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REDUCING MATH ANXIETY OF CCS STUDENTS THROUGH E-LEARNING IN ANALYTIC GEOMETRY

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ABSTRACT

This study was conducted in an undergraduate level with the use of e-learning particularly in analytic geometry to lessen the common fear of Filipino students to mathematics. Since teen age students used to engross themselves with the use of technology specifically computers, this study maximized the capability of computers in reducing math anxiety by teaching mathematics subject using e-learning thus improving student academic performance.

Keywords: Math Anxiety, E-learning, academic performance, learning in mathematics

INTRODUCTION

Computer-based technologies are now commonplace in classrooms, and the integration of these media into the teaching and learning of mathematics is supported by government policy in most developed countries. However, many questions about the impact of computer-based technologies on classroom mathematics learning remain unanswered, and debates about when and how they ought to be used continue (Lynch, 2006).

There are a lot of advantages in using e-learning in the in-school and off-school settings in the Philippines. It allows interactivity between the lesson and the learner. The individualization of each learner is enhanced (Manzano, 2002).

It is a common fact that most of the college students tend to choose courses on the basis that the particular course has less mathematics subjects and that the students tend to consider that mathematics is a very hard subject.

The authors consider fear in mathematics particularly called mathematics anxiety which can be reduced if the lessons will be presented using the computer and particularly be implemented as an E-learning.

Analytic Geometry was the subject for consideration since the subjects deals with diagrams, drawing of figures, translating formula into figures which was presented in animation and using different multimedia application techniques which are part of E-learning.

The Bachelor of Science in Computer Science (BSCS) students who are enrolled in Math 4 – Analytic Geometry were the subjects of the study. The subject was offered during the first semester of Second year level. Two sections were used for the study, one as the experimental group and the other as the control group. The pairing of students was done based on the final grades of the students to the two subjects (Algebra and Trigonometry) that they have taken prior to Analytic Geometry.

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E-learning as an additional mode of teaching Analytic Geometry was used to determine the math anxiety among students thus before and after the study, enhancing the student performance in the subject.

With the commitment of the College of Computer Studies (CCS) to its research agenda entitled "ICT Use and Utilization for the Improvement of Delivery of Instruction", this research would be an addition to the efforts of the college to be true to its mission to provide quality IT education.

The result of this research will provide more avenues for more researches that can be conducted by the college.

OBJECTIVES OF THE STUDY

The objectives of this study are as follows : (1). use and implement a previously developed E-learning on selected topics (circle and parabola) in Analytic Geometry that can be presented in an interesting manner and provide graphical presentation of the figures and diagrams of formulas in Analytic Geometry with animation for easy understanding of the students; (2). adopt and use an instrument to determine the level of math anxiety of CCS students; and (3) determine the level of math anxiety of students as can be reduced by using an E-learning on selected topics in Analytic Geometry and their attitude towards mathematics.

Math Anxiety

Mathematics anxiety which can be extreme is often caused by having a negative attitude due to a previous bad experience. Studies show that one-half of all students in a developmental mathematics class suffer forms of this type of anxiety. The good news is that a student can manage this behavior but must learn to manage both the stress as well as improve the basic mathematic skills.

According to Nordin (2008), teachers need to be aware of the effects of anxiety on students' achievement and motivation. They should make an effort to lessen anxiety on these students. Teachers should develop teaching strategies that help highly anxious students.

The study by Nordin investigated whether there was a statistical difference between matriculation students' motivation and achievement when they were classified according to the math anxiety levels. Further, that study also sought to find out whether there was a significant correlation between (a) mathematics anxiety and motivation, and (b) mathematics anxiety and achievement.

Technology in Education - E-learning

According to the dissertation of Akir (2006), the most exciting feature about technology enhanced education is the abundance of communication tools available. Learning is a communication process. Two-way communication is vital for learning to occur. When students have questions, instructors need to provide feedback and students need to discuss among themselves. Such interactivity is facilitated with the tools now available in classroom and online education applications.

Through communication, learners can share their experiences, discuss with instructors and peers asynchronously or in real.

According to Chiang (2005), several problems exist in the process of teaching in the traditional, non-electronic classroom. With limitations on space and time, it is very difficult for one teacher to provide equally effectively for all students in a class given their differing abilities, interests, preferences and learning styles. The reiterative and simultaneous characteristic of e-learning system improves above problem and promotes adaptive learning.

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Also, web-based learning systems and electronic materials allow users to repeat exercises and to learn simultaneously. This learning mode helps overcome the limitations of time and space in the classroom. It also promotes adaptive learning in a class with one teacher and many students.

In the study of Dharaksar (2005), the innovative e-learning techniques have drastically reduced the teaching time of computer graphics. The experience shows that these e-learning techniques make the teaching-learning process four times faster than classrooms teaching. The new method is more effective than traditional methods of teaching. It also helps a lot for the memory retention process of students for this subject and thus 60% classroom teaching can be replaced using the technique.

An article from the Data Access Center entitled "Computer – Aided Instructions and Mathematics "revealed that "Computer-assisted instruction improves instruction for students with disabilities because students receive immediate feedback and do not continue to practice the wrong skills. Many computer programs can move through instruction at the student's pace and keep track of the student's errors and progress. Computers capture the students' attention because the programs are interactive and engage the students' spirit of competitiveness to increase their scores. Also, computer-assisted instruction moves at the students' pace and usually does not move ahead until they have mastered the skill. Programs provide differentiated lessons to challenge students who are at risk, average, or gifted".

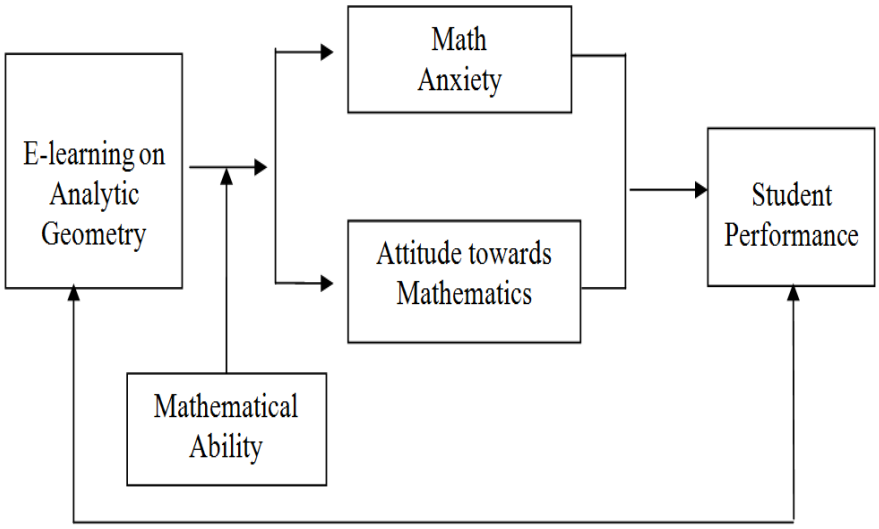

Figure 1. Framework

Subjects of the Study

This study was limited to the investigation on the effects of e-learning to the math anxiety and attitude of the students towards mathematics.

Specifically, the experimental study was conducted at the Lyceum of the Philippines – Batangas during the First Semester, school year 2008-2009, on students enrolled in Math 4 – Analytic Geometry particularly on the topics of circles and parabolas. Further, the study was conducted for a period of 4 weeks for the period of after Midterm up to Semifinal Exam (August to September).

Two sections of BSCS – Bachelor of Science in Computer Science were used such that one section was taught by E-learning using the blended mode (BSCS II-A) and the other (BSCS II-B) was subjected to the traditional class and the other section was subjected to e-learning.

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The effects of e-learning in reducing math anxiety were measured by using instruments adopted from different studies.

There were 20 students in each section. They were initially classified into three ability groups based on their average grades in all mathematics taken (Algebra and Trigonometry) prior to Analytic Geometry. The data were taken from the OPRHA system and the classification of the students according to mathematical ability followed the guide.

Table 1. Classification of Students According to Mathematical Ability

Grade Point Average	*Mathematical Ability*
88 – Above	Above Average
84 – 87.99	Average
Below – 83.99	Below Average

Since Lyceum of the Philippines University Batangas adopt the grade point average by using a transmutation table, the following table will be used to convert the grade point average.

Table 2. Conversion of Grade Point Average

Grade Point Average	*Mathematical Ability*
2.00 – Above	Above Average
2.25	Average
2.75 and below	Below Average

The Attitude Scale

To assess the attitude of the participants towards mathematics, the attitude scale developed by Sillorequez (1997) was used. This instrument was designed to measure attitude towards mathematics as a school subject and towards its application in life.

This instrument is a Likert-scale type which consists of 30 items, 15 of which are positively oriented and the other 15, negatively oriented. Its reliability coefficient is high (0.91), which means that the instrument has high internal consistency reliability.

Scoring was based on the respondent's agreement or disagreement with each statement using the 5-point scale as follows:

Table 3. Scoring based on Likert-Scale

Response	*Positive statement*	*Negative Statment*
Strongly Agree	5	1
Agree	4	2
Undecided	3	3
Disagree	2	4
Strongly Disagree	1	5

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Mean Scores of the respondents in the attitude scale were interpreted as follows:

Table 4. Mean Scores in the Attitude Scale

Mean Score	*Level of Attitude Towards Mathematic*
4.20 – 5.00	Very positive/Very favourable attitude
3.40 – 4.19	Positive/Favourable attitude
2.60 – 3.29	Undecided/Neither positive nor Negative attitude
1.80 – 2.59	Negative/Favourable attitude
1.00 – 1.79	Very negative/ Very unfavourable attitude

Data Analysis

The mean and standard deviation were used to describe the grades of the students in the mathematics subjects that they have taken prior to Analytic Geometry. The GPA for Algebra and Trigonometry were computed both for the control and experimental groups.

The t-test for dependent samples were used to determine if there is significant difference between the scores of the students using the blended mode and traditional mode. To determine if there is significant difference between the students who were taught using traditional mode of teaching and e-learning mode, the t-test for independent samples were used.

To find out if the effect of e-learning mode is moderated by mathematical abilities of the students, the two-way analysis of variance (ANOVA) was used.

All statistical computations were processed using the SPSS (Statistical Packages for Social Sciences).

RESULTS

Comparability of the Control and Experimental Group

To assure that the control and the experimental groups were initially comparable before the actual experiment, the two groups were compared in terms of grade point average. The students were categorized based on the grade point averages of the control and experimental group.

Table 5. Profile of the Participants of the Study According to Mathematical Ability

	Control Group		*Experimental Group*	
	Number of Students	*Percentage*	*Number of Students*	*Percentage*
Above Average	5	25%	8	40%
Average	1	5%	4	20%
Below Average	14	70%	8	40%
Total	20	100%	20	100%

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Table 1 shows that 5 students or 25 percent of the control group are above average compared to the 8 students of 40% of the experimental group. In terms of the average students, there is only 1 or 5 percent of the control group while there are 4 students or 20 percent in the experimental group. There is a trend that the experimental group is better than the control group since the number also of below average students' favours the experimental group since there are 14 students or 70 percent below average for the control group while the experimental group has only 8 students or 40 percent only. It also shows that majority of both classes are dominated by below average students. Also, since less of the students belong to the above average group; new ways of teaching mathematics should be delivered to enhance learning of the students.

Table 6. Grade Point Average (GPA) of the Students in the Control Group based on All Mathematics Courses Taken

Student No.	*Math 1*	*Math 2*	*Average*
1	1.25	1.50	1.38
2	1.50	2.00	1.75
3	2.25	1.25	1.75
4	2.00	1.75	1.88
5	2.00	2.25	2.13
6	2.25	2.25	2.25
7	2.25	2.75	2.50
8	2.25	2.75	2.50
9	2.50	2.50	2.50
10	2.75	2.50	2.63
11	2.75	2.50	2.63
12	2.75	2.50	2.63
13	2.75	2.50	2.63
14	2.50	2.75	2.63
15	2.75	2.50	2.63
16	2.75	2.50	2.63
17	2.50	3.00	2.75
18	2.75	3.00	2.88
19	3.00	2.75	2.88
20	2.75	3.00	2.88
		Mean	*2.42*
		Std Dev	*0.43*

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Table 6 shows the grade point average of the students in the control group based on the average of the mathematics taken such as College Algebra and Plane and Spherical Trigonometry prior to their subject Analytic Geometry. Since the average is arranged from highest to lowest so as to get the pairing of each student in the control group to the experimental group, it showed that the highest is 1.38 while the lowest is 2.88.

The overall mean also reflected that in addition to the result of table 1, majority of the students in the control group are below average as shown by the overall mean of 2.42.

Table 7. Grade Point Average (GPA) of the Students in the Experimental Group Based on All Mathematics Courses Taken

Student No.	*Math 1*	*Math 2*	*Average*
1	1.25	1.75	1.50
2	1.25	1.75	1.50
3	1.50	1.75	1.63
4	1.75	1.75	1.75
5	1.75	2.00	1.88
6	2.25	2.00	2.13
7	2.00	2.25	2.13
8	2.00	2.25	2.13
9	2.25	2.25	2.25
10	2.25	2.25	2.25
11	2.00	2.50	2.25
12	2.25	2.25	2.25
13	2.25	2.50	2.38
14	2.50	2.25	2.38
15	2.50	2.50	2.50
16	2.50	2.50	2.50
17	2.50	2.75	2.63
18	2.75	2.75	2.75
19	2.75	2.75	2.75
20	2.75	3.00	2.88
		Mean	*2.22*
		Std Dev	*0.41*

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Table 7 shows the grade point average of the students in the experimental group of the mathematics subjects taken such as College Algebra and Plane and Spherical Trigonometry prior to Analytic Geometry. The overall mean of 2.22 also showed that majority of the students in the experimental group are below average also like the control group.

Table 8. Weighted Average of Attitude of the Control and Experimental Group

Student No.	*Control*	*Experimental*
1	3.00	2.87
2	2.77	2.23
3	2.90	2.87
4	3.07	3.00
5	2.97	3.13
6	2.87	3.00
7	2.37	2.70
8	2.90	3.00
9	3.00	2.87
10	2.67	2.57
11	2.23	3.10
12	2.67	2.90
13	2.97	2.83
14	2.67	2.80
15	3.27	2.97
16	2.87	2.80
17	2.77	2.57
18	2.87	2.23
19	2.73	3.00
20	2.73	3.07
Mean	*2.82*	*2.83*
Std Dev	*0.23*	*0.26*

Table 8 shows that the weighted average of the attitude of both the control and experimental group is undecided/neither positive nor negative attitude. This warrant the status that the two groups are comparable since their status is the same as a best assumption for the conduct of the study.

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Table 9. Weighted Average of Level of Math Anxiety of the Control and Experimental Group

Student No.	*Control*	*Experimental*
1	1.80	3.20
2	2.00	3.00
3	2.30	2.20
4	2.20	2.70
5	1.70	1.50
6	2.80	2.70
7	3.20	2.50
8	2.30	2.40
9	2.90	2.70
10	2.10	3.20
11	3.60	2.20
12	4.00	2.40
13	3.00	2.80
14	3.70	2.30
15	3.10	1.80
16	2.70	2.80
17	3.10	2.10
18	2.80	3.40
19	2.70	2.90
20	2.40	1.90
Mean	2.72	2.54
Std Dev	0.63	0.50

Table 9 showed that the weighted average of level of math anxiety of the control and experimental group mean that perhaps the two group had math anxiety that's why e-learning will be used to at least reduce or finally remove fear of mathematics being experienced by the participants.

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Table 10. Scores of the Experimental and Control Group in the Exam in Circle

Student Number	*Experimental*	*Control*
1	86	95
2	94	88
3	94	88
4	98	88
5	96	89
6	93	75
7	89	80
8	84	85
9	92	75
10	89	75
11	83	85
12	94	85
13	86	75
14	94	80
15	85	85
16	90	85
17	85	80
18	89	75
19	92	75
20	85	75
Mean	89.90	81.90
Std Div	4.33	6.02

Table 10 showed the scores of the experimental and the control group in the exam on the topic circles. It can be inferred that even if the two groups have the same mathematical capability as shown by their GPA in the previous tables, it can be observed that there is an improved scores for the particular exam of the experimental group, meaning the use of e-learning helped them a lot in improving their exam scores.

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Table 11. Scores of the Experimental and Control Group in the Exam in Parabola

Student Number	*Experimental*	*Control*
1	90	90
2	95	80
3	95	90
4	95	90
5	97	80
6	95	83
7	92	77
8	80	75
9	90	75
10	85	83
11	80	75
12	85	88
13	80	83
14	93	83
15	87	83
16	88	78
17	91	88
18	90	75
19	90	83
20	91	80
Mean	84.95	81.95
Std Dev	5.10	5.09

Table 11 showed the scores of the experimental and the control group in the exam on the topic parabola. It can be inferred that even if the two groups have the same mathematical capability as shown by their GPA in the previous tables, it can be observed that there is an improved scores for the particular exam of the experimental group, meaning the use of e-learning same in the topic circles helped them a lot in improving their exam scores.

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Table 12. T-test results for Paired Samples (Two-tailed Test)

	t-test result
GPA	0.0000029560
Scores in Circle	0.0000753677
Scores in Parabola	0.0000302733
Attitude in Math	0.8886276600
Math Anxiety Text	0.3506699550

Table 12 shows the values obtained by doing the t-test for paired samples to test the hypothesis. Using the two-tailed test, the results showed that there is no significant difference in the mathematical ability of the two groups as shown by the t-test value of 0.0000029560 < the tabular value of 0.196016. As such, the assumption that the two groups can be paired is in order to test the effect of the e-learning is justifiable.

CONCLUSIONS

Topics on circles and parabolas are to be taught using the e-learning since these topics can best be presented through diagrams that needs animation and visual presentation that will enhance the learning of students Also, as a product of another finished study, a developed module on e-learning of the said topics was used to determine its effects on students academic performance.

An existing non-standardized instrument available in the internet was adopted to measure the level of math anxiety of the participants. Also, an instrument to measure the attitude of students towards mathematics, developed through the dissertation of Sillorequez, was used since it was developed and validated for the purpose.

It was found out from the results of the exams for the particular topics that there is a positive effect on the use of e-learning since there is an improved score of the experimental class on the topics considered thus reducing math anxiety.

RECOMMENDATIONS

Based on the findings of the study, the following are suggested for the college to consider enhancement of their curriculum for future course offerings in the College of Computer Studies.

For the administration to continuously provide the necessary facilities especially in the computer laboratories to meet the demands of the respective courses being offered; The use of e-learning not only in the major subjects of BSCS students especially on the subjects of mathematics will entail additional computer laboratory hours used and that mathematics being considered as a general education subjects will also be conducted inside the computer laboratory using the e-learning mode of teaching.

A similar study should be replicated to other courses with more mathematics subjects in order to further validate the results of the study not only to CCS students. Thus, the same e-learning module used in this study is used also in teaching the same topics to non-CCS students taking Analytic Geometry.

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Faculty members teaching mathematics should find an alternative way of teaching mathematics by integrating technology in the classroom like using e-learning to enhance the interest of the students to mathematics and finally reduce the math anxiety and improve the attitude of students towards mathematics.

For further study, standardized instrument should be used in order to validate the results of the present study.

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