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Identification of Influential Factors that Affect Students' Behaviors in Traditional Classes Versus Technology-Mediated Learning (TML) Classes

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ABSTRACT

Learning environments are rapidly changing from the traditional setting to include the use of multimedia technology in the classroom. In the past, researchers studied how the use of technology as a learning tool affects students' learning and performance. There are, however, few studies that report students' learning behavior in technology based learning environments. The purpose of this study is to find out whether or not there are any unique behaviors exhibited by students that are related to a different learning environment. In this study, two researchers observed two undergraduate elementary statistics classes (traditional class versus Technology-Mediated Learning (TML) class), and documented student behavioral differences between them. The data included quantitative and qualitative observations based on specific behavior categories. The results of the analysis lead to identification of six influential factors that affect students' learning behaviors in different learning environments. Implications of results for both educators and administrators are discussed.

Keywords

Technology-mediated learning, observation, student behavior

INTRODUCTION

While Technology-Mediated Learning (TML) has been studied by psychology or educational researchers, Information Systems (IS) researchers have also been investigating TML in terms of educational and learning effectiveness. Due to the job market's evolving business environment, the influx of students to business school has also increased the number of students learning using TML as opposed to learning in a traditional classroom (Gemeinhardt, 2002). In a TML study, researchers have sought to answer "How does technology enhance learning?" (Alavi and Leinder, 2001, p. 5) Typically, TML is defined as "a learning experience that is significantly moderated through the use of information and communication technology" (Alavi and Gallupe, 2003, p. 140). Under this definition, most TML studies by IS researchers compared the learning outcomes of the traditional classroom and TML classroom by employing IT instructional methodology (Alavi and Leinder, 2001). TML researchers have investigated whether the use of technology made any significant difference in student learning outcomes when compared with traditional teaching methods (Alavi, 1994; Leidner and Fuller, 1997; Leidner and Jarvenpaa, 1993). Unfortunately, the results have not been consistent. Some researchers proposed that the learning environment did not have any effect on students' learning abilities; additionally, some researchers stated that the TML methodology fails to elicit more effective learning results than individually different technology, student's characteristics, and instruction methodology (Hsiao et al., 2006). For example, Mintu-Wimsatt (2001) compared student course evaluations between students in a traditional, face-to-face classroom and those in a TML classroom. The results indicated that students in the TML classroom gave lower class ratings than did the students in the traditional classroom. One recent study also concluded that there were no differences in terms of learning effectiveness and student satisfaction between computer-mediated instruction (CMI) and lecture-mediated instruction (LMI) (Jamero, Borghol, and Mihm, 2009). However, other researchers believe that the use of technology can improve students' learning abilities (Bull et al., 1998). Several previous TML studies have focused on the input-output designs rather than employing the theoretical background (Gupta and Bostrom, 2009); therefore, those studies suffered from a lack of appropriate, comprehensive theoretical guidelines for further study. Recently, Gupta and Bostrom (2009) suggested a theoretical model by adopting the Adaptive Structuration Theory (AST), which "has a global perspective that encompasses the important elements of the learning phenomenon and can use theories from educational psychology" (Gupta and Bostrom, 2009, p. 707). Hsiao et al. (2008) tested Alavi and Leinder's model by employing a case study; they concluded that learning context and psychological foundation was the key to TML's effectiveness, as well as technological features and instructional method (Hsiao et al., 2008). Regarding the performance perspective in a TML study, most

measures of learning performance involved only the students' self-reported learning outcomes or final grades; therefore, the significance of these learning behaviors on the final learning outcome has been questioned. The TML studies indicated that the outcomes of learning effectiveness were highly dependent on students' individual characteristics (Alavi and Leinder, 2001); therefore, direct observation of classes is an excellent methodology to use when attempting to understand student behaviors and characteristics in various classroom environments (Mehan et al., 1982; Turanli and Yildirim, 1999).

Using this premise, this research study used the observation methodology (Rose et al., 2005) to increase understanding of students' behavior (Mehan et al., 1982). The objectives of this study are to 1) employ observers to compare student behavior in two different Introduction to Statistics classes (traditional vs. TML classes), 2) identify student behavioral differences in the two classes, and 3) classify these observations into factors that show how students retain knowledge as well as those factors that foster interaction between the instructor and students. The following sections describe the research design, results of the class observations, and, the findings of the study. The final section concludes the paper and provides implications for educators.

RESEARCH DESIGN

Contents Covered In Classes

The research study was performed in an Introduction to Statistics for Business and Economics class. The class contents covered in both the traditional and TML classes were identical and used the same textbook. The topics covered included: 1) how to gather, summarize, or describe data; 2) how to make statistical inferences about a population based on sample information; and 3) what kinds of statistical analyses are appropriate and necessary to answer particular questions.

Observation Environments

The observation environments of the current study are presented in Table 1 below. Traditional class refers to a classroom where an instructor teaches contents. As a supplemental tool, an instructor console (i.e., an instructor computer and document projector) is provided in the classroom. In the TML class, the instructor teaches contents using MS Excel spreadsheets in a computer lab while simultaneously giving verbal explanations. Each student has access to a computer where he/she is capable of emulating what the instructor does using his/her own computer.

	Traditional Class	Technology-Mediated Learning Class
Instructional Methods	Listening to a lecture and taking notes	Listening to a lecture and working with MS Excel
Classroom Environment	Traditional classroom (with an instructor console)	Computer lab (with an instructor console and student computers)

Table 1. Experimental research design

Observation Subject

Two sections of an introductory statistics classes for undergraduate students were taught at a large southeastern university. The traditional class had an enrollment of 47 students whereas the TML class had 23 students.Due to the limited capacity of a computer lab, fewer students were enrolled in the TML class than in the traditional class. Students were not allowed to cross over to the other class during the semester. Lectures were given to both classes every Tuesday and Thursday and lasted 75 minute each during the semester.

Observation Instrument and Process

The researchers designed an observation instrument based on past research and consultation with other educational experts (available from authors). Observational data were split into two categories: quantitative observations and qualitative observations. The quantitative observations consisted of class-related behaviors, class-unrelated behaviors, and overall attentiveness. As every class began, observers initially checked student attendance. Then, during class hours, observers counted the frequencies of both class-related and class-unrelated students' behaviors. Observers also checked student attentiveness using a 5-point scale ranging from poor (1) to excellent (5) at three points during the class period. For qualitative observation data, observers noted any noticeable student behaviors or activity in the classroom. Observers were allowed to stand up and watch the students' behaviors as long as this did not disrupt the class. Any participation, however, was not permitted. The two observers attended the TML classroom for a total of 24 class days (total 1800 minutes) and the traditional classroom for 12 class days (total 900 minutes). To prevent the inconsistence of recording observations during the semester, the two observers summarized their observation forms every two weeks and made necessary modifications so that the data collection was completely consistent.

RESULTS

Observations

The results of quantitative observation are shown in Table 2. First, for the quantitative results of class-related behaviors, the TML class had a higher attendance rate than the traditional class (80% and 75%, respectively). In terms of the average number of students who "attempt to verbally answer question posed by the instructor," the rate of answering questions was 20% in the traditional class, a 2% drop when compared to the TML class. However, the rate of asking questions was 15% higher in the traditional class than the TML class (26% and 11%, respectively). The average number of students who were able to "help a classmate with a computer or calculation task, understand a concept, and interpret a question" had a 6% higher rate in the TML class over the traditional class (11% and 5%, respectively). Second, the results are described with respect to the class-unrelated behavior. The average number of students who were "doing work from another course" was 9% higher in the TML class than in the traditional class (11% and 2%, respectively). An average of 14% of students in attendance who were "sleeping or conducting running conversation with neighbor" were observed in the traditional class with the rate decreasing by 3% in the TML class, which was 11%. The average number of students who were "surfing web or reading email" was 15% higher in the TML class than in the traditional class (27% and 8%, respectively). "Daydreaming" was 6% more prevalent in students attending the traditional class compared with the TML class (11% and 5%, respectively).

Categories	Items	Traditional class	TML class
Attendance	Total in attendance	35 (75%)	18 (80%)
Class-related behaviors	Attempt to verbally answer a question posed by the instructor	7 (20%)	4 (22%)
	Ask a question about the material	9 (26%)	2 (11%)
	Help a classmate with a computer or calculation task, understand a concept, or interpret a question	2 (5%)	2 (11%)
Class-unrelated behaviors	Doing work from another course	1 (2%)	2 (11%)
	Sleeping or conducting running conversation with neighbor	5 (14%)	2 (11%)
	Surfing web or reading email	3 (8%)	5 (27%)
	Daydreaming	4 (11%)	1 (5%)
Attentiveness	Overall attentiveness on 5-point scale at 10^{th} minute	5	4
	Overall attentiveness on 5-point scale at 40^{th} minute	4	4
	Overall attentiveness on 5-point scale at 70^{th} minute	4	4

Table 2. Quantitative description of observations

No significant attentiveness differences were found at the 10^{th}, 40^{th} and 70^{th} minutes after the start of class between the two classes. In addition, qualitative observations were written by the observers at the end of each class and summarized.

FINDINGS

Quantitative Observation

Categories	Higher-rated items between class types	
	Traditional Class	TML Class
Class-related behaviors	Asking Questions	Attempt to answer question
		Helping other students
Class-unrelated behaviors	Sleeping and Conversation	Doing other course work
	Daydreaming	Web-surfing and emailing

Table 3. Higher-rated items between class types

Table 3 summarizes findings. These two categories indicate that the students in the TML class responded more readily to the instructor and interacted more freely with other students than those who were in the traditional class; however, the students in the TML class showed more passive attitudes in terms of asking the instructor questions compared with the traditional class. Likewise, two items in the class-unrelated behaviors category also had recorded rates higher in the TML class than in the traditional class: "Doing work from another course" and "Surfing web or reading email." Two other class-unrelated behaviors, "Sleeping or conducting running conversation with neighbor" and "Day dreaming," showed higher rates in the traditional class than in the TML class.

Qualitative Observation

Based on the observations, the results were analyzed and led to the identification of six influential factors under the categories of student learning and interaction between the instructor and students. We describe each of these categories (Table 4).

Student Learning

Student learning is divided into three factors: understanding content, attentiveness, and lose track of lecture. First, we define these factors. Understanding the content is defined as the students' understanding of new concepts by their responses during the lecture (i.e. nodding, confirming by question, and explaining to others). Second, attentiveness is defined as how much students concentrated on other activities during the instructor's lecture. Last, lose track of the lecture was defined by the accessibility and availability of reference and the frequency of referring to the material when they seem to have trouble understanding. Students in the TML class used spreadsheets as a reference material; however, students in the traditional class used their notebook as a major reference material.

Categories	Influential Factors	Student Behaviors	
		TML Class	Traditional Class
Student Learning	Understanding content	Rare Responses	Slightly Better Responses
	Attentiveness	Low	High
	Lose track of the lecture	Harder to recall	Easily recall
Interaction between instructor and student	Distance between instructor and student	The shorter the distance, the better the responses received from students	
	Eye contact	Less eye contact	More eye contact
	Seating pattern	No effect	More attentiveness and participation by front-seated students

Table 4. Influential factors toward student behaviors

Understanding the content

During the semester, it was observed that students in the traditional class showed better responses, implying they better understood the lecture content. Comparatively, in the TML class, rather than understand the concepts, students tended to concentrate more on how to emulate the spreadsheet what the instructor did.

Attentiveness

When the instructor verbally explained concepts, students were more attentive in the traditional class than in the TML class. Students in the TML class possibly assumed that working on the spreadsheet was considered a classroom activity, resulting in less attentiveness than when they were not working on the spreadsheet.

Lose track of lecture

Students in the traditional class seemed to easily catch up on new materials delivered regardless of whether or not previous lectures were missed. Students in the TML class, however, gave the impression of having difficulty understanding the lecture once they lost track of the lecture. The observations appeared to show that students in the traditional class always brought their textbook and continuously took notes as their references. On the other hand, the students in the TML class rarely took notes while working on the spreadsheet. Accordingly, they seemed to have a limited access to written references on their encountered-difficulties. There were also differences in terms of understanding the problem-solving process. The students in the traditional class appeared to easily understand the problem-solving process by referring to their notebooks, but the students in the TML class appeared to have difficulties following the steps of a problem-solving procedure. Rarely, students looked up the written references but most students did not. Whether students had the references on their hand or not affected the frequency in which the instructor's questions were answered. The students in the traditional class often looked up the references while they strived to answer the questions, but students in the TML class usually did not attempt to answer at all.

Interaction between Instructor and Student

This category had three factors: maintaining eye contact, distance between instructor and students, and seating pattern. We describe the results for each of these factors.

Maintaining eye contact

While most of students in the traditional class concentrated their attention on the instructor during lecture hours, students in the TML class looked at either the projected screen where the instructor's key strokes appeared, or at their computer monitors.

Those differences dictated how frequent the chances of eye contact with the instructor were. Likewise, the instructor spent a large portion of the lecture time on operating the spreadsheet to lead the lecture; consequently, the instructor rarely had the chance to make eye contact with the students in either class.

Distance between the instructor and students

The class attentiveness increased when the instructor approached the students in both the traditional and TML class settings. If the instructor walked close to the students, then the students turned their attention more on the lecture or operated the spreadsheet program in a more serious manner. In addition, the student who was located closest to the instructor appeared to have better response rates than students who sat some distance away. Students also returned to the lecture very quickly when they were distracted from other work if the instructor approached them.

The seating pattern and response rates

The seating patterns were self-selected because students could freely take a seat at any place in both the traditional and TML classes. The seating patterns were different in every class. However, most of seating patterns were a U- or D-shape in the traditional class. Interestingly, the response rate of questions depended on the seating patterns in the traditional class. Most of answers came from the students who sat in the first three rows and rarely from the very back of the classroom. Additionally, if the instructor stood in the left corner, the left-side-seated students answered most of the questions. Likewise, right-side-seated students behaved in the same way if the instructor headed to the right corner of the classroom.

IMPLICATIONS

Implications for Educators

The results of this study have several implications for educators in designing classes and delivering them. First, the students' behavior and attitude toward lectures were affected by the instructors' behavior: 1) limited eye contact allows the easy distraction of students' attentiveness, and 2) a shorter distance between the instructor and students caused students to concentrate more on the lecture in both the traditional and TML class settings. Second, the observations showed that the traditional classroom appeared to be a more effective learning environment since students offered more responses to questions, did not fall behind in lectures, and easily looked up references. Third, providing Internet access to the students during the classes seemed to be a less effective learning environment because students surfed the web for personal work rather than working on lecture-related topics.

Implications for Administrators

While reviewing the observations, the current study discovered that the seating design of a classroom and placement of computer equipment had an impact on students' learning behaviors. First, the computer equipment setting can be positioned to get more students' attention on the lecture. There are more chances to make eye contact with the instructor if the computer display is placed under the desk in the TML classroom. Second, the design of seats needs to be effective so that effective communication between the instructor and the students can happen.

LIMITATIONS AND FUTURE RESEARCH

This research has several limitations. First, two observers viewing the same situation might evaluate the same behavior differently. To minimize these discrepancies, observers reviewed each other's observations on a regular basis and adjusted the standpoint for future observations. However, despite this effort, we cannot disregard subjectivity of observations. Second, one observer only attended the computer-environment classroom and the other observer attended both the traditional class and the TML class. Attending both the classes might serve to create a different perspective for the observer when that observer sees some phenomenon take place in both classes.

This study uses a less rigorous research framework and brings a sense of thoroughness (not rigor) to the research. This study needs to be extended to include student-performance pegged observations. Future study needs to exhibit rigor in methodology and model proposition. Statistical analysis needs to go deeper than the surface treatment of the data collected. Effectual outcomes are needed for creating and substantiating interventions that could follow a research of this nature.

CONCLUSIONS

This paper is the result of observational research conducted in two classroom settings: a traditional classroom and a TML classroom. The purposes of this study were to compare student behaviors in two different Introduction to Statistics classes via observation. The students in the traditional classroom performed more class-related activities than did the students in the TML classroom. While both the traditional classroom and the TML classroom allowed students to learn independently, this research indicates that the traditional classroom provides a better learning environment for the study of Introduction to Statistics. Many existing studies point out that TML results in better learning performance. However, the results of this study suggests otherwise (i.e. Ozdemir et al., 2008; Hsiao et al., 2009, etc.). In this study, one of the problems of TML classroom is that it allowed students to access the Internet during class time. Observers noticed that students seemed to be easily attracted

to web-surfing that was unrelated to class work. This could significantly impact the students' learning behavior in the TML class. Overall, both classroom environments provided advantages: the TML classroom encouraged cooperation among students on their learning activities, and the traditional classroom allowed students to become actively involved in the lecture.

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