal and visual systems (Rieber). In this study, static graphics facilitate representational processing by providing the illustrations. Animation as an attention-gaining strategy facilitates associative processing by highlighting specific parts of the heart using animated arrows. Animation as an attention-gaining and elaboration strategy facilitates both the associative and referential processing by building the connections between the animation graphics and the correspondent texts.

Animation as an Aid to Information Processing

Animation, with its unique dynamic function, is expected to facilitate the learner encoding the information into long-term memory by providing a “deeper” and “harder” encoding process than static visuals (Lin, 2001). Reiber, Boyce, and Assad (1990) suggested that “although animation did not affect learning, it helped decrease the time necessary to retrieve information from long-term memory and then subsequently reconstruct it in short-term memory” (p. 50). Reiber (1990) further explained that animations facilitate the reconstructing process during retrieval by encouraging organization.

One animation strategy used in this study was attention-gaining. Reiber (1990) pointed out attention-gaining is one of the three major functions of animation. Attention-gaining animations provide additional ways to insure selective perception where specific features of the presentation are emphasized, stored and processed in the STM (Gagné, 1985). Similarly, Hannafin and Peck (1988) suggested that animations can help emphasize important information by providing contrast to the static background. In addition, Levin, Anglin, and Carney (1987) argued attention-gaining graphics can help make relationships between ideas more apparent by facilitating organization.

Another strategy used in this study is animation for elaboration. According to E. Gagné (1985), “elaboration is the process of adding to the information being learned” (p. 83). Elaboration can have many forms: a logical inference, a continuation, an example, a detail, or anything else that serves to connect information. She further stated that elaboration facilitates retrieval because it provides alternative pathways and extra information to generate answers.

This study investigates the effects of animation as attention-gaining and elaboration strategies in facilitating students’ achievement. Animated arrows which direct learners’ attention to specific image parts were used as an attention-gaining strategy to help arouse student interest as well as help them attend to relevant cues or details provided by animation. Animated text prompts were used as an elaboration strategy to add extra new information to students’ existing knowledge.

A Model of Animation, Dual-coding, and Information Processing

Gagné and Driscoll (1988) created a basic model of learning and memory underlying modern information processing theories. It was revised to show how animation works as an aid to dual-coding and information processing (see Figure 1). Humans process visual and verbal information from the environment simultaneously. Animation is processed as a part of the visual information. Animation as an attention-gaining strategy helps to gain attention and reduce the processing demands in STM, while animation as an elaboration strategy not only helps reduce the processing demands in STM, but also facilitates encoding and retrieval processes by connecting information and providing alternative retrieval pathways (E. Gagné, 1985).

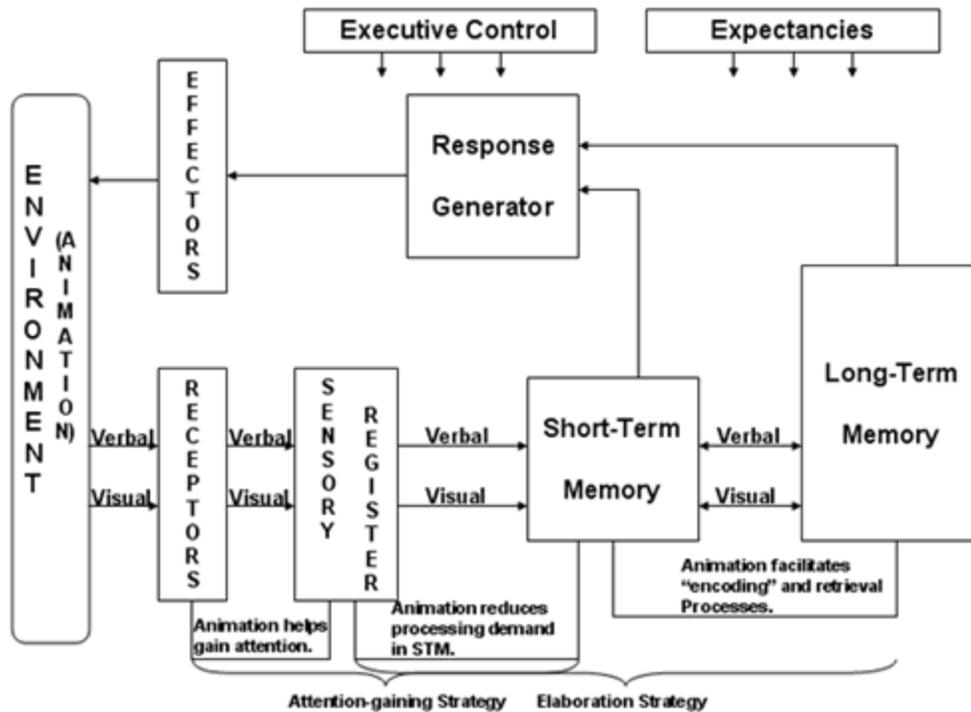


Figure 1. A model of Animation, Dual-Coding and Information Processing Revised from "The Basic Model of Learning and Memory Underlying Modern Information Processing Theories," by R. M. Gagné and M. P. Driscoll, 1988, *Essentials of learning for instruction*, p. 13.

Animation Research

The previous research on animations in CBI has showed somewhat mixed results. Reiber (1990) reviewed 13 empirical studies investigating the effect of animation in CBI and found only 5 of them showed a significant effect for the animated treatments, while 8 showed insignificant differences. Park and Hopkins (1993) summarized 25 studies investigating the effects of dynamic versus static visual displays. Fourteen of the studies found significant effects for dynamic visual displays. Reiber (1990) suggested the reason for the mixed results could be rooted in the procedural flaws of the previous research, or maybe it was because animations were not used in locations where they were necessary.

More recent animation research has been conducted which use the same content as this study. Wilson (1998) tested four types of treatment groups: still graphics, progressive reveal, animation, and animation and progressive reveal. Haag (1995) conducted a study which included the following treatment groups: control group, visual summary with manipulation, learner-manipulation and computer manipulation group. Lin (2001) proposed using additional instructional strategies, and the treatment groups in his study were: static visual, animated only, animation with advance organizers and animation with adjunct questions and feedback. Owens (2002) used three treatment groups: animation, animation and attention-directing strategies, and animation and visual-elaborating strategies. The results of these studies showed insignificant differences in students' achievement among the treatment groups.

In sum, previous animation research shows mixed results while current animation research suggests insignificant differences for treatments incorporating animation strategies.

Prior Knowledge

Prior knowledge has been considered the most important single factor that influences learning (Ausubel, 1968). Jonassen and Grabowski (1993) defined prior knowledge and achievement as the knowledge, skills or abilities that the learners brings to the learning environment before the instruction. Dwyer (1994) further classified students' prior knowledge into high, medium and low level. Hannafin (1997) suggested that compared to individuals who have lower prior knowledge, individuals who have

higher prior knowledge can quickly determine their own learning needs, generate their own learning strategies, and assimilate new information to their existing knowledge structure. Rieber (2000) also stated related prior knowledge provides the learners unique relevant elaboration that is unavailable to learners with limited prior knowledge. It is suggested that knowledge will be encoded more meaningfully and retrieved more easily by learners with high prior knowledge.

Mayer and Anderson (1992) found that learning significantly improved for students who possess low prior knowledge when verbal and visual information are presented simultaneously. They suggested that experienced students might be able to build referential connections between verbal and visual information and their existing knowledge on their own. The computer-based instruction utilized in this study presented verbal (the text) and visual (the graphic illustration or animation) information simultaneously. One of the purposes of this study is to investigate if varied animation strategies will improve the performance of the students identified as possessing low levels of prior knowledge.

Research Purpose and Questions

In this regard, the purpose of this research was to investigate the instructional effect of various animation strategies on facilitating achievement of college level students with high and low levels of prior knowledge. Three research questions were explored.

Do various animations used to gain attention or to gain attention and elaborate on the content improve students' performance on tests measuring different types of educational objectives?

Do various animations used to gain attention or to gain attention and elaborate on the content improve the performance of the students identified as possessing high and low levels of prior knowledge on tests measuring different educational objectives?

Is there an interaction between levels of prior knowledge and the selected animation strategies?

Methodology

Participants

One hundred and fifteen student volunteers participated in the study. Most were freshmen. Fifty eight were classified as high prior knowledge participants while 57 were classified as low prior knowledge participants. Four participants did not complete the study.

Instructional Materials

The self-paced web-based instruction used in this study was adapted from paper-based text materials developed by Dwyer and Lamberski (1997) about the human heart. The original script of the heart content contains approximately 1,800 words divided into three sections: the parts of the heart, circulation of blood and cycle of blood pressure. Integration and positioning of the animation strategies was determined by an item analysis which identified where students were having difficulties based on their performance on the criterion tests from a previous pilot study conducted in Summer, 2003.

Treatments

Static graphic (Control group, T1): This treatment contained one page of directions and twenty pages of instructional screens with instructional text on the left and the correspondent static graphic on the right. An example screen is shown in Figure 2.

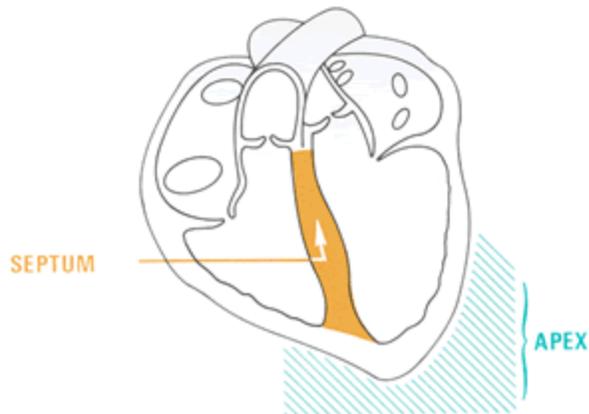


Figure 2. Example screen of static graphic treatment

Animation as attention-gaining strategy (T2): This treatment is the same as T1 except that thirteen instructional screens contained embedded attention-gaining animations. The other seven screens contained only static graphics since previous item analysis did not indicate students have difficulties with those items.

Thirteen screens contained animation with the static graphic on the right of the screen and a “Click to See the Animation” button below. Animated arrows were used as an attention-gaining strategy to direct students’ attention to specific parts of the heart. In order to lower the cognitive load of the students, animations were grouped into chunks. When one animation was finished, a “Continue” button appeared. The students then clicked on the “Continue” button to see the next animation. After all the animations were shown, the static graphic was restored and a set of three buttons appeared: “BACK”, “NEXT”, and “Replay the Animation.” See example screen in Figure 3.

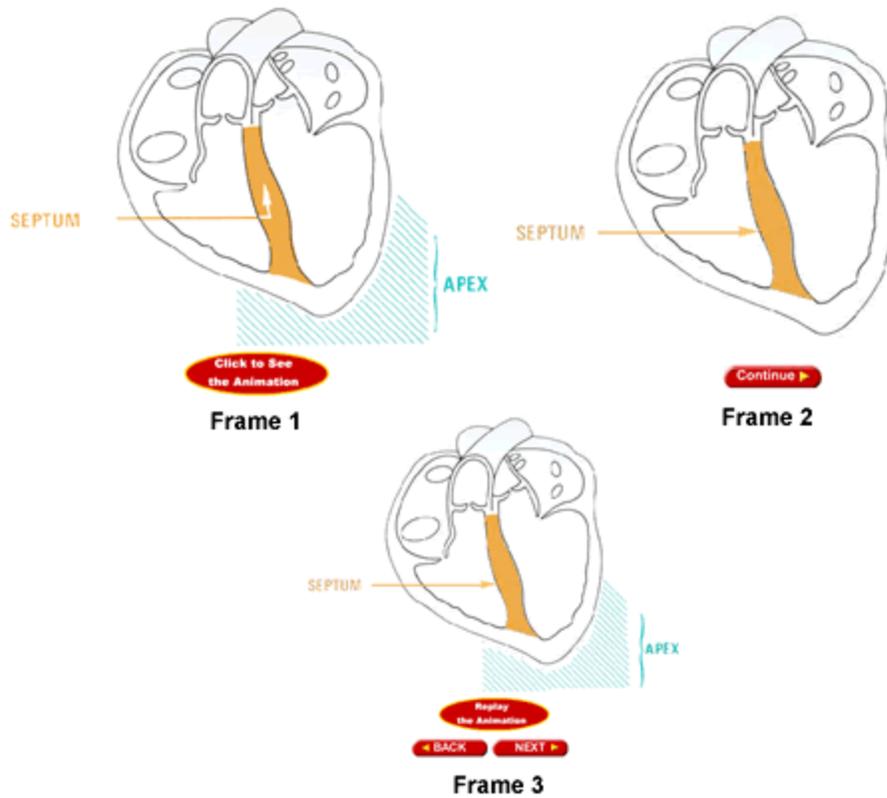


Figure 3. Example screen of animation as attention-gaining strategy treatment

Animation as attention-gaining and elaboration strategy (T3): this treatment is also the same as T1 except that thirteen instructional screens contained embedded attention-gaining and elaboration animations. A pop-up animation that highlighted the most important information in this instructional screen was used in combination with the animated arrows. See example screen in Figure 4.

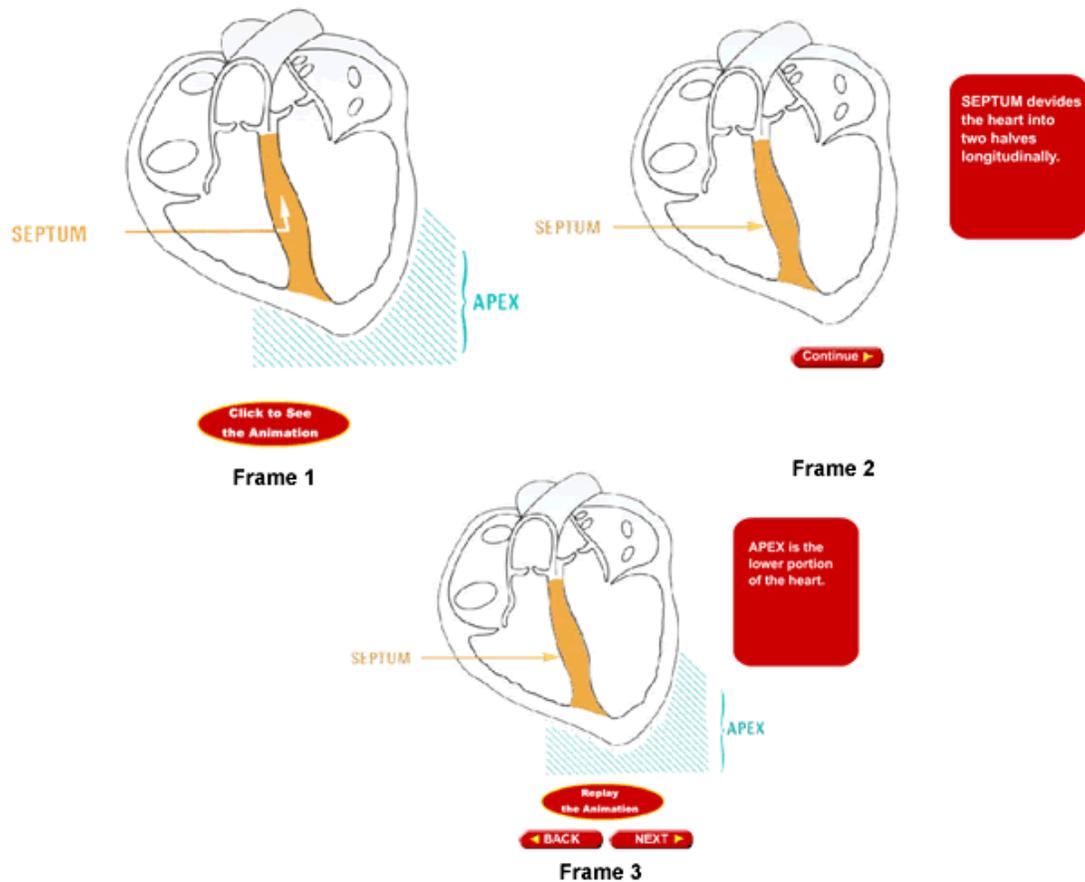


Figure 4. Example screen of animation as attention-gaining and elaboration strategies treatment

Procedures

The two-stage study included an online pretest to classify the participants into high and low prior knowledge and a following lab session. The mean of the human physiology pretest scores (57.55) of the original 115 participants was used as a cut point to distinguish between high or low prior knowledge individuals, who were then systematically assigned to one of the three treatment groups.

There were 111 participants who went to the lab session. The participants were instructed to go to a specified URL for the treatment. Afterwards, the participants took four criterion tests: the drawing test, identification test, terminology test and comprehension test.

Criterion Measures

The criteria measures included a 20-item paper-based drawing test, and three separate 20-item multiple-choice web-based criterion tests: identification test, terminology test and comprehension test.

In all the four criterion tests, the test reliabilities were all above 0.8 (Drawing = .89; Identification = .86; Terminology = .82; Comprehension = .82), which is the satisfactory reliability suggested by Anastasi and Urbina (1997).

Data Analysis

SPSS was used to analyze the data. The study used a 2 X 3 factorial design with two levels of prior knowledge and three animation strategies. A two-way MANOVA was used to test for the main effects and the interaction between the prior knowledge level and the three treatments.

Results

Analysis of the Physiology Pretest

The scores of the human physiology pretest were converted into percentages. They ranged from 33

to 78 with a mean of 57.55. A one-way ANOVA was conducted to determine if there was a difference among the three treatment groups in the means of their prior knowledge. The p-value from the ANOVA ($p > .05$) indicated that the three groups were not significantly different in terms of their prior knowledge.

Descriptive Statistics

Table 1 below shows the means and standard deviation for the four criterion tests and their combined total by treatments and levels of prior knowledge. They showed that the mean scores for the high and low prior knowledge participants in each treatment group were similar.

Table 1 Means and Standard Deviation for Four Tests by Treatment and Levels of Prior Knowledge

| Prior Knowledge Level | N | Drawing | | Identification | | Terminology | | Comprehension | | Total | |
|--|----|---------|------|----------------|------|-------------|------|---------------|------|-------|-------|
| | | Mean | S.D. | Mean | S.D. | Mean | S.D. | Mean | S.D. | Mean | S.D. |
| Static Graphic Group (T1) | | | | | | | | | | | |
| Low | 19 | 14.63 | 4.90 | 15.16 | 3.95 | 11.68 | 4.61 | 10.84 | 3.89 | 52.31 | 17.35 |
| High | 19 | 13.47 | 5.56 | 16.16 | 3.25 | 13.00 | 4.06 | 12.05 | 4.65 | 54.68 | 17.52 |
| | 38 | 14.05 | 5.23 | 15.66 | 3.60 | 12.34 | 4.34 | 11.45 | 4.27 | 53.50 | 17.44 |
| Animation as Attention-gaining Strategy (T2) | | | | | | | | | | | |
| Low | 16 | 11.69 | 6.19 | 15.44 | 5.10 | 9.50 | 5.16 | 9.25 | 5.45 | 45.88 | 21.90 |
| High | 19 | 12.95 | 4.37 | 13.89 | 5.05 | 11.63 | 4.65 | 10.68 | 4.35 | 49.15 | 18.42 |
| | 35 | 12.32 | 5.28 | 14.67 | 5.08 | 10.57 | 4.91 | 9.97 | 4.90 | 47.52 | 20.16 |
| Animation as Attention-gaining and Elaboration Strategy (T3) | | | | | | | | | | | |
| Low | 19 | 14.26 | 4.95 | 13.84 | 4.61 | 12.53 | 4.70 | 11.89 | 4.33 | 52.52 | 18.59 |
| High | 19 | 14.74 | 4.86 | 14.32 | 4.22 | 11.74 | 4.40 | 11.79 | 4.72 | 52.59 | 18.20 |
| | 38 | 14.50 | 4.91 | 14.08 | 4.42 | 12.14 | 4.55 | 11.84 | 4.53 | 52.56 | 18.40 |

Note: Drawing, Identification, Terminology and Comprehension scores could range from a low of 0 to a high of 20.

The results of an ANOVA for the sum means showed that the differences in variance were not significant among T1, T2 and T3, $F(2,108) = .957$, $p = .387$.

Table 2 below shows the means and standard deviation for the four criterion tests scores for the 23 questions identified in the pilot study that the students have difficulties with. Maximum possible score is equal to the number of items on each test.

Table 2 Means and Standard Deviation for the Four Criterion Tests Scores (23 items) by Treatment

| Four Criterion Tests | Number of Items | Static Graphic | | Animation as attention-gaining | | Animation as attention-gaining and elaboration | |
|----------------------|-----------------|----------------|------|--------------------------------|------|--|------|
| | | Mean | S.D. | Mean | S.D. | Mean | S.D. |
| Drawing | 4 | 2.66 | 1.38 | 2.31 | 1.37 | 2.68 | 1.45 |
| Identification | 3 | 1.92 | 1.15 | 1.83 | 1.04 | 1.66 | 1.12 |
| Terminology | 9 | 4.89 | 2.48 | 3.83 | 2.54 | 4.45 | 2.24 |
| Comprehension | 7 | 2.76 | 2.03 | 2.89 | 1.80 | 3.24 | 1.70 |
| Sum | 23 | 12.23 | | 10.86 | | 12.03 | |

Analysis of Null Hypothesis

A two-way MANOVA was run to test the research question. Two prerequisites, equality of variances and the correlations between the dependent variables, were checked before the MANOVA was used. In all cases, except the identification tests, the Pearson correlation coefficient is .6 or higher at the 0.01 level. A two-way ANOVA was conducted for the identification test to check if there were any

differences.

Table 3 below showed the overall MANOVA Results using Pillai's Trace F.

Table 3 *Summary of Two-Way MANOVA Results of Four Achievement Measures (80-items) by Treatment Group and Prior Knowledge Levels (Low, or High)*

| Source | Pillai's Value | F | df1 | df2 | P |
|-----------------|----------------|-------|-----|-----|------|
| Treatment | .074 | .990 | 8 | 206 | .445 |
| Prior Knowledge | .017 | .452 | 4 | 102 | .771 |
| Interaction | .079 | 1.053 | 8 | 206 | .398 |

The results of Pillai's Trace in a two-way MANOVA analysis showed that:

There were no significant differences among the three animation strategies on any of the criterion tests, $F(8,206)=.990$, $p=.445$. Therefore, the null hypothesis 1 was retained

There were no significant differences between students with high and low prior knowledge on any of the criterion tests, $F(4,102)=.452$, $p=.771$. Therefore, as predicted, the null hypothesis 2 was retained.

There was no significant interaction between the two levels of prior knowledge and three types of treatments, $F(8,206)=1.053$, $p=.398$. Therefore, the null hypothesis 3 was retained.

Further analysis (See Table 4) was conducted for the 23 questions identified in the pilot study that the students were having difficulties with.

Table 4 *Summary of Two-Way MANOVA Results of Four Achievement Measures (23-items) by Treatment Group and Prior Knowledge Levels (Low, or High)*

| Source | Pillai's Value | F | Df1 | Df2 | P |
|-----------------|----------------|------|-----|-----|------|
| Treatment | .071 | .945 | 8 | 206 | .480 |
| Prior Knowledge | .007 | .184 | 4 | 102 | .946 |
| Interaction | .045 | .591 | 8 | 206 | .785 |

Again, based on the above results, all the hypotheses were retained.

Conclusions and Discussion

Given that prior knowledge has been considered the most important single factor that influences learning (Ausubel 1968), the findings that low prior knowledge students perform equally well as those high prior knowledge students become important. Given that creating animation is also time-consuming and costly, these findings add to the growing literature supporting the power of static graphics.

Static Graphic vs. Animation Strategies

This study attempted to examine different animation strategies from the previous research. Insignificant differences were found between the groups using animation strategies and the control group using static graphics. The results showed that the static graphics group performed equally as well as the animation strategies group. This overall finding continues the debate about the value of animation versus just providing visualization. Visualization, included in all treatments seemed to be a powerful factor in learning this material. The results were in accordance with many previous literature and animation-related studies. Mayer (1997) justified the effect of using coordinated presentation of explanation in visual format (illustrations). Wilson (1998) found a general tendency of the mean score for the static treatment produce somewhat better results than any of the dynamic treatments. Owens (2002) found a trend that the students' performance decreased as animation strategies were added to the instructional screens.

Theoretically, the results of the study strengthened the results and conclusions of some of the previous animation-related studies. Practically, the results also raised a very important question to the practice of instructional designer, it is it really worth it to design and develop instructions utilizing animation strategies versus simply using static graphics if static graphics have been shown to be at least as effective as animation? As we all know, static graphics are more cost-effective and cost-efficient than animations. In future design, maybe it is better to utilize static graphics as much as possible and use animations only when the use of animation is justified (Rieber, 1990).

High vs. Low Prior Knowledge

The result of the interaction between level of prior knowledge and strategy use also provides an important contribution to the debate about the effectiveness of animation. What this study showed was that students with lower prior knowledge performed equally well to those with high prior knowledge in all three treatments. This result was contrary to much previous research that showed high prior knowledge students performing better than low prior knowledge students regardless of treatment. We believe this can be explained by dual coding theory. Students with low prior knowledge are helped more when verbal and visual information are presented simultaneously since it helps them build referential connections (Mayer & Anderson, 1992). In this study, by rearranging the layout of the instructional text and static visuals, the static graphics or the animations were put side by side instead of static graphics on the top and instructional text at the bottom. Based on the previous literature, the researchers believed that this layout would encourage the learners to read the instructional text as well as build connections with the static graphic or animations. There was a significant difference between the high and low prior knowledge participants in the pretest, but the differences were obviously reduced to insignificant differences in the four achievement tests after they went through the treatments.

Prior Knowledge and Treatments

The results also showed that there was an insignificant interaction between levels of prior knowledge and the instructional treatments, different from the predictions of the researchers. It was expected that the animation as an attention-gaining and elaboration strategy group would perform better than animation only as an attention-gaining strategy, which would be better than the static graphic group (control group). It was also predicted that the high prior knowledge participants would perform better than lower prior knowledge participants in each treatment.

One possible explanation is that the animations as an attention-gaining strategy were attracting the students' attention to the animation itself instead of to the instructional content. The repeated single movement of the animated arrows may have bored the students. Or the students just simply were not motivated enough to participate the study since their performance would not affect their course grade.

In addition to the above reasons, another important reason may be that for college students, static graphics are effective enough to facilitate referential connection between the verbal and visual information, making animation unnecessary.

To sum, the findings indicated that static graphics were as effective as animation. These results imply that it will be more beneficial to use correspondent static graphics more in our instructions.

Limitations

The results of the study are limited to the population of undergraduate students with similar characteristics (e.g. prior knowledge, field-dependence/field-independence, etc). Further, the study used systematic randomization to assign students to different treatment groups according to their pretest scores instead of strictly stratified randomization. Therefore, these generalizations should be interpreted cautiously.

Further Research Suggestions

Future studies may rerun this research with more generalized population and use strictly stratified randomization. Secondly, the effects of other animation strategies, such as animations as practice and feedback strategies, need to be explored. Lastly, future studies may assess the effectiveness of animation strategies on facilitating high order thinking, such as problem-solving.

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Qualitative Evaluation On Facilitator's Contributions To Online Professional Development

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The Florida Online Reading Professional Development (FOR-PD) program is funded by the Florida Department of Education (DOE) and is housed at the University of Central Florida (UCF). FOR-PD is an online staff development project designed to help teachers improve reading instruction for learners in grades preK-12. Developed collaboratively with literacy and technology experts, school districts, professional organizations, and teacher educators across the state of Florida, the project functions as a primary statewide delivery mechanism for improving teaching methods in reading instruction to preK-12 teachers.

As indicated in the Request for Proposal (RFP) from the Florida Department of Education (FL DOE), for example, “feedback and leader-peer response” and “monitoring of assignments” were considered essential. In response to the RFP, the UCF proposal for FOR-PD highlighted the role of facilitators, asserting in the grant proposal text, “Feedback by facilitators is critical to the performance of participants.” In addition, the discussion boards were also depicted as critical factors for successful delivery of online learning by both documents.

Prior research has emphasized facilitator's roles in online education or training courses, “facilitating online dialogue, community, and ultimately, education” (Collison, Elbaum, Haavind, & Tinker, 2000). Meanwhile, Lieblein (2000) explored the role of threaded discussion board as a critical factor for successful delivery of online programs based on nearly 10 years of academic and administrative experience with online programs. On the other hand, qualitative analysis could complement and be used in conjunction with the quantitative methods by explaining reasons for observed differences (Gunawardena, Lowe, & Carabajal, 2000).

Recruiting Facilitators

We relied on three core criteria for selecting facilitators for FOR-PD. First, the facilitator needed to have strong content knowledge in reading. Second, we sought online facilitators who had experience as literacy leaders and literacy experts. Third, we looked for facilitators who expressed desire to learn along with us about helping preK-12 teachers develop their reading knowledge and expertise. Given the novelty of this large-scale high profile state online project, prior experience with the Internet was not mandatory. However, we knew that some facilitators were reasonably comfortable in online learning since they had been involved in it before as students or facilitators.

FOR-PD Facilitators

FOR-PD facilitators play a vital role in developing and maintaining an online professional development program that is effective, efficient, and supports the realization of the FOR-PD project objectives. The primary purpose of a FOR-PD facilitator is to interact with FOR-PD course participants. This translates to encouraging and replying to email messages and discussion postings, providing feedback on assignments, and being the “point person” for answering their questions. They must also be responsive to individual district requests and needs.

A facilitator in the online environment must possess a unique set of skills to perform effectively. Some of the basic criteria for a person to be successful as an online facilitator include the following. Facilitators must be able to create a supportive environment where all students feel comfortable participating and especially where students know that their facilitator is accessible. Facilitators should give students timely

quality feedback on student contributions to discussions, assignments, and quizzes. Facilitators should keep students advised of their progress respect to the course evaluation process on a regular basis. Facilitators should feel comfortable communicating in writing. The face-to-face contact traditionally available in a classroom setting is not available in the online learning process. The ability to verbally communicate is replaced with a keyboard. Facilitators must be comfortable communicating in writing because that is the fundamental process of online learning. The facilitator is the primary person participants interact with who provides the human factor. Facilitators should be experienced and well trained in online learning. This includes: sending and receiving email; using discussion boards; using chat tools; using a web browser- Netscape or Internet Explorer.

Facilitator Training and Certification Course

To become a certified FOR-PD facilitator, interested educators must complete an online application and possess the following qualifications: 1) successful completion (80% mastery or above) of the FOR-PD course; 2) a minimum of three years teaching experience; 3) master's degree in reading or other related areas; 4) advanced knowledge of research-based reading strategies; 5) ability to provide explicit instruction in the following elements of reading as they apply to appropriate grades: phonemic awareness, phonics, fluency, vocabulary, and comprehension; 6) ability to systematically use effective reading strategies that have been tested and have a record of success; and 7) identified by school or district as a reading/literacy leader. In addition to these requirements, successful completion of the FOR-PD Facilitator Training and Certification Course is also required. The FOR-PD Facilitator Training and Certification Course is a 25-hour online professional development course intended to ensure that our facilitators have the knowledge and skills they need to become successful online class facilitators for the Florida Online Reading Professional Development Course. The course consists of the five lessons that encompass an introduction to FOR-PD, details about the project and goals of FOR-PD, information on online learning, and support options to facilitators

Following completion of the FOR-PD Facilitator Training and Certification Course, facilitators are expected to demonstrate mastery of the following skills: 1) describe the FOR-PD course and the goals of the course; 2) identify advantages of online learning; 3) identify potential disadvantages of online learning and describe at least one way each disadvantage can be addressed; 4) identify the role of the online class facilitator; 5) describe techniques for facilitating an online course; and 6) identify and use online tools such as chat, discussion boards, email, and grade books.

There is no charge to take the FOR-PD Facilitator Training and Certification Course. An electronic certificate (pdf) is emailed to participants upon successful completion, their district staff development office is notified, and they are then added to the pool of certified FOR-PD facilitators. Completion of the FOR-PD Facilitator Training and Certification course and certification as a FOR-PD facilitator does not guarantee employment as a facilitator. For the most part, facilitators are selected to facilitate by school districts from the pool of qualified facilitators. Many school districts have a "favorite" facilitator or two that they assign to facilitate again and again. These are generally reading specialists, reading coaches, or literacy leaders in the district with particular knowledge of the unique qualities of the district, its reading programs, teachers, and student population.

Facilitator Support

Facilitators receive assistance from the FOR-PD office to support them in their roles as online mentors for participants. Support in place includes a facilitator manual, performance support tools, electronic newsletters, facilitator forums, monthly chats, and supervision.

Facilitator Manual

One of the most important documents available to facilitators, the Facilitator Manual, outlines specific tasks facilitators must complete before their section of the FOR-PD course begins. Such tasks include getting access to the course, getting participants' names, posting the first discussion, and sending a welcome message to participants. The facilitator manual also offers a detailed description of facilitator tasks to be completed throughout the course including reminders to monitor participants' progress, grading assignments, offering feedback, handling course "no shows," and those who fall behind. The Facilitator Manual offers detailed explanations for after-course tasks such as sending a wrap-up message, thanking participants for their participation, and instructions for notifying school district and FOR-PD offices that the

course has ended. The manual also describes the various support mechanisms available to facilitators and outlines the responsibilities of key stakeholders including participants, school districts, and the FOR-PD office. Conditions of employment are carefully explained and tutorials for WebCT chat, discussion boards, email tools, and grade book tools are provided. The manual's appendix offers sample messages for a variety of purposes including welcoming participants to the course, helping those with login trouble, notice to those lagging behind, and a sample message to thank participants for their participation.

Performance Support Tools

FOR-PD course facilitators have access to a variety of performance support tools to help them in their role as course facilitator. Specifically requested by course facilitators, printable rubrics streamline assignment grading for busy facilitators who prefer to use a paper-based method of grading course assignments. The Excel grade book template offers a convenient method of grading for facilitators more comfortable with storing grades electronically. Developed at the request of course facilitators, model postings provide examples for facilitators to share with participants as needed and in a way controlled by the facilitators. The model postings also help facilitators calibrate their own grading standards. Some facilitators have requested a course completion certificate for participants in their sections. This optional component is available to facilitators as needed through the Facilitator Forum. The end-of-course checklist serves as a convenient reminder to facilitators about the specific tasks that must be carried out to assure proper in-service credit for participants and prompt payment to course facilitators.

Electronic Newsletter for Facilitators

Entitled *Facilitation With Felicity* (FFF*), the facilitator newsletter helps keep course facilitators informed of the latest literacy news and events from around the state and from the FOR-PD project. The FFF* highlights one literacy strategy each month and offers a variety of tips and tricks to keep facilitators' skills polished. One section focuses on "fine facilitation" to highlight and promote desirable facilitator actions. The "Dear Felicity" column answers facilitators' questions about handling problems, dealing with challenging participants, and keeping participants involved in the course. The FFF* also announces awards, contests, and conferences of interest to facilitators and highlights a wide variety of literacy and professional resources likely to be useful to FOR-PD's facilitators.

Facilitator Forum

Housed on the FOR-PD course server, the Facilitator Forum is a series of discussion boards offering 24/7 access for facilitators to interact with each other to share information and ideas about the FOR-PD course, to ask for help from others, and to share successes. Links to FOR-PD course content, the FFF*, the Facilitator Manual, and optional course completion certificate offer convenient access for facilitators. Specific discussion areas include a place to meet fellow facilitators, to ask for and offer help, hints, and advice, to make suggestions for an upcoming FFF*, and to share success stories. The Facilitator Coffeehouse discussion board enables facilitators to interact with each other on matters unrelated to the FOR-PD course, but likely to be of general interest. Finally, there is a discussion area specifically for facilitators to discuss issues related to each of the 14 FOR-PD lessons.

Monthly Chats

Monthly facilitator chats serve to keep facilitators in touch with each other and the FOR-PD office. Chats feature discussions with subject matter experts and cover a range of literacy-related topics. Facilitators often discuss the mechanics of facilitating a course, recent changes to the course or participate in an open forum facilitated by FOR-PD staff to answer questions.

Personnel

All FOR-PD staff members assist facilitators in answering questions or solving problems. The FOR-PD Help Desk is available for technical support to facilitators and participants alike. One full-time staff member is dedicated to assisting facilitators perform their duties. The Facilitator Support Specialist monitors discussions on the Facilitator Forum, providing answers as necessary and identifying issues raised in the Facilitator Forum that need to be addressed more broadly by other FOR-PD staff members and sharing suggestions to improve the project. Additional responsibilities include answering email from facilitators, writing the FFF* and coordinating monthly chat sessions, as well as answering Help Desk calls.

The Facilitator Support Specialist responds to emails received from the forpdfac email account for day-to-day, routine implementation questions, and is also available to support facilitators through the duration of their facilitation experience, including sending reminders and instructions to facilitators as course sections begin and end. After the course has finished, Facilitator Support Specialist sends follow-up information and reminders and processes payroll paperwork.

Facilitator Supervision

In addition to the required training and certification, facilitators are closely monitored throughout their facilitation of the FOR-PD course. Each section of the course is monitored at three points: 1) the beginning of the course (Lesson 1); 2) the midpoint (Lesson 5-8); and 3) at the end (Lesson 14). The monitoring helps to ensure that facilitators are creating a supportive environment where all students feel comfortable participating and especially where students know that their facilitator is accessible; giving students timely quality feedback on student contributions to discussions, assignments, and quizzes; and keeping students advised of their progress in the course on a regular basis.

The FOR-PD project has been exceptionally well received by school districts, universities, administrators, and teachers throughout the state. We believe that our facilitators and the training, certification, and support that we provide to them has been critical to the success of the FOR-PD project. Currently, FOR-PD has 200 certified facilitators located throughout the state. Of these 200, 111 reported having taken an online course previously, however only 23 had ever taught or facilitated an online course before coming to FOR-PD. 390 sections of the FOR-PD course have been offered since January 21, 2003 and 139 facilitators have facilitated a section within the last year.

FOR-PD Evaluation

The outside interim report of the first year of the FOR-PD project and course, drawn from various sources including narrative reports from facilitators, surveys of participants at the end of the course, and follow-up telephone interviews with administrators, reported the following. Over 87% of FOR-PD participants indicated they would make changes and/or additions to classroom reading instruction as a result of FOR-PD. Over 90% (93%) of participants indicated that the value of reading strategies introduced in FOR-PD was excellent or good. Approximately 97% of participants indicated FOR-PD was excellent or good in covering the state and national reading initiatives, with nearly three-fourths of participants (73%) indicating FOR-PD covered the reading initiatives to an excellent degree. Over 90% of participants indicated that FOR-PD has contributed to their knowledge of effective reading theory, research, and instructional practice to an excellent or good extent. The extent FOR-PD contributed to understanding student needs and instructional adaptations for struggling readers to an excellent or good extent was 89% with over one-half indicating excellent (52%). Over 90% of participants rated the support from their facilitator as excellent (74%) or good (17%).

For the purpose of the qualitative evaluation of FOR-PD in phase II of the project, internal and external documents were reviewed.¹ Hundreds of pages of qualitative data were collected and analyzed from the discussion boards of facilitators, with a focus on what contributions FOR-PD facilitators have made to the program, how they have experienced the program, and particularly, how they like the changes and revision of the FOR-PD course since summer 2003.

FOR-PD Pilot Summary Report

The FOR-PD Course was piloted September 16-27, 2002. The pilot summary report focused on feedback from participants and concluded that “Overall, the feedback from the participant was extremely positive... Teachers indicated that the course provided aspects that they would utilize in their classroom instruction”. This interim report drew from various sources including narrative reports from facilitators, surveys of participants at the end of the course, and follow-up telephone interviews with administrators.

FOR-PD Courses, Participants and Facilitator’s Discussion Board

The first sections of the FOR-PD course were launched on January 21, 2003. A total of 4,570 participants had enrolled and 2,045 had completed FOR-PD prior to beginning phase 2 (September 2003). Of this number, 4,504 participated as employees of Florida school districts and 66 participated through a Florida college or university. The latter participants may include students and college/university faculty. During fall 2003, approximately 2,200 additional students enrolled in FOR-PD.

In February 2003, a Facilitator Forum was established using the WebCT discussion board. The

primary purpose for this discussion board was to provide a support mechanism for facilitators to ask for, and provide advice to other facilitators. A total of 287 individuals were accepted to facilitate in FOR-PD, 70 (25% of those accepted) of which were facilitating at least one section of FOR-PD as of September 2003. The average years of teaching experience for facilitators was nearly 18 years with one-half boasting at least 17 years of experience. Approximately 56% of facilitators had taken an online course, however only 12% had previous experience in facilitating online.

Facilitator Focus Group Report

A facilitator focus group was conducted in May 2003 at UCF. Twenty-seven facilitators attended the focus group meeting. The focus group report provided a broad picture of the FOR-PD system from facilitator’s perspective. The general tone of responses from the focus group was very positive. Facilitators appreciated the current research-based content, the database of materials and resources developed as part of FOR-PD. However, issues and concerns were raised in the focus group, too. For example, some participants had copied from each other and had submitted work that had been directly copied from the Internet. In addition, facilitators listed the WebCT grade book as their No. 1 technology problem. Finally, the report gave eight recommendations for full-time FOR-PD staff to consider and stated that many of those (concerns and issues) had been addressed through the work of the editing team several weeks after the focus group meeting and the current course revision underway (before the beginning of phase 2)”

Methods

The site and major data source for the current qualitative evaluation was the facilitators’ discussion board postings from fall September 2003. There were 161 postings as of December 31, 2003, including topics such as: meeting peer facilitators and introducing their backgrounds, making comments, extending greetings to each other for the new semester 2003 fall, offering help, hints and advice, sharing success stories of FOR-PD participant learning, providing suggestions the FOR-PD facilitator’s electronic newsletters, providing general ideas and suggestions, posting messages related or unrelated to FOR-PD course, and discussing Lesson 1 to Lesson 14. The data used for the evaluation consisted of 120 messages posted by the facilitators out of the total of 161 on the discussion board since the beginning of phase 2. As the major source of data for the present evaluation, facilitator’s discussion board met some requirements of the RFP and a few focuses indicated in the UCF proposal for FOR-PD. Robert Yin's book, *Case study research: design and methods* (2nd ed.) was used for the design for this qualitative evaluation and one of its dominant mode of case study analysis, the combination of ‘pattern-matching’ and ‘time-series analysis’ was applied to analyze and explain facilitators’ perceptions and experiences of FOR-PD. Moreover, with the qualitative software Nvivo Revision [1.3], automatic coding of the data was used in addition to hand coding and various codes were developed (see details in Appendix: Data Analysis).

Findings

From the Facilitators’ discussion board postings, two major categories emerged, messages conveying facilitator’s comments and messages conveying facilitator’s activities. Meanwhile, the frequency of postings on the discussion board varied largely from month to month at different data points: September, October, November and December. As Table 1 shows, out of the total 161 posts including coordinator or instructor’s messages, there are 95 more in the first half of the semester (September and October) than the later half (November and December).

Table 1 *Monthly Posts in Facilitator’s Discussion Board Phase 2*

| Month | Number of Posts |
|-----------|-----------------|
| September | 89 |
| October | 39 |
| November | 20 |
| December | 13 |

Facilitators' Comments

Operationally, 'encouragement' included expressions like 'look forward to new session', 'like the changes since summer', 'learn a lot' from FOR-PD, and etc, while 'criticism' connoted 'frustrating about participants who dropped out', 'unavailable assistance' and etc. In terms of comments (see Table 2), the first half of the semester had a contrastingly larger amount of 'encouragement' from facilitators than the later half of the semester, with a ratio of 57 to three. Likewise, 15 negative messages appeared in the first half while none in the later half. In general, there were a lot more 'encouragement' than 'criticism' during the whole section.

'Encouragement' messages were divided into six categories (Table 3). Specifically, a lot of facilitators expressed cheerfulness, looked forward to new session and liked the changes of layout and content since summer.

Table 2 *Monthly Posts of Comments in Facilitators' Discussion Board Phase 2*

| | Comments | |
|-----------|---------------|-----------|
| | encouragement | criticism |
| September | 50 | 8 |
| October | 7 | 7 |
| November | 2 | 0 |
| December | 1 | 0 |

Table 3 *Facilitators' Comments in the Discussion Board in Phase II*

| Facilitators' Comments | | | | | |
|--|---------------|------|------|------|--|
| | Encouragement | | | | |
| | Sept. | Oct. | Nov. | Dec. | |
| look forward to new session and like the changes, including the scoring rubric | X | X | | X | |
| enjoy being a facilitator, and show pride in completion rate | X | X | | | |
| like FOR-PD course | X | | | | |
| appreciate facilitator discussion boards | X | X | | | |
| Identify with participants' encouragement | X | | | | |
| share influence of for-pd course in both schools and families, something beyond participants' learning | X | X | X | | |
| Total Monthly No. | 50 | 7 | 2 | 1 | |
| | Criticism | | | | |
| | Sept. | Oct. | Nov. | Dec. | |
| frustration over participants' low completion rate | X | | | | |
| complaints/confusion about technical problems, some caused by the changes in the new session | X | X | | | |
| empathy with participants' frustration over assistance from FOR-PD project staff, such as help desk | X | X | | | |
| Total Monthly No. | 8 | 7 | 0 | 0 | |

Following are quotes identified and extracted from the discussion board for 'encouragement' messages from facilitators.

- I am excited to see the final version of the changes. I know the previews were impressive. I am looking forward to the start of the new sections... I look forward to my next chance to facilitate. Until that time I plan on regular visits to the Discussion area to see what exciting things continue to transpire in the wonderful land of FOR-PD."*
- "I look forward to the new format. So far, it looks great and seems so much more user friendly. Of course, I didn't realize that the old course could be improved upon that much!"*
- "The summer course design was SO much easier to manage. I just wish that more teachers would take advantage of this wonderful opportunity."*
- "The changes that were made for the fall are awesome! Thanks for all of the hard work FOR-PD*

staff...you guys are great.”

Other facilitators enjoyed being a facilitator or liked the FOR-PD course itself. Following are examples.

“Catherine, This is not a difficult course to facilitate. I did it for the first time this summer and I loved it.”

“I loved facilitating this summer. This is a terrific course. I've learned a lot”.

“I took the FOR-PD course as a student last fall and was impressed... I found that the FOR-PD course offered that and a window to the ever-changing legislative directives. The more I learn the more I can share with my students, teachers and parents.”

“We had a third grade unit open up last week and I will be moving to the 3rd grade unit on the 18th. I am very excited and plan on using much of what I have learned here in my class”.

“It was a great experience for me to travel to different places around the state. It's shame that we really don't get to interact with more educators in different districts. That's one of the great benefits of this course.”

“The FOR-PD class has been a big part of my life since March. I carried my laptop all summer long as I traveled through the state with my daughter's softball team. I was not given a new section to facilitate and I will miss the interaction, the lesson discussions, and the daily information bank on literacy!”

A few more appreciated the role of the facilitator discussion board.

“Well I'm thankful for the facilitator discussion boards because I think this will be my lifeline. This is my first time facilitating a course & honestly I'm a little nervous.”

“This site will save you when you need really need it!”

“I am looking forward to learning from all the experts who have already facilitated this course and I know I will get a lot of use out of this discussion board.”

A few facilitators identified with participants' satisfaction with the course.

“I look forward to the new look of the course and hope to hear many more wonderful things about this course. I had a participant show how much she enjoyed this course by making it part of her plan (lesson 14). She is going to be working with her administration to try to convince everyone that they need to take this course. That was a big “Wow” to me”.

“I truly enjoy the notes I've received from course participants sharing how they've used strategies from the FOR-PD course in their classrooms. It's exciting to be a part of the process of having EVERY teacher become a reading teacher!”

“We have had a great response from our teachers...”

Moreover, some extremely positive themes that occurred in the discussion board, including the influence of FOR-PD course in schools and families, the impact beyond participants' learning success.

“Our SAC wrote the course into our School Improvement Plan this year, so all of our instructors who teach high school students will be taking the course. Several of our instructors who teach only adult students opted to take it also!”

“What a great idea! I am SAC coordinator at my school, along with all my other jobs...I think that writing the course into the SIP is a great idea. I'll have to look into it.”

“And YES, we are currently applying FOR-PD to Competency #2 in our district Reading Endorsement Plan. I am very happy to be involved in this professional development activity. I believe that we will have a better completion rate this fall than in the past.”

“This was shared by one of my course participants....‘I also want to tell you that when I was doing the ABC brainstorming page for lesson 4 (I think), my 5 year old daughter was watching and asking what I was doing. She asked me to print a page for her, which I did, and she did all by herself. I am enclosing it in my literacy log. I think you'll get a kick out of it.’ Just shows that we never know what effect this course might have on others!! :-)”

Table 3 also shows through the whole course, there were 15 messages that facilitators provided **‘criticism,’** all of which appeared in the first half of semester. Some conveyed facilitator's confusion and frustration over technical problems, including those that might be caused by the change since summer, or facilitator's uneasiness about participant's low completion rate “It's been frustrating because of participants who didn't complete.” Moreover, a few facilitators expressed they could not reach administrative and technical support, such as the Help Desk. Following are a series of criticism at the end of October.

“I just wanted to pass two things along.... 1. Several of my participants have been complaining about the help deskthat they have not been returning phone calls nor have they been able to

reach a person during the hours posted. 2. It seems that there has been many more technical problems than any other section (this is my third section), is there a reason for that? Participants cannot get to the site, they cannot get a quiz or it does not post until several tries, they cannot get to links.”

“This is my fourth section of the course and my participants have had more technical issues this time than before. Initially, I thought it was growing pains with our district network, but we have supposedly solved those problems, yet participants are still complaining about various technical problems. Any insight?”

“I have to agree, this is the third time I have been a facilitator and there have been many technical difficulties... could this be because of the newly designed site?”

“That is actually what I was thinking, because they resigned the site right after the end of the last section before that my participants did not have any of these problems ... that is a good point!”

Facilitator’s Activities and Contributions

One great use of the discussion forum was to ask for help, report to the FOR-PD program coordinator about problems and errors, and respond or give suggestions to questions raised by other peer facilitators (see Table 4). Facilitators’ posts of activities, similar to their comments, were posted more frequently in the first half of the semester than in the later half, with a ratio of 43:18.

Table 4 Facilitator’s Activities in the Discussion Board in Phase 2

| Facilitator’s Activities | Sept. | Oct. | Nov. | Dec. |
|--|-------|------|------|------|
| ask for information; seeking help including how they could solve problems for participants’ | X | X | X | X |
| report to FOR-PD UCF program coordinator and discuss with peer facilitators about technical, administrative and content problems and errors in different aspects, including access to quizzes and participants’ course pacing. | X | X | X | X |
| respond/give suggestions to questions from peer facilitators | X | X | X | X |
| Total Monthly No. | 27 | 16 | 11 | 7 |

Examples of comments from facilitators asking for information or seeking help, including how they could solve problems for participants, follows.

“Could you please send me more brochures? I want to share them with the faculty again. Some people have shown an interest in taking the course. Is it possible for someone to sign up now for the fall course?”

“I know this information is in my manual, but I’m at school. I need a refresher on how to close a session.”

“How do you manually go back in and change the score? I need to fix a few of my participants’ scores.”

“Since this is my first time facilitating the course, I’m not sure where I should post general feedback to the discussion. Do I create a new message in lesson 1 or somewhere else? Most of my participants have completed lesson 1. I would like to post a generalization about the discussion & test. If I have any specific comments to participants I will send it directly to the participants. Thanks for your help with this.”

“I have several participants who are getting the following message when they go to take quizzes...I have emailed them about the pop-ups...is there any other reason it may be this way??

Here is the question I received: Susan, this past weekend I was on a different computer. However today is Monday and I am back on the computer that I have been using. I still cannot take a quiz. In fact, all of the quizzes are marked unavailable.

I’d like to ease these participants’ troubles.”

An example of a response to a question raised by a peer facilitator (for example, a response to the last question in the above paragraph) was phrased, “sounds crazy, but has she taken the survey? I had a few contact me about not being able to take lesson 2 quiz, but they hadn’t taken the survey. As soon as they did, all was okay.”

Following is a series of posts concerning accessing quizzes which provides an example of reporting correspondence with FOR-PD UCF program coordinator and discussion with peer facilitators

about problems and errors.

“I have a participant that can not access quiz 3. I have called the help desk, she has called the help desk, I have tried her in every way that I can. She has submitted lesson 2's quizzes and they have been graded. She still cannot access the quizzes. Now she is considering dropping from FOR-PD. What can I do? We can't figure out why she can't access the quizzes. The Help Desk sees no reason why she couldn't access the quizzes. I am at a loss!!!!”

“Has she done all the quizzes prior to Lesson 3 and the pre-course survey and have grades been posted for all? I do know that it will not let you skip a quiz. Has she tried to use another computer, some of my participants are having difficulties with their school computers”.

“I had a participant who couldn't do the quizzes because the pop-ups were turned off on her computer. That's yet another thing to check....”

Evaluation Summary

The investigation of facilitator's discussion board revealed that the overall pattern of facilitators' use of the forum matched the expectations and requirements as indicated in the Request for Proposal (RFP) of Florida Department of Education and the UCF proposal for FOR-PD system. Facilitators' activities and contributions ranged from giving technical support, monitoring of content including assignments, rubrics and course pacing, to facilitating interaction between FOR-PD Help Desk and participants. Moreover, facilitators generally provided encouragement for the revised FOR-PD course (phase II), including its new layout such as the facilitators' forum and its new content such as the rubrics. However, some facilitators still had certain confusion and frustration over the change of the course, particularly about the access to quizzes and other technical problems, and about the availability of Help Desk in terms of administrative support during the first half of the semester (September and October 2003).

Compared with the facilitator focus group report done May 2003, which provided a broad picture of FOR-PD system from facilitators' perspective as the preliminary data for this evaluation, the discussion boards revealed to the current researchers how facilitators played their roles and helped participants enhance learning in a much greater depth. In addition, the 'time-series' analysis of the discussion board has shown that FOR-PD was getting better over time although confusion and problems still existed in phase II. To be specific, good themes had been maintained, as seen in both the focus group data in phase I and the data from the discussion board in phase II. For example, the general tone of responses from both data sources indicated that facilitators appreciated the current research-based content, and the database of materials and resources developed as part of FOR-PD. In addition, facilitators did not mention the WebCT grade book as their technology program any more in phase II. Neither did the facilitators suggest that interaction among participants were inhibited in this section as in the focus group report. To sum up with one post in the facilitator's discussion board, “I am surprised there is so little activity on the discussion board this section. I guess so many of us are 'old-timers' that most of the questions have been answered.”

Moreover, a trend was also found at different points of phase II, that is, more activities and comments of facilitators appeared on the discussion board in the first half of phase II than the later half in November and December, which implied that facilitators had helped participants solve their learning problems in a timely fashion.

Recommendations

The findings from the facilitator's discussion board and the comparison made with the previous facilitator focus group also showed several ongoing problems in FOR-PD program. Following are a few recommendations to address them and a couple of suggestions for the final qualitative evaluation of FOR-PD program planned for May 2004.

The Help Desk currently has a goal of addressing and resolving technical problems within a 24-hour period. Careful attention to continuing quick response should be monitored to ensure efficient and effective support in response to problems encountered by FOR-PD facilitators and participants.²

Facilitators should not only be updated and familiarized before changes are made in the FOR-PD system to ensure they are comfortable with and understand how the changes will impact the course and can thereby be more effective in assisting participants, but they should also be reminded about the changes— for example, the changes of access to quizzes caused some confusion with facilitators.³

While FOR-PD has been overall effective in using the online system, various technical problems have been frustrating to some participants and facilitators, which may or may not have been problems

within FOR-PD itself. It is suggested that attention to improving the technical aspects of FOR-PD and researching and implementing ways to make the technology more user-friendly should be continued.

To understand the factors that have an impact on FOR-PD better, additional qualitative analyses should be conducted including telephone/on-line interviews and/or focus groups with five key audiences: school districts, participants, facilitators, Florida Department of Education staff, and FOR-PD content contributors or course designers/instructors.

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Appendix: Data Analysis

Robert Yin's book, *Case study research: design and methods* (2nd ed.) was used for the design for this qualitative evaluation and one of its dominant mode of case study analysis, the combination of 'pattern-matching' and 'time-series analysis' was applied to analyze and explain facilitators' perceptions and experiences of FOR-PD phase II. Pattern matching "compare an empirically based pattern with a predicted one (or with several alternative predictions) for dependent variables" (Yin, 1994). In this case, the outcome of the use of facilitators' discussion board was matched with the requirements of the RFP of Florida DOE and the focuses of the UCF proposal for FOR-PD program. On the other hand, time-series analysis or "the match between a trend of data points compared with a theoretically significant trend specified before the onset of the investigation" (Yin, 1994) was applied, too. In this paper, data points were set in each month: September, October, November and December; time-series analysis also included a comparison of the outcome of the investigation into the facilitator's discussion board with the facilitator's focus group report done May 2003.

Moreover, with the qualitative software Nvivo Revision [1.3], automatic coding of the data was used in addition to hand coding. Firstly, all 161 messages were copied and imported to the Nvivo system, forming six major documents representing different genre of the data: Facfocus (the facilitator focus group report), Facilitator E-community, Problems, Suggestions and Comments, Success Stories, and Miscellaneous. Next, dozens of codes were developed following the basic guideline of the role, time, and content of the message, forming three dimensions in the coding process. By reviewing the data and the codes, or namely, 'nodes' as termed in the Nvivo system, the codes indicating the role of facilitators and those explaining the content of the message were combined into two big categories: facilitators' 'comments' and 'activities'. Later, using cross-search of the Nvivo system, some within the two dimensions of 'time' and 'comments', and others within the two dimensions of 'time' and 'activities',

several 'trees' of the 'nodes' as termed in the Nvivo were formed. Finally those 'trees' of codes became the main themes of the data and were quoted as the findings of the paper under the two big categories: 'facilitator's comments' and 'facilitator's activities and contributions'.

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