In: Computers in Education, Volume 1
Editor: Sergei Abramovich, pp. 195-211
ISBN: 978-1-62100-621-3

Chapter 11

A COMPARISON OF STUDENT PERFORMANCE AND SATISFACTION IN BLENDED AND CLASSROOM MULTIMEDIA APPLICATIONS EXPERIENCES

Nikolaos Vernadakis, Eleni Zetou, Maria Giannousi, Panagiotis Antoniou and Efthimis Kioumourtzoglou
Department of Physical Education and Sport Science,
Democritus University of Thrace, Greece.

ABSTRACT

As universities extend their blended learning offerings to reach more time-and-place-bound students, the degree to which students in the blended courses are successful, compared to their classroom counterparts, is of interest to accreditation review boards and others charged with assessment. Instructors use information about the effectiveness of their instruction to evaluate and improve the learning experience. Therefore, the purpose of this study was to evaluate student performance and satisfaction with a blended learning approach to deliver a computer science course concerned the multimedia applications in comparison to delivering the same course content in the form of traditional classroom lectures. Eighty seven undergraduate students were randomly assigned into two teaching method groups: Classroom Lecture Instruction (CLI) and Blended Lecture Instruction (BLI). Each group received thirteen 95-min periods of instruction divided into four sections: a) 5-min brief outline of the key learning points, b) 40-min lecture on general knowledge, c) 45-min constructivist-inspired learning activities, and d) 5-min summary of key learning points. In the beginning and the end of this study students completed a 31-item multiple choice knowledge examination. The additional measurements of course achievement that were collected included individual student's scores from three class exams plus the overall course grade. Finally, participants in both groups completed a satisfaction survey upon termination of the course after completing the post-test examination. Two-way analysis of variances (ANOVA), with repeated measures on the last factor, were conducted to determine the effect of teaching method (CLI, BLI) and measures (pre-test, post-test) on student performance. The time effect was significant. Two paired-samples of t-test were conducted to follow up the significant time main effect. For the two groups, differences in the post-test knowledge scores were remarkably greater than pre-test knowledge

scores. Furthermore, independent sample t-test analyses were conducted to measure students' satisfaction towards the CLI and BLI methods. Results indicated that a blended course delivery is preferred over the traditional lecture format. In addition, the accomplishment of the learning objectives, as measured by the final grade in the course, is dependent on the mode of instruction.

Keywords: instructional technology, multimedia applications, blended instruction, traditional instruction, cognitive learning, satisfaction.

INTRODUCTION

Distance education has become commonplace in today's tertiary education scene. One has only to look in course-listing books published by colleges and universities of all sizes to see that one or more technology-mediated courses are part of the curriculum offerings. Technology-mediated instruction includes a wide variety of instructional delivery methods including, but not limited to, teleconferencing, video teleconferencing, web-based courses, and distance courses. Teleconferencing and video teleconferencing are generally synchronous (occurring in real-time with instant communication) while web-based and distance courses can be synchronous, asynchronous (communication is delayed for example by email, blogs, or chat boards), or a combination of synchronous and asynchronous communication.

At one extreme are those institutions of tertiary education that have totally online programs and degrees offered exclusively via the Internet (i.e., University of Phoenix). At the other extreme are those institutions that remain totally traditional in their educational approach. Most universities, however, fall on a continuum somewhere between the two extremes maintaining a traditional view of education while incorporating online/distance courses into their existing programs.

The current trend to complement face-to face classes with web-based materials is known as "blended learning" (Tabor, 2007). This style of learning is normally defined as the integration of traditional classroom methods with online activities (Tabor, 2007; Macdonald, 2008). Blended instruction is different than traditional instruction in that it employs a web-based curriculum and shifts the emphasis from a teacher-centered to a learner-centered philosophy (Harker and Koutsantoni, 2005; Schober, Wagner, Reiman, Atria, and Spiel, 2006). Furthermore, blended instruction is different than distance instruction in that learners are required to meet as a group in a centralized location such as a classroom/lab with an instructor for a specified period of time. To help clarify the nuances among the various type of online courses, Allen and Seaman (2008, p. 4) provide us the following definitions (Table 11.1):

While there are a number of studies comparing traditional education to distance education, (Fortune, Shifflett, and Sibley, 2006; Mansour and Mupinga, 2007; Olapiriyakul and Scher, 2006) there is little research comparing blended instruction to either distance or traditional education. The few studies that have been conducted suggest that blended instruction is more effective than either traditional or distance education in at least one facet of the studied program. For example, in Vernadakis, Antoniou, Giannousi, Zetou, and Kioumourtzoglou's (2011) study, the blended instruction proved more successful than traditional instruction in increasing student academic performance in a new technology in

Physical Education course. Schober et al. (2006) suggested that the blended instructional model is more effective than traditional instruction at generating or increasing student interest of and motivation toward course content for a credit-bearing research methods course for graduate students. Harker and Koutsantoni's (2005) study pointed out that the biggest benefit of blended instruction over distance instruction in a non-credit bearing English for Academic Purposes course was the increased rate of student retention. Finally, El-Deghaidy and Nouby's (2008) study indicated that Pre-Service Teachers in the blended lecture group had higher achievement levels in their post-overall-course test, "comprehensive-score," and attitudes towards e-learning environments compared to those in the traditional lecture group.

Table 11.1. Various types of online courses

Proportion of Content Delivered Online	Type of Course	Typical Description
0%	Traditional	Course with no online technology used – Content is delivered in writing or orally
1%-29%	Web-Facilitated	Course that uses web-based technology to facilitate what is essentially face-to-face course. Uses a course management system (CMS) or web pages to post the syllabus or assignments for example (i.e. WebCT)
30%-79%	Blended/Hybrid	Course that blends online and face-to-face delivery. Substantial proportion of the content is delivered online, typically uses online discussions, and typically has some face-to-face meetings.
80% +	Online	A course where most or all of the content is delivered online. Typically have no face-to-face meetings.

Despite findings in current literature supporting the notion that blended instruction is more effective than either traditional or distance education, there are, in actuality, very few studies available to confirm or refute such conclusions, especially in the Physical Education area (Vernadakis et al., 2011). Plus, the existing studies focus on different variables (Grade Point Average - GPA, student retention, student perception, student interest/motivation). The research proposed here will contribute to the overall literature in distance education and alternative forms of instructional delivery of curriculum; and more specifically, it will add to the academic literature focused on comparing blended instruction to traditional instruction in Physical Education. More studies are needed assessing the effectiveness of blended instruction in general, and more specifically assessing the effectiveness of blended instruction in credit-bearing courses. This study contributes to that needed body of literature.

Although most research in distance education has examined the effectiveness of blended courses in the light of course grades and test scores, some researchers have contended that simply looking over grades was not sufficient to estimate the effectiveness of a course, since other factors such as student satisfaction might influence student achievement (Abdous and Yoshimura, 2010). Student satisfaction was considered an important indicator of the effectiveness of a course (Bolliger and Wasilik, 2009). Paechter, Maier & Macher, (2010) stressed the need to investigate the students' satisfaction criteria in order to fully understand the online learning environment.

Moreover, e-learning technology developed around the blended paradigm is beneficial for improving the quality of learning, but is useless if it is not based on pedagogical prescriptions (Alonso, López, Manrique & Viñes, 2005; Papastergiou, 2007). Pedagogical principles are theories that govern good educational practice. Both Thurmond (2002) and Oliver (2001) stated that the use of learning theories could contribute to the quality of blended courses by providing a framework for the development and implementation of appropriate teaching–learning activities. Woo and Reeves (2007) identified three main learning theories: behaviorism, cognitivism, and constructivism. Behaviorist learning theory focuses on observable behavior (objectivity) while cognitivism has a focal point on unobservable behavior (subjectivity). Constructivism emphasizes the construction of new knowledge by the learner, as well as a focus on active learner-centered experiences (Young and Maxwell, 2007). Presently, the educational environment is changed from teacher-centered to student-centered. Constructivism is a learning theory that could prove useful for designing and developing a blended learning program based on active learner-centered experiences (Low, 2007).

Therefore, the purpose of this study was to evaluate student performance and satisfaction of a blended learning approach to deliver a computer science course concerning the multimedia applications in comparison to delivering the same course content in the form of traditional classroom lectures. Constructivist design was applied in these approaches to help students develop constructive learning habits. In the blended learning approach, 67% of content and activities were delivered online computer-mediated communication and 33% of content and activities were delivered through classroom face-to-face interaction.

METHOD

Design

This study measured the effectiveness of a blended general multimedia course at Democritus University of Thrace in the Department of Physical Education and Sport Sciences. Research methodology employed a quantitative, pre-test and post-test control group design. Use of intact classrooms, where students are not individually assigned to groups, denotes a quasi-experimental research design. In this study, students' knowledge acquisition was measured along with end-of course class satisfaction, exams and course grades. A pre-test and a post-test control group design is one of the strongest methodological research designs, assuring that significant differences discovered between and among groups can be attributed to the intervention. With this research design, threats to internal and external validity are controlled and generalization to other similar settings is possible (Green and Salkind, 2007).

Specifically, the experiment on the knowledge test was a factorial design with teaching method groups (CLI and BLI) and repeated measurements (pre-test and post-test) as independent variables, and knowledge learning as the dependent variable. The experiment on satisfaction, exams and course final grade determination used a factorial design with teaching method groups (CLI and BLI) and post-test measurement as independent variables, and students' scores from the satisfaction scale, the three class exams and the overall course grades as dependent variables.

The research questions of this study were:

- Should one or more items on the knowledge test be deleted or revised to obtain a better measure of interactive multimedia systems?
- Do students, on average, report differently on the knowledge test using the CLI and the BLI teaching approaches?
- Do students, on average, report differently on the knowledge test for the pre-test and post-test measurements?
- Do the differences in means for the knowledge test between the CLI and the BLI teaching method groups vary between the pre-test and post-test measurements?
- Are students more satisfied on the average by CLI or BLI teaching approaches?
- Do students, on average, report differently on class exams using the CLI and the BLI teaching approaches?
- Do students, on average, report differently on overall final course grade using the CLI and the BLI teaching approaches?

Participants

The participants in this study were eighty seven (N = 87) third-year undergraduate students from the Department of Physical Education & Sport Sciences at the Democritus University of Thrace taking an elective course titled "Information and Communication Applications: Multimedia Systems" in two successive years. Four classes were selected from two successive years for this quasi-experiment. These classes were taught and instructed by the same instructor according to the designed teaching plan throughout the entire course. Participants were randomly assigned to one of the two different teaching methods: CLI (24 males and 21 females) and BLI (22 males and 20 females) creating two independent groups of 45 (51.7%) and 42 (48.3%) students respectively. Prior to group assignments, participants were orientated to the purpose of the study, the experimental group to which they belonged, the method by which the course would be taught and obligations for participation in the experiment. All students in the four classes were asked to participate, but the procedures were different for the two course delivery formats. Each student was asked to give consent to participate in the study and was informed that participation was voluntary.

The Course

The course under study was a semester-long, 2 credit-hour class, targeted at third-year undergraduate students in the Department of Physical Education & Sport Sciences. Its purpose was to introduce students to the fundamentals of multimedia design. The course provided students with the fundamental skills and knowledge to define a problem and design a multimedia application to solve it, to understand and recognize the characteristics of good multimedia design, to begin to use and apply popular multimedia development tools, and to work as part of a team to produce a workable multimedia solution.

Specifically, students in both environments (CLI, BLI) were required to build a prototype of their multimedia application in the initial stage of this course. In particular, each student

was asked to assume the role of a Physical Education teacher working in a secondary school, and to prepare a video presentation aimed at introducing his/her pupils to a specific physical activity and life quality topic, chosen by the student. In the first 45-minutes of each class, the teacher lectured on the guidelines or mistakes and bugs of the video presentation frames. Then, the students had 50-minutes to discuss with their team members about how to implement what they learned. When the online classes were delivered, students could synchronously discuss and collaborate on the construction of their video presentations through using an online messenger and chat room. They could also asynchronously interact with team members in their exclusive forums. Moreover, when the classes were delivered in the classroom, students discussed and assigned their tasks in this physical learning environment. Students had to reconsider and modify the prototypes of their video presentations according to the new knowledge they had just acquired.

In this experiment, the instructor initiated students in CLI and BLI into the field of multimedia applications development, planning and creation. He first established the students' essential knowledge and developed required skills in the initial stage of the course. After students climbed the stiff learning curve and encountered bottlenecks, students were required to gather information and solve problems by themselves.

Online, the BLI instructor played a role different from the role of the CLI instructor, although the general issues and situations with which they must deal were essentially identical - to facilitate the process of active learning by students and foster the skills of critical thinking. However, the BLI instructor had to fulfill additional conditions for successful online tutoring, which can be categorized as pedagogical, social, managerial, and technical. Specifically, the BLI instructor facilitated their online classes by posting important announcements, guiding assigned readings and asynchronous discussions, answering student questions, and leading synchronous chat sessions. The use of a CMS environment was the main difference between the two groups. The amount of material covered in the hybrid learning course, and the depth with which it is covered, was in general equal to that of a classroom face-to-face course.

Course Management System

The Open eClass platform in version 2.1 was used to provide an alternative method of distributing information to the traditional method approach. This platform allowed the teachers to quickly organize practical on-line courses, contact student users registered to them, upload educational materials (texts, images, presentations, video, assignments, exercises, etc.), and create discussion forums where course participants could interact. Students for their part could have access to educational materials via the Internet and participate in working groups, discussion forums and exercises (GUnet Asynchronous eLearning Group, 2010). Users logged in the Open eClass platform by inserting their username and password, which allowed them to enter into their personal portfolio, an area that helped them to organize and control their eCourses participation in the platform. On the eCourse home screen, there was a short description, in which basic information (title, code, responsible teacher, department etc.) were reposted. Also, there was an "email" hyperlink, which allowed registered student-users, who had defined their email address in their profile, to communicate with the course teacher via email. On the left, there was a menu with all the

active eLearning tools (modules) provided for the eCourse by the teacher in charge (Figure 1).

Upon completion of the eCourse, students could sign out from the Open eClass platform, by clicking on “Logout” on the right side, at the top of the screen.

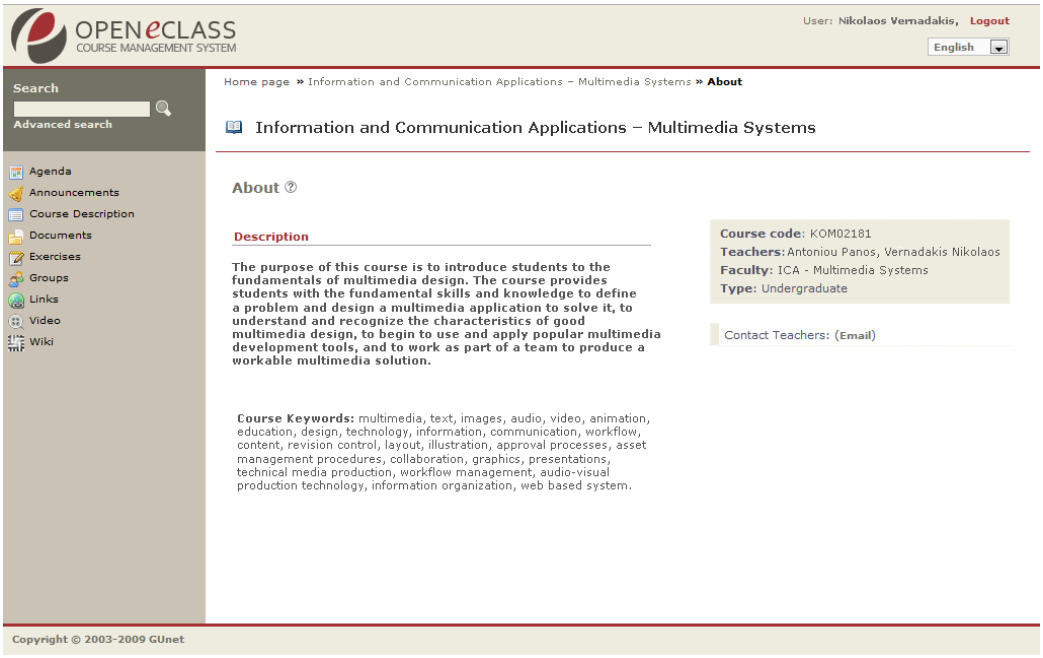

Figure 1. The asynchronous e-learning platform open eClass.

Instrumentation

Knowledge Test

A knowledge test was developed to determine students’ achievement on cognitive learning of interactive multimedia systems. A table of specifications was developed to reflect the interrelationship between the identified course content and the levels of learning. Based on these specifications a 34-item, multiple-choice test was constructed. Each test item had four options in order to reduce the probability of guessing. The test construction was based on the linear model which required that the test scores were obtained by summing the number of correct answers with equal weighting over the 34 item. The questions were written based on the book "Information Society and the Role of Interactive Multimedia" (Deliyannis, 2006).

After the questions were constructed as explained above, a panel of experts in multimedia systems teaching was used to evaluate and judge the content validity of the test instrument. This group reviewed the test items and established whether each item measured the target skill. Every time a set of changes was made, the questionnaire was reviewed again by the consultants, until the instrument was deemed adequate. The revised version of the knowledge test consisted of a 31-item multiple-choice test. A pilot study was performed to access item difficulty and clarity of questions (Green and Salkind, 2007). Questions were scored one point (1) for a right answer and no point (0) for a wrong answer.

Satisfaction Scale

One of the best developed and most widely used student feedback questionnaires in the literature is the Student Evaluation of Educational Quality (SEEQ) (Marsh, 1982). The SEEQ is not based on student learning research but on psychometric analysis. A consequence of this is that while the constructs underlying the SEEQ are less well supported by learning theory, the psychometric characteristics of the questionnaire are developed to a high degree. Participants in this study completed a 12-item modified version of the SEEQ questionnaire (Centra, 1993) using a 5-point Likert scale with the following variables: strongly agree = 5, agree = 4, neutral = 3, disagree = 2, and strongly disagree = 1. The SEEQ has an exceptionally high level of reliability (Cronbach's alpha from 0.88 to 0.97). It also has a reasonable level of validity in that scale scores correlate significantly with a wide range of measures of learning outcome such as student marks on standardized examinations, student feelings of mastery of course content, plans to apply skills learned on the course and plans to pursue the subject further (see Table 11.3).

Procedure

Pilot Study

A pilot study was conducted to determine the reliability and validity of the knowledge scale, to test the research procedures and to make any necessary revisions before full implementation of the study. The participants in this pilot were 38 undergraduate students enrolled in a blended course at Democritus University of Thrace. This population was chosen to keep the pilot study similar to the main study regarding participant's age. Participants were given two online 95-minute class periods of instruction and a face-to-face overview concerning the interactive multimedia systems. The knowledge test was administered on the fourth day at the computer lab facility on the university campus. Eighteen Windows-based computer workstations were used in the knowledge test implementation. Each computer had access to an online selection answers system for completion and submission of the 34 multiple choice questions. Participants completed the knowledge test in a section-by-section manner, that is, after the completion of one question, the participant was asked to click a next button to go to the next question, until all questions were completed. The questionnaire was also designed with an embedded program so that if a participant chose to skip any item, a remark designed using JavaScript appeared requiring the participant to complete the missing item before he or she proceeded to the next section. After completion of the entire questionnaire, the participant clicked on a submit button, which sent the completed questionnaire to a secure server accessible only by the researchers. It was determined that participants would need approximately 30 minutes to complete all questions of this instrument.

Main Study

After the pilot study, a main study was conducted to compare the scores obtained by 87 undergraduate students in the knowledge test, the three written exams, the final course grade and the satisfaction survey. The knowledge test was administered on the first day to measure participant's learning on the interactive multimedia systems. Procedures for the knowledge

test were the same as the pilot test. There were three questions fewer, reducing the number of questions to thirty one (see Table 11.2).

On the second day, the computer lab facility was set up according to the needs of the experimental procedure. In this facility there were 18 Windows-based multimedia computer workstations with the same infrastructure (hardware, software) and Internet connectivity. Computers were separated as much as possible to create individual workstations. Before the experiment started, the BLI group was given a 95-minute introductory session on how to use the open eClass platform and its tools. Then, the instructor of the course gave a 45-minute lecture to all participants introducing the unit of "Information and Communication Applications – Multimedia Systems." Instruction, practice (activities), and testing for this study were held on thirteen separate and successive weeks. The groups met for 95-minutes, each week.

The CLI method incorporated a direct style of teaching including lectures, activities, and discussion. Participants attended a typical live lecture that provided ample opportunity for teacher-student interaction (reviewing the lecture material through discussion). During the lecture, PowerPoint slides were used to present textual information, graphics, and a few animations. Immediately after the lecture, students were given computer activities to enhance and enrich teaching and learning in the computer lab. Specifically, each CLI group received six 95-min periods of instruction divided into 4 sections: a) 5-min briefly outline of the key learning points, b) 40-min lecture on general knowledge, c) 45-min constructivist-inspired learning activities that corresponded with the lecture content and d) 5-min summary on key learning points. Participants were allowed to work alone or with a partner. Oral instructions (feedback) could be given during the 45 minutes of activity.

Participants in the BLI method composed classroom face-to-face interaction and online computer-mediated communication into an integrated mix. The experimental structure of blended designing was followed on a one to three ratio (1/3). Five (5) instructive units were accomplished with the traditional teaching method in the classroom, while the remaining eight (8) units with the use of asynchronous course management system open eClass. The five (5) traditional activities functioned as completion of each instructive unit (an educational goal), which ended, and at the same time introduced students to the next instructive unit. Each BLI group received thirteen 95-min periods of instruction divided into 4 sections: a) 5-min briefly outline of the key learning points, b) 40-min e-lecture on general knowledge (video feed of the lecturer synchronized with PowerPoint slides), c) 45-min constructivist-inspired e-learning activities that corresponded with the e-lecture content and d) 5-min summary on key learning points. A member of the university assistant staff was present for organization and management supervision only. Participants were allowed to work alone or with a partner.

At the end of the treatment, the knowledge test that previously served as a pre-test was given to students as a post-test. After completing the post-test knowledge examination, the participants in both groups completed the SEEQ scale. The additional measurements of course achievement that were collected included individual student's scores from three class exams during the course plus the overall course grade. Both groups had the same learning conditions, such as topics and principles introduced in the treatments, and equal opportunities to achieve their learning outcomes.

RESULTS

An item analysis using the responses of the pilot study was conducted to determine the difficulty rating and index of discrimination. In determining the internal consistency of the knowledge test, the alpha reliability method was used. Two-way analysis of variance (ANOVA), with repeated measures on the last factor, were conducted to determine effect of method groups (CLI, BLI) and measures (pre-test, post-test) on knowledge acquisition. Independent sample t-test analyses were conducted to measure students' satisfaction, class exams scores and final course grades towards the CLI and BLI methods. Each variable was tested using an alpha level of significance .05. The results of each analysis are presented separately below.

Item Analysis of the Knowledge Scale

The pilot study knowledge test had a mean difficulty rating of 54%. When all items were analyzed, two questions, or 5.9% of the 34 item, had unacceptable difficulty rating values. The utilization of a difficulty rating criterion of between 10% and 90% resulted in 94.1% of the items yielding an acceptable level of difficulty. The pilot study knowledge test had a mean index of discrimination of .32. When all items were analyzed, one question, or 2.9% of the 34 item yielded an unacceptable index of discrimination values. The acceptable value for index of discrimination was .20 or higher. Acceptable index of discrimination values were observed for 97.1% of the items. As indicated by the information in Table 11.2, three of the 34 items (18, 30, & 34) were therefore deleted from the test for the main study.

Reliability of the Knowledge and Satisfaction Scales

Reliability measures for the knowledge test and satisfaction survey were assessed. An alpha reliability coefficient .77 was computed based on the inter-item correlation coefficients of the pilot study knowledge test. Since the Cronbach *a* coefficients of the satisfaction scale were .92, all results > .70. According to Green, and Salkind (2007), the reliability coefficient should be at least .70 for the test to be considered reliable. Thus, the determination was made that the pilot knowledge test and the satisfaction survey were reliable measurement instruments.

Knowledge Test Comparison

There were not significant initial differences between the two teaching method groups for the mean knowledge test scores, t (85) = .31, p = .83. A significant main effect was noted for the Time, F (1, 85) = 34.97, $p < .001$, while the interaction Time X Group was not significant, F (1, 85) = 6.74, p = .37. The univariate test associated with the Group's main effect was also not significant, F (1, 85) = 6.25, p = .34.

Table 11.2. Summary of Item Analysis for pilot study knowledge test

Questions	Index of discrimination	Difficulty rating	Results
1. Which of the following is a picture layer?	.40	40%	Retained
2. Which of the following is not a stage in multimedia?	.28	55%	Retained
3. Which application require extreme realism including moving images?	.25	59%	Retained
4. The Bezier is a	.35	47%	Retained
5. Which of the following changes the position of the picture?	.38	51%	Retained
6. Which of the following changes the orientation of the picture?	.41	57%	Retained
7. Which of the following changes the size of the picture?	.52	63%	Retained
8. Antialiasing is	.49	34%	Retained
9. Aspect ratio is	.58	46%	Retained
10. Authoring software is	.32	57%	Retained
11. AVI is	.39	48%	Retained
12. Frame is	.62	32%	Retained
13. DPI is	.59	45%	Retained
14. Hyper media is	.45	67%	Retained
15. Adapter cards are	.51	49%	Retained
16. Which is the computer software graphics?	.33	45%	Retained
17. Which of the following device is used for interaction with the computer model?	.61	37%	Retained
18. Which of the following techniques are used to brighten the parts of the image closer to the observer?	.14	86%	Eliminated
19. JPEG stands for	.44	46%	Retained
20. Kiosk is	.55	58%	Retained
21. Morphing is	.50	66%	Retained
22. MP3 is	.46	54%	Retained
23. PNG is	.49	56%	Retained
24. Sound editor is	.51	60%	Retained
25. Which of the following is used in all image generation?	.34	77%	Retained
26. Multimedia environments is	.63	52%	Retained
27. Capacity of DVD runs in	.53	51%	Retained
28. Features of Modeling Tools are	.41	49%	Retained
29. Which of the following is not a feature of OCR?	.47	65%	Retained
30. In which form of the drawing area are contents printed on the matrix printer?	.21	96%	Eliminated
31. Which technique is useful to teach and to entertain?	.56	72%	Retained
32. Selection feedback is implemented using	.43	64%	Retained
33. In a multimedia project, a storyboard is	.52	54%	Retained
34. With reference to multimedia elements, of the following, pick the “odd-one” out	.29	94%	Eliminated

Two paired-sample *t* tests were conducted to follow up the significant Time main effect and assess differences across time within each teaching method group. Differences in mean ratings of the knowledge test in CLI group were significantly different between pre-test and post-test, t (43) = 4.45, $p < .001$. Similarly, differences in mean ratings of the knowledge test in the BLI group were significantly different between pre-test and post-test, t (41) = 5.37, $p < .001$. The magnitude of the effect as assessed by Cohen's d was small to medium d=.032 for CLI and medium d=.046 for BLI. As shown in Figure 2, the post-test knowledge scores were remarkably greater than pre-test knowledge scores for the two groups.

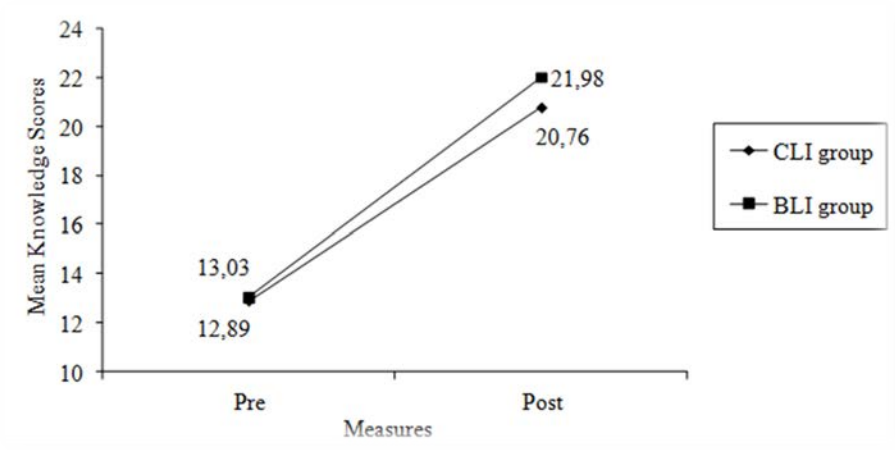

Figure 2. Groups' performance on all measures of the Knowledge test.

Student Course Satisfaction

To compare student course satisfaction, at the completion of the course, all participants completed a satisfaction survey which consisted of a modified SEEQ (Centra, 1993). All of the 12 questions that comprised the SEEQ were rated higher for the blended course design (Table 11.3). A composite score for the SEEQ was calculated, and the overall mean was higher for the blended course (44.79) than the traditional course (39.80).

Significant differences for total mean scores of SEEQ are reported in Table 11.3. The total scores between the blended (44.79) and traditional (39.80) were significantly different [t (85) = 3.51, $p< .001$] indicating that blended students judged the quality of education to be higher than traditional students.

Class exams and Final Course Grade

Four independent-samples *t*-tests were conducted to determine significant differences between the blended and traditional students on class exams and the final course grade (Table 11.4). No significant differences were noted in the first written exam, while the blended students significantly outscored traditional students in the second [t (85) = 2.21, p = .016] and third [t (85) = 3.01, p = .005] written exam. The final course grades were significantly higher

for blended students than traditional students, demonstrating a mean score of 81.53 and the latter a mean score of 74.47 (p = 0.001).

Table 11.3. Means and standard deviations for post-test scores of the two groups on satisfaction

	Blended Mean (*SD*)*	Traditional Mean (*SD*)*	*T* value	Sign.
1. Class size is appropriate	4.45 (0.63)	3.93 (0.95)		
2. The class activities were engaging	4.11 (0.78)	3.69 (0.98)		
3. The class environment was inviting	4.10 (0.82)	3.49 (1.07)		
4. The class was fun	3.66 (0.90)	3.02 (1.17)		
5. I was bored in class	2.72 (1.09)	3.19 (1.21)		
6. I enjoyed going to class	3.16 (1.01)	2.80 (1.17)		
7. I felt comfortable to voice my opinion in class	3.72 (0.92)	3.13 (1.09)		
8. I learned from my peer experiences	3.42 (1.00)	2.89 (1.07)		
9. I felt my presence was valued in the class	3.41 (0.97)	2.71 (1.11)		
10. I felt comfortable approaching the instructor	3.97 (0.96)	3.83 (1.04)		
11. The instructor encouraged class discussion	4.21 (0.72)	3.57 (1.08)		
12. I would recommend this class to a friend	3.86 (0.96)	3.55 (1.26)		
Composite Student Evaluation Score (Q1 – Q12)	44.79 (10.76)	39.80 (13.20)	3.51	p<.001

* 1= strongly disagree, 2=disagree, 3=don't know, 4=agree, 5=strongly agree.

Table 11.4. Independent-samples *t* test for traditional and blended section on class exams and final course grade

Source of Variation	Blended Mean (*SD*)	Traditional Mean (*SD*)	*T* value	Sign.
First written exam	69.24 (2.04)	70.69 (1.11)	0.58	*p*=.385
Second written exam	78.15 (1.37)	73.63 (1.08)	2.21	*p*=.016*
Third written exam	79.48 (1.52)	74.36 (0.95)	3.01	*p*=.005*
Final course grade	81.53 (1.23)	74.47(1.03)	3.51	*p*=.001*

*p<0.05.

DISCUSSION

This research study represents an initial attempt to measure undergraduate student achievement and satisfaction between blended and traditional course formats. With regard to the knowledge test, results indicated that both the blended learning and traditional course formats effectively presented material and enhanced knowledge levels of the students in

multimedia systems. Also, no significant difference was found in pre-testand post-test scores between the groups. One possible reason for the success of both the blended and the traditional method of instruction could be that each of the two models represented a student-centered approach to learning. Traditional face-to-face instruction tends to be teacher-centered with the focus being on what and how the teacher chooses to teach. In a student-centered approach to learning, the learner is center-stage. Course material for this particular multimedia course was designed in such a way that students apply concepts to their personal and immediate learning situations. Module questions and situational scenarios were meant to be answered based upon the individual experiences of each student. In other words, each student had a unique interaction with the concepts presented throughout the course modules. This was true for both versions of the course.

A second potential explanation for this dual success was the strength and consistency of the curriculum itself. The content was based upon solid educational and psychological research (Tuckman, 2002) and the structure of the course limited the ability of students to procrastinate. All students should have completed the modules within the specified time frame. It cannot be determined, based upon the available data, exactly when within that timeframe students actually completed the work. BLI students, who were more self-regulated, may have completed the work immediately while the CLI students, who had higher procrastination tendencies, may have waited until the very end of that timeframe to complete the work. Thus both completed the work within the specified time, but the procrastination variable appears to have been still in play.

Another possibility for the non-significant differences could be due to sample size of both groups. This study was not a true experimental design with randomized participants but rather a quasi-experimental study with samples of convenience. At the time the data were collected, there was a very limited pool of available participants in both groups of the course for whom research permission had been granted. Therefore, every available participant was included in the analysis.

Nevertheless, blended students significantly outscored traditional students in the second and third written exam and the final course grades. This may have occurred because the blended course format may actually lend itself to more active learning due to students' becoming more responsible for learning the content on their own time, while classroom time is spent with application of newly acquired knowledge. Therefore, active learning may also account for the higher grades in the blended group.

Additionally, this study found significant differences in class satisfaction between the blended learning section and the traditional sections, with blended learners reporting a higher level of class satisfaction. The blended learning design focused on active learning in the classroom portion of the course; the students might have higher satisfaction ratings due to the enjoyment of the in-class portion, and not necessarily the blended design.

This finding was fairly consistent with other studies in the literature which seem to indicate that student knowledge acquisition and success rates in blended courses was equivalent (Delialioglu and Yil-dirim, 2008) or slightly superior to traditional courses (El-Deghaidy and Nouby, 2008; Schober et al., 2006; Vernadakis et al., 2011). In addition, studies have shown that most online learners do prefer some face-to-face contact with instructors and tend to be more successful when this occurs, thus supporting the blended course model (Riffel and Sibley, 2005; Schober et al., 2006).

LIMITATIONS

Given that this study was not a true experimental study, there are certain limitations inherent in the sample groups. The participants used were samples of convenience pulled from a population of course-enrolled students who had given permission during the first week of class for their course data to be collected and used for future research. The limitations of the sample groups include, but are not limited to, non-randomization of participants and personal characteristics of the students within each group. Another limitation is that the course used is an elective course. The students who choose to enroll in this elective course may be very different in character, maturity, motivation, and ability than students who chose not to take the course. Finally, the results reported in this study are based on a single asynchronous course management system. This is a case-specificity problem. It is possible that a different type of course management system package covering different content would yield different results.

CONCLUSION

In conclusion, this study has revealed that the blended course has the potential of bringing the best ends of two worlds together through its possibility of meeting diverse learning needs with its multiple modes of delivery. Student learning and satisfaction could increase when the instructor provided learning environments not only in a traditional classroom, but in an asynchronous e-learning platform as well. However, because the demands on both students and faculty were higher in a blended course, enough adequate transition and preparation should be given before rushing into any blended learning.

Recommendations emanating from the study include repeated research on achievement and satisfaction among different course formats in general physical education courses, accompanied by longitudinal studies to determine any long-term effectiveness. An important consideration will be whether students can continue to have acceptable achievement and satisfaction scores when blended formats are applied to upper level courses of various degree programs with more specialized content material. One may find that initial documented success of the blended format may be limited to lower level undergraduate courses.

REFERENCES

Abdous, M., & Yoshimura, M. (2010). Learner outcomes and satisfaction: A comparison of live video-streamed instruction, satellite broadcast instruction, and face-to-face instruction. *Computers & education*, *55*(2), 733-741.

Allen, I. E., & Seaman, J. (2008). *Staying the course: online education in the United States, 2008*. Needham MA: Sloan Consortiun

Alonso, F., López, G., Manrique, D., & Viñes, J. M. (2005). An instructional model for web-based e-learning education with a blended learning process approach. *British journal of educational technology*, *36*(2), 217-235.

Bolliger, D. U., & Wasilik, O. (2009). Factors influencing faculty with online teaching and learning in higher education. *Distance education, 30*(1), 103-116.

Centra, J. A. (1993). *Reflective faculty evaluation: Enhancing teaching and determining faculty effectiveness*. San Francisco, CA: Jossey-Bass Inc.

Deliyannis, I. (2006). *Information society and the role of interactive multimedia.* Athens, GR: Fagotto books.

Delialioglu, O., & Yildirim, Z. (2008). Design and development of a technology enhanced hybrid instruction based on MOLTA model: Its effectiveness in comparison to traditional instruction. *Computers & education, 51*(1), 474-483.

El-Deghaidy, H., & Nouby, A. (2008). Effectiveness of a blended e-learning cooperative approach in an Egyptian teacher education programme. *Computers & education, 51*(3), 988-1006.

Fortune, M. F., Shifflett, B., & Sibley, R. E. (2006). A comparison of online (high tech) and traditional (high touch) learning in business communication courses in Silicon Valley. *Journal of education for business, 81*(4), 210-214.

Green, B. S., & Salkind, J. N. (2007). *Using spss for windows and macintosh* (5th Ed.). Upper Saddle River, NJ: Prentice Hall.

GUnet asynchronous eLearning group. Platform description (Open eClass 2.3) [online]. 2010 [cited 2010 Dec 18]. Available from: http://eclass.gunet.gr/manuals/OpeneClass23_en.pdf

Harker, M., & Koutsantoni, D. (2005). Can it be as effective? Distance versus blended learning in a web-based EAP programme. *ReCall, 17*(2), 197-216.

Low, C. Too much e-learning ignores the latest thinking in educational psychology [online]. 2007 [cited 2010 Dec 8]. Available from: http://www.trainingreference.co.uk/e_learning/e_learning_low.htm

Macdonald, J. (2008). *Blended learning and online tutoring* (2nd Ed.). Hampshire, UK: Gower.

Mansour, B. E., & Mupinga, D. M. (2007). Students' positive and negative experiences in hybrid and online classes. *College student journal, 41*(1), 242-248.

Marsh, H. W. (1982). SEEQ: a reliable, valid, and useful instrument for collecting students' evaluations of university teaching. *British journal of educational psychology, 52,* 77-95.

Olapiriyakul, K., & Scher, J. (2006). A guide to establishing hybrid learning courses: Employing information technology to create a new learning experience, and a case study. *Internet & higher education, 9*(4), 287-301.

Oliver, R. (2001). Developing e-learning environments that support knowledge construction in higher education. In S. Stoney & J. Burn (Eds.), *Working for excellence in the economy* (pp. 407-416). Churchlands: Australia, We-B Centre.

Papastergiou, M. (2007). Use of a course management system based on claroline to support a social constructivist inspired course: A Greek case study. *Educational media international, 44*(1), 43-59.

Paechter, M., Maier, B., & Macher, D. (2010). Students' expectations of, and experiences in e-learning: Their relation to learning achievements and course satisfaction. *Computers & education, 54*(1), 222-229.

Riffell, S., & Sibley, D. (2005). Using web-based instruction to improve large undergraduate biology courses: An evaluation of a hybrid course format. *Computers & education, 44*(3), 217–235.

Schober, B., Wagner, P., Reiman, R., Atria, M., & Spiel, C. (2006). Teaching research methods in an internet-based blended-learning setting. *Methodology, 2*(2), 73-82.

Tabor, S. (2007). Narrowing the distance: Implementing a hybrid learning model for information security education. *The quarterly review of distance education, 8*(1), 47-57.

Thurmond, V. A. (2002). Considering theory in assessing quality of web-based courses. *Nurse educator, 27*(1), 20-24.

Tuckman, B. W. (2002). Evaluating ADAPT: A hybrid instructional model combining web-based and classroom components. *Computers & education, 39*(3), 261-269.

Vernadakis, N., Antoniou, P., Giannousi, M., Zetou, E., & Kioumourtzoglou, E. (2011). Comparing hybrid learning with traditional approaches on learning the microsoft office power point 2003 program in tertiary education. *Computers & education, 56*(1), 188-199.

Woo, Y. & Reeves, T. C. (2007). Meaningful interaction in web-based learning: a social constructivist interpretation. *Internet and higher education, 10*(1), 15-25.

Young, L. E., & Maxwell, B. (2007). Teaching nursing: theories and concepts. In L. E. Young & B. L. Paterson (Eds.), *Teaching nursing: Developing a student-centered learning environment* (pp. 8-19). Philadelphia: Lippincott Williams and Wilkins.