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The Effects of Blended E-Learning on Mathematics and Computer Attitudes in Pre-Calculus Algebra

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Abstract**:** This study examines the influence of blended e-learning on students' attitude towards mathematics and computers. A random sample of 70 students of the preparatory year program of King Fahd University of Petroleum & Minerals (KFUPM), Dhahran served as the sample of this study. Data were collected at the beginning (pre-program) and the end (post-program) of the semester using Aiken Mathematics Attitude Scale and Greessen and Loyd Computer Attitude Scale. The result indicates that the subjects have positive attitude towards mathematics and computer. However, analysis of variance shows no statistically significant change in students' attitudes towards mathematics and computer except for computer confidence and anxiety subscale.

Keywords: Affect; E-learning; Computer attitudes; Mathematics attitudes; Math anxiety

1. Introduction

Attitude has been defined as "a learned predisposition to respond positively or negatively to a specific object, situation, institution, or person" (Aiken 2000: 248). Therefore, attitude affects people in everything they do and in fact reflects what they are, and hence a determining factor of people's behavior. Also, it provides people with a framework within which to interpret the world and integrate new experiences (Galletta and Lederer, 1989). That is to say by understanding an individual's attitude towards something, one can predict with high precision the individual's overall pattern of behavior to the object (Ajzen and Fishbein, 1977). Some educators defined learning as a change in behavior. Since attitude is the determining factor of peoples' behavior, the issue then is critical in education. It is a common practice that if a new program is introduced part of the evaluation is to determine people's attitude toward the program. In most cases, positive attitudes are interpreted as an indicator that the program may succeed. Otherwise, there is a tendency of failure, and so, the attitude needs to be modified or possibly changed.

Mathematics as a subject has remained mysteriously difficult and unpopular for most students. This is despite the fact that no one is in doubt of its importance in almost all careers, especially in the science and technological fields. Many studies have found attitude to be one of the stumbling block for progress or otherwise in learning mathematics (Aiken, 1976). A strong correlation between mathematics achievement and attitude has been found in many studies, and that the two interrelates and affects each other in a reciprocal manner (Aiken, 1970 & 1985, Reyes 1984). Studies have shown that students that have positive attitude toward mathematics tend to do well in the subject, and students that have negative attitude toward mathematics tend to perform badly

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in the subject (Begle, 1979). As a result, intensive research has been done to determine students' attitude towards mathematics in relation to different variables. The aim was to identify the variables that can assist in developing positive attitude of students towards mathematics or at least reduce negative attitude. Most of these efforts are through modification/innovation of instructional approaches that make the subject attractive to the students. According to (Aiken 1976), most of these experimental methods of teaching mathematics have not been shown to be superior to traditional methods with respect to changes in attitude towards the mathematics. However, research has shown that technological aids such as calculators and computers have improvement effects on students' attitudes toward mathematics (Aiken, 1976; Collins, 1996).

On the other hand, given the pervasiveness of computers in all levels of educational system, it is likely that students will have developed some attitudes towards these machines. In a classroom setting, studies have shown that students often experience reactions towards computers either positively or negatively. This in turn either enhances or interferes with their development of effective learning (Geer, White & Barr, 1998). Furthermore, attitude towards computers has been found to influence not only the acceptance of computers in classroom, but also future behavior, such as using a computer as a professional tool or introducing computer applications into the classroom (see Al-Badr, 1992). A student with a negative attitude towards computers may not pay attention to anything to do with computers. Similarly, students that are computer enthusiasts may pay attention to any program that is computer based and this may influence their attitudes toward the subject. Studies have shown that computer attitudes are a strong predictor of performance and evaluation of a computer literacy courses (Batte, Fiske and Taylor, 1986). Some other studies have shown that the use of computer in education has the potential of changing students' attitudes positively towards mathematics and computers (Bangert, Kullik, & Kullik, 1983; Kulik, 1984; Ganguli, 1992 and Funkhouser, 1993).

For instance, Ganguli (1992) investigated the effect of using computers as a teaching aid in mathematics instruction on student attitudes toward mathematics. He used computers as a supplement to normal class instruction. The sample in the study consisted of 110 college students enrolled in four sections of an intermediate algebra class offered by the open-admissions undergraduate unit of a large Midwestern state university. The instruction focused on how to develop the concept of relationship between the shape of a graph and its function. The results indicated that the attitudes of the experimental group which was taught with computer aid were significantly changed in a positive direction whereas the control group that was taught without computer aid failed to show a similar result. Similarly, the results have shown that students in the microcomputer treatment group experienced a more positive self-concept in mathematics, more enjoyment of mathematics and more motivation to do mathematics than their counterparts in the control group. Furthermore, the two instructors who participated in the study both indicated that the computer-generated graphics led to more active classroom discussions in experimental sections and consequently created more rapport between the teacher and the students than in the control sections.

In a similar study conducted in Saudi Arabia, Al-Rami (1990) examined the students' attitude toward learning about and using computers and correlated their attitudes with their achievements in computer classes. One hundred and seventy two male students participated. Student attitudes were determined at the beginning and end of the semester using the Computer Attitude Scale (Loyd and Gressard, 1984). Academic achievement was based on end-of-semester scores. Findings indicate that students' attitudes toward computers were positive at all semester levels

and almost the same at the beginning and end of the semester. Both pre-test and post-test attitude results were statistically significant in predicting achievement, with the post-test shown to have be more reliable in predicting achievement.

However, despite all these, very little is known on the effect of blended e-learning to students' attitudes towards mathematics and computers, especially among the pre-calculus algebra students. In line with this, this study seeks to explore this area of endeavor as it is a necessary step for successful blended learning.

2. What is blended E-Learning?

Education is one of the sectors that most benefited from the current technological advancement. With this development, time and space are no more barrier to education. As a matter of fact, the concept of distance learning has been revolutionized to what is now known as e-learning or Web-based learning programs. However, it has been observed that the first generation of e-learning programs focused on presenting physical classroom-based instructional content over the internet with very little attention given to the peculiar nature of this delivery program in comparison to the tradition classroom lesson (Singh, 2003). This observation has lead educators and researcher to realize that the two approaches are structurally different and so direct translation of traditional material to online will in no way yield a successful program. In addition, learning styles of each learner tend to be different, and hence, "a single mode of instructional delivery may not provide sufficient choices, engagement, social contact, relevance, and context needed to facilitate successful learning and performance" (Singh, 2003). An attempt to accommodate all these realized challenges is what lead to what come to be known as blended learning or blended e-learning. According to Singh,

> Blended learning mixes various event-based activities, including face-to-face classrooms, live e-learning, and self-paced learning. This often is a mix of traditional instructor-led training, synchronous online conferencing or training, asynchronous self-paced study (Singh, 2003).

Originally, blended learning according to Singh was often associated with simply linking traditional classroom training to e-learning activities; however, the term has now evolved to encompass a much richer set of learning strategies or dimensions. It is the combination of two or more of these dimensions that is today referred to as a blended learning. For a more detailed description of blended learning concept and it theoretical framework, one can see Badrul Khan (1997, 2001) and Sing (2003).

3. Methodology

A one semester experiment was designed to conduct the experiment and collect data for this study. Data were collected at the beginning (pre-program) and at the end (post-program) of the experimental semester. The pre-questionnaires was administered during the first week of the semester, and the post-questionnaire was given to the students in the last week of the semester. The software MINITAB was used to analyze the data collected.

3.1 Sample

The subjects of this study were 70 randomly selected students of the second pre-calculus course at the Prep Year Math program at King Fahd University of Petroleum & Minerals, Dhahran Saudi Arabia. These students are fresh from high school where the mode of teaching and the language of instruction are completely different. As a result of language switched from Arabic to English, all newly admitted students undergo a one year intensive English training. At the same time they are required to take two compulsory pre-calculus algebra courses (Math 001 and 002). The subjects of this study were the second pre-calculus course (Math 002) students at the preparatory year program at KFUPM.

3.2 Design of the experiment

Simplest form of blended learning was used in this experiment due to the fact that at the preparatory year, students are undergoing academic, social and environmental adjustment, and hence, need to be handled with sensitivity. Two modes of learning implemented during the experiment are the online and offline forms. The offline learning consisted of normal classroom lecture that was conducted three times in a week in a more or less traditional manner. The online learning consisted of a weekly computer lab session and availability of online learning resources in the intranet and internet available to the students. WebCT was used as a delivery mood of the online part of this course. Accounts were created for each student in the WebCT, and the following were some of the online activities of the students during the experiment.

- MATLAB manual was provided for the students online to enable them see an alternative way of solving problem using mathematical software. This was placed in WebCT platform for reference.
- Resources related to the material of the course were made available in the prep-year website for students' perusals. This includes solutions of the past exams, homework, and quizzes. The subjects were encouraged to use them.
- Some problems were posted online on weekly basis for the student to solve and submit online. These problems are usually none traditional, and in most cases students will require the uses of some software like MATLAB to solve.
- Self-Tests were provided online on regular basis. Students were expected to take these tests at their free time, and immediate feedback was provided to guide the student on his performance.
- Solutions of the exercises and exams are provided online.
- All announcements were sent online through WebCT
- Online discussion forum and e-mail communication was part of the program, and were vie WebCT.

3.3 Measurement

The Mathematics Attitude Scale by Aiken (2000) was used in this study for measuring students' attitude towards mathematics. Many different scales for measuring attitude towards mathematics and science are associated with Aiken. Three of these scales were reported in (Taylor, 1997). According to her, all the three scales "are characterized by their brevity, simplicity, and as such are useful instruments for both the teacher and the researcher" (p.125).

On the other hand, Computer Attitude Scale (CAS) developed by Loyd and Gressard (1984) was used to measure students' attitudes. According to Nash and Moroz (1997), the Scale is one such measure of attitude towards computers which has been used extensively with college students and professional educators. CAS consists of four separate subscales of different dimensions, these are: computer anxiety, which assesses the fear of computers; computer confidence, which assesses the confidence in the ability of dealing with computers; computer liking, which assesses the enjoyment of dealing with computers; and computer usefulness, which assesses the perception of the proliferation of computers on future jobs.

4. Results and Discussion

Table 1 presents the summary of the results in this study. The first column is the scales and their subscales. The second column gives the number of students that responded in the pre and post program. The third column is for the mean of the score of both the pre and post program, while the fifth column is for standard deviation of the two scores. The result of F-statistics is given in the sixth column, and the last column gives the significance or p-values. As can be noted from Table 1, only 50 students responded to the questionnaire during the pre-program data collection, and 65 responded in the post-program.

TABLE 1
Descriptive statistics and the summary of F and p-value of the comparison between Pre-program and Post-program data

Scale		N		Mean		Sta.Dev.		F	p
		Pre	Post	Pre	Post	Pre	Post		
Mathematics attitudes		50	65	55.22	51.51	12.57	10.29	3.03	0.08
Computer attitudes (total)		50	65	111.9	106.0	22.70	16.56	2.60	0.109
	Anxiety	50	65	28.64	26.19	6.30	5.09	5.35	0.023*
	Confidence	50	65	30.04	27.22	5.78	5.45	7.20	0.008*
	Liking	50	65	27.68	26.74	5.10	4.09	1.21	0.27
	Usefulness	50	65	29.66	28.49	5.49	4.96	1.43	0.24

*significant at p = 0.05

To be able to have a good interpretation of the data summary in Table 1, it is worth noting that in the computer attitude scale, the minimum point that one can obtain if he answer all the questions is 40, while the maximum is 160. Therefore, a student with a score of 100 or above is considered having positive attitudes. Similarly, in the mathematics attitude scale, student that answered all the questions gets a minimum score of 20, while the maximum is 80. Hence, a student with a score of 50 or above is considered having positive attitude toward mathematics. The mean of both mathematics and computer attitudes (total) in Table 1 indicated that the subjects have positive attitude towards mathematics and computer, and this was maintained in both pre-program and post program data. The subject appeared to have slightly higher mean in the pre-

program data, but the difference is not statistically significant in almost all the items except for Computer Confidence ($p = 0.008$) and Anxiety (0.023). This finding is not inline with what was mostly reported in the literature; that the more computer use the less the anxiety and the more confidence (Or, 1997, Loyd and Gressard, 1984). It is difficult to trace the real reason for this slight change. However, a possible interpretation is that in addition to sudden change in the medium of instruction, the system in the preparatory year at KFUPM is more rigorous and higher in standard than what the students were used to in high schools. Consequently, at the end of each academic semester, a good number of students get exhausted and sometime frustrated. This frustration may result to some negative response. But this change is not peculiar to this experiment, rather general. Another possible reason might be due to the variation in the number of respondents in the pre and post data. As can be noted in Table 1, there are 15 people difference in the pre (50) and post (65) data. It is possible that most of those that did not respond in the first place are negatively oriented and so their responses in the post program bring down the mean. In any case, if the slight change of attitudes is due to the program, this was not noticed throughout the experiment. Student spent a lot of their time working and experimenting with various problems in the lab. Many students were fascinated with different type of graphs they were able generate using MATLAB, and the mathematics discussion in the webCT. The only complain we receive from some pocket of students was that they felt overworked compared to their other colleagues who were taking normal lecture in a traditional mood only, but they all agree that they have leant much more.

5. Conclusion

This study investigated the effect of blended e-learning on students' computer and mathematics attitudes. Student underwent a semester experiment of learning pre-calculus in both online and offline approach. Data were collected regarding students' attitudes towards mathematics and computer at the beginning and at the end of the program. Statistical methods were used to analyzed the data collected. The results did show any significant effect of the program in students attitudes toward mathematics and computers in all the items measured except for computer confidence and anxiety.

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