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Introduction

The traditional lecture method, used most frequently in today's college classrooms, has a number of limitations. Lectures do not encourage students to be active, may not be an adequate means of communication for complex concepts, do not encourage critical thinking, and may not be adaptive to individual student needs. The use of information technology (IT) applications in the classroom is often portrayed as the silver bullet for the problems associated with lectures. Every major university is investing a significant amount of money on creating classrooms that can support a variety of information technologies. Almost all technologically enabled classrooms provide support for two kinds of technologies: networking and multimedia. The assumption made here is that instructors would develop or use applications that can take advantage of the networking/multimedia infrastructure available in the classrooms and use them in an innovative fashion to improve teaching. Multimedia presentations and Group Support Systems are two such applications.

Lectures that use multimedia presentations are in essence a combination of text, pictures, computer graphics, audio, full-motion video, animation, and electronic transparencies coordinated and integrated by a computer into one product (Townsend and Townsend, 1992). Many textbooks, especially in the introductory computing classes, come packaged with such presentations. These presentations can potentially be used in place of the traditional lecture to encourage students to be more active, to improve the communication process, to increase the amount of information retained by students, and to adapt lectures more readily to the needs of individual students (Townsend and Townsend, 1992). A Group Support System (GSS) on the other hand is a computerized system that provides communication and collaboration capabilities to support group interaction (Briggs et al. 1995). A GSS can be used in the college classroom to encourage students to actively participate in the learning process, to support information sharing, to provide immediate feedback, to increase the amount of information retained by students, and to help students develop critical thinking skills (Briggs et al. 1995).

The results of previous studies involving the use of multimedia presentations or GSS have provided mixed results. Students in some previous studies have indicated a preference for the use of these technologies in the classroom when compared to a traditional lecture approach. They have also tended to perceive that they understand the presented material better when these technologies are used (Briggs et al. 1995; Pearson et al. 1994). However, other studies using the same technologies have either shown no improvements or in some cases have had a negative effect on student performance. Possible explanations for these disparate results could be the differences in the way the technologies were used in the studies as well as the duration for which students were exposed to the technologies. Thus, while both multimedia presentation and GSS hold some promise for improving student performance and increasing the amount of information retained by students it is not clear how best to achieve the desired performance benefits. Also, given the complementary benefits that can be obtained from using the technologies it is possible that the concurrent use of these technologies in the classroom might lead to some unequivocal performance improvements.

In this article, we describe the details of a study that was conducted to examine the effect that the combination of multimedia presentations and Group Support Systems has on learning outcomes in higher education. Our specific focus was on using these technologies in the classroom to supplement lectures for an entire semester.

Description of the Study

A study of 227 students enrolled in a college-level introductory computer course was conducted to fill in the gaps in the existing research and provide more conclusive answers regarding the benefit of using multimedia presentations and GSS technologies, individually as well as in combination, in the classroom. The effectiveness of multimedia presentations, traditional lectures supported by a GSS, and a combination of multimedia presentations and a GSS (the experimental groups) was compared to the effectiveness of traditional lectures (the control treatment).

Results and Discussion

The results of the study, very surprisingly, indicate that no significant differences exist between students exposed

to any of three experimental conditions and the students in the control groups with regard to performance (on quizzes and exams over the course of the semester), satisfaction, or perceived understanding. Table 1 (shown at the end of this paper) provides the mean, standard deviation, and the number of students included in the sample for the midterm exam, the final exam, the unannounced quiz average, and the announced quiz average for each of the four treatments. Table 2 provides the results of performing multivariate tests (using SPSS) for the dependent variables: midterm exam, final exam, unannounced quiz average and announced quiz average, by teacher and treatment.

The results essentially indicate that the mere adoption and use of the information technology may not be sufficient to induce improvement in student performance. From a multimedia perspective, the results seem to suggest that careful attention needs to be paid to factors such as appropriateness of technology based on content, attitudes of teachers toward the use of technology, attitudes of students toward the technology, etc. From the perspective of appropriateness of Group Support Systems in the classroom, the results seem to confirm the findings of Briggs et al. (1995) that the mere increase in participation and feedback to students based on increased classroom interaction is not sufficient to induce performance improvement. The lack of significant results in our study and Briggs et al. (1995) combined with the success of past studies that have used GSS to support teaching methods requiring explicit collaboration, such as the case method of teaching, suggests that future research in this area should focus on the use of GSS to develop alternatives to lectures.

The study does indicate that there may be some differences between treatments when data for each teacher is analyzed individually. In an attempt to determine why differences existed among the three teachers (who taught a section using each treatment), each teacher was asked to complete a questionnaire and participate in a post-study interview. Based on analyses of the qualitative data, it appears that multimedia presentations and/or Group Support Systems have a positive impact on performance, student satisfaction, and perceived understanding when used by particular teachers. Analysis of the results for individual teachers suggest that students may perform better, may be more satisfied, and may understand the material better when the teacher enjoys using the chosen technology and does not face any difficulty using the technology in the classroom. Thus, teachers should not only be given the option of using technology in the classroom, they should also be allowed to choose the technologies that they want to use. In addition, it may be beneficial if teachers are trained in the use of the chosen technologies to reduce the amount of difficulties encountered in the classroom.

However, what may really be needed in order to dramatically improve learning in a higher education setting is an entirely new teaching approach that implements the concepts of constructivist learning theory (rather than simply support it as we did in this study). Constructivism is a cognitive learning theory that contends that learning is an active process in which a student constructs new knowledge in a collaborative social setting by building on prior knowledge (Jonassen, 1994). Instead of using technology as a tool for the teacher, it may be better to use it as a tool for the student (Hannafin et al. 1996). One possibility is to allow students to interactively control the pace and sequence of their own instruction, but studies of such systems have shown mixed results (Hannafin et al. 1996). Another technique may be to use a problem-based learning approach that is supported by computerized tools that assist students in collaboratively solving complex problems. However, such a major change in the educational approach would require extensive training for both teachers and students so that they can make the best use of the new learning environment.

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	Treatment	Mean Score (Max. 100)	Std. Deviation	N
Midterm Exam	Multimedia Presentations	89.24	11.32	55
	Traditional Lecture & GSS	89.71	10.04	63
	Multimedia Presentations & GSS	84.67	12.50	57
	Traditional Lecture (control)	90.15	10.97	52
Final Exam	Multimedia Presentations	165.96	26.17	55
	Traditional Lecture & GSS	168.78	21.66	63
	Multimedia Presentations & GSS	156.56	27.99	57
	Traditional Lecture (control)	168.77	26.04	52
Average of Unannounced Quizzes	Multimedia Presentations	64.43	15.82	55
	Traditional Lecture & GSS	60.86	14.19	63
	Multimedia Presentations & GSS	61.75	16.32	57
	Traditional Lecture (control)	64.60	16.83	52
Average of Announced Quizzes	Multimedia Presentations	58.92	8.65	55
	Traditional Lecture & GSS	59.43	8.87	63
	Multimedia Presentations & GSS	57.99	9.07	57
	Traditional Lecture (control)	60.88	9.68	52

Table 1. Mean and Standard Deviation for Quiz and Exam Scores

Effect	Test	Value	F	Hypothesis df	Error df	Sig.
Treatment	Pillai's Trace	.086	1.583	12.000	642.000	.092
	Wilks' Lambda	.915	1.598	12.000	561.191	.088
	Hotelling's Trace	.092	1.610	12.000	632.000	.084
Teacher * Treatment	Pillai's Trace	.233	2.213	24.000	860.000	.001
	Wilks' Lambda	.783	2.237	24.000	740.790	.001
	Hotelling's Trace	.256	2.249	24.000	842.000	.001

Table 2. Multivariate Test Results by Teacher and Treatment