

## **The Potency of Using Math Educational Software in Teaching Business Mathematics Courses**

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### **Abstract**

This study aimed to evaluate the effectiveness of using math educational software in the academic achievement and attitude of the learners in a business mathematics course. The experimental research design was used particularly the pre-test post-test control group design. The experimental group was exposed to math educational software namely, the *QM for Windows* while the control group was taught using the traditional teaching approach. The results of the study showed that the experimental group performed better in academic achievement and showed a higher positive attitude towards the course than the control group. Hence, educational software is effective and has a positive impact on the academic achievement of the learners in business mathematics as well as their attitude toward the course.

**Keywords:** control group; experimental group; posttest; pretest; QM for Windows

### **1. Introduction**

Today, computer has become a very important tool in man's everyday life. Computer technology has emerged as a common tool for communication, text messaging, playing games and many more. Computers are vital for they are significantly utilized in the industry, education, agriculture, health sciences, or even in business and economics. Furthermore, technology is essential in the teaching and learning of mathematics. Several mathematical tools have been developed to facilitate the teaching and learning process that can be utilized for classroom instruction. The integration of such a tool in the teaching-learning process could provide opportunities and benefit students in developing their mathematical knowledge and skills in the learning process. Many researches claim that technology helps the student to visualize certain math concepts better and that it adds a new dimension to teaching mathematics.

According to Adler, et al. (2005), in order to provide a higher quality education for students, capable teachers who are willing to implement creative learning environments with technology for the purpose of maximizing their students' learning success are desperately needed. Therefore, teachers should utilize innovative technology in the classroom to enhance their students' learning opportunities by

creating or selecting an interactive mathematical task that could take advantage on the use of technology like computing, graphing and visualizing. In mathematics education, teachers should provide interactive instructional materials like slides, modules, learning materials, and dynamic mathematical software that could benefit students' learning.

Numerous teachers use educational software packages that allow more flexibility and enable both teachers and students to visualize and explore mathematical concepts in their own creative ways (Barzel, 2007). According to Funglestad (2005), such software makes it possible for the user to plan and decide what to do and it can be used for a wide variety of problems and can provide learning situations to explore and experiment with mathematical connections, and can provide new ways for approaching the task. While students need hardly any computer skills in order to be able to work with prepared virtual manipulatives, both teachers and students need to learn basic skills concerning the operation of specific mathematics software before being able to effectively integrate it into teaching and learning (Preneur, 2008). However, providing the students with mathematical software and basic knowledge and skills needed to operate the tool do not guarantee an effective use and benefit of the learning process but instead, the teacher must select an effective and appropriate mathematical software tool that can solve and enhance the task given to them. Otherwise, this software should be introduced to students.

According to Ochkov & Bogomolova (2015), opponents of the use of any type of computers for learning mathematics in schools and universities have their own hidden agenda. First, many school teachers and university professors, unfortunately, simply do not know how to work with mathematics software. They have mastered the computer at the office level like word processing, spreadsheets, e-mail, browsing the internet but they do not want to go further justifying it that these programs are not good and don't give significant to the learning process. Second, the implementation of these programs in the educational process requires a radical revision of the content and methods of teaching. Mathematics textbooks and collections of problems ought to be rewritten or at least substantially reprocessed (Zimina & Kirillov, 2010). Third, the above-mentioned computer programs are quite expensive. They are not always affordable for schools and colleges because most software requires a license and the license fee is quite expensive. However, some companies that develop math programs give substantial discounts to educational institutions and sometimes these programs are free and can be downloaded from the internet.

Likewise, Sevari & Falahi (2018) mentioned in his study that applying educational software in learning environments is the easiest way to discover and access information resources to prepare students for future life. Also, educational software enhances the initiative's ability to respond to students' ideas and activities. Hence, the integration and the use of educational software delivers a background for the students' innovative ideas. Moreover, the result of the study showed that the use of educational software in the development of flexibility of students' thinking is more effective than the traditional teaching method. Thus the use of educational software can increase the importance of this in students who in dealing with problems and problems when they are transformed or made from another dimension change their thinking and be consistent with the problem. The quality of education depends on taking proper and continuous advantage of educational software in the classroom setting. The learner is in the center of learning by applying for educational software programs and interacts with its environment. Challenging learning environments, emphasis on exploratory learning methods, accountability of

learners in learning and engaging learners with content are other educational software features that lead to mental ability, thinking flexibility, thinking expansion, and student thinking authenticity.

The study of Cheung & Slavin (2013) supports the use of technology on the effects of educational technology applications on mathematics achievement in K-12 classrooms. The results of the study suggest that educational technology applications generally produced a positive, though modest, effect ( $ES = +0.15$ ) in comparison to traditional methods. However, the effects may vary by educational technology type. In addition to these, the three types of educational technology applications, supplemental CAI had the largest effect with an effect size of  $+0.18$ . The other two interventions, computer-management learning, and comprehensive programs had a much smaller effect size,  $+0.08$  and  $+0.07$ , respectively.

In business education, software is developed to facilitate and enhance the tasks given to students like graphing and computing math problems as a basis for analysis. The math software includes SPSS, MegaSTAT, MS Excel, QM for Windows and many more. One of the powerful mathematical software that is used in business mathematics is the QM for windows. QM for Windows was developed to provide students with the most user-friendly package available for production or operations management, quantitative methods, management science, and operations research. The said software is available from the internet for free. The first version of the software was a DOS version published in 1989 as PC-POM. The first Windows version, *QM for Windows* (Version 1.0), was distributed in summer of 1996 whereas a separate but similar program, *POM for Windows* (Version 1.1), was first distributed in the fall of 1996 (Weiss, 2010).

A study of Ku (2009) entitled, "Teaching of Critical Path Networks Using Software Packages" found out that POM-QM for Windows is effective to enhance the teaching of Engineering Management Science regarding critical path networks rather than the other software packages like the Microsoft Excel.

In this study student used QM for Windows as mathematical software in solving math problems for them to enhance solving math problems. Outcome-based education (OBE) requires the use of curriculum involving computer applications in all business mathematics courses, such as Business Statistics, Math of Investment, Business Calculus, Quantitative Techniques or even Probability and Statistics. By nature, Quantitative Techniques in Business requires iterated processes and complex formulas in finding the solution to a problem. Students find difficulties in arriving at a solution for a particular problem in the different quantitative methods because of its lengthy and time-consuming process. For example, in solving linear programming problems using the simplex method for more than two variables, it requires repeated iterations in order to find the optimal solution to the problem. Thus, in solving the problem it needs enough time and analysis in finding the optimal solution. As a result, students would eventually conclude that the course is very difficult to learn because of its complexity and that students tend to dislike the course.

With these issues, the researcher is being motivated to conduct an experimental study on the effectiveness of the utilization of the software in the teaching and learning process that may also improve students' learning and attitude towards the course. The main purpose of this study is to

determine the effectiveness of using educational mathematics software in teaching Business Mathematics Courses.

## 2. Objectives of the Study

This study sought to determine the effectiveness of using educational mathematics software in teaching Business Mathematics Courses,

The following are the specific research questions:

1. What is the mean attitude score of the control and experimental group towards the courses before the experiment?
2. Is there a significant difference in the mean attitude scores of the control and experimental group towards the courses before the experiment?
3. What is the mean attitude score of the control and experimental group towards the courses after the experiment?
4. Is there a significant difference in the mean attitude scores of the control and experimental group towards the courses after the experiment?
5. What is the pre-test mean score of the control and experimental group before the experiment?
6. Is there a significant difference in the pre-test mean scores of the control and experimental group before the experiment?
7. What is the post-test mean score of the control and experimental group after the experiment?
8. Is there a significant difference between the post-test mean scores of the control group and the experimental group after the experiment?

## 3. Methods

### 3.1 Research Design

This study made use of the experimental research design, particularly the pre-test post-test control group design since the main objective of the study is to determine the effectiveness of using a Math Software in teaching Business Mathematics courses.

The experimental design is illustrated as follows:

Table 1. The experimental design of the study

Group	Pre-Test	Approach	Post-Test
Experimental	O1	X	O2
Control	O3		O4

### 3.2 Participants of the Study

The participants of this study are students enrolled in Quantitative Techniques in Business (Business Math 13) for the First Semester SY 2017-2018 under the College of Business, Entrepreneurship, and

Accountancy of Cagayan State University. The selected participants were those students enrolled in BS in Entrepreneurship program. One group was labeled as the control group and they were exposed to the traditional teaching approach while the experimental group was exposed on the use of math software, namely *QM for Windows*. The heterogeneous group composed a total of 294 students officially enrolled in the course.

Table 2. Learners' Prelim Grade before the conduct of the study

Grade	Control Group n=147	Experimental Group n=147
<70	3	12
70-75	42	21
75-80	42	51
80-85	36	30
85-90	18	27
90-95	3	6
>95	3	0
Grand Total	147	147
	$\bar{x}=79.03$	$\bar{x}=79.44$

It can be seen from table 2 that the mean prelim grade of both groups is almost equal which shows that both groups have the same academic performance before the conduct of the study. The prelim grade of the learners was considered in the study to avoid bias and the selection of participants in both groups is fair.

### 3.3 Research Instrument

The research instruments employed in this study include the Quantitative Techniques in Business Attitude Questionnaire and Pre-test and Post-test exams. The attitude survey questionnaire consists of 25 items constructed in a positive statement by the researcher. Rest assured, the validity and reliability coefficient of the questionnaire was tested before the implementation of the study. The pre-test and post-test examinations also consist of 10 items true or false and 20 items multiple choice.

### 3.4 Data Gathering Procedure

Prior to the conduct of the study, the researcher sought approval from the office of the College of Business, Entrepreneurship, and Accountancy through the University Dean. The researcher administered the pre-test to both groups to determine their attitude and academic performance towards the course before the conduct of the experiment. The researcher had introduced the software to the experimental group for orientation and familiarization on the use of the software and its features within the entire midterm period.

On the other hand, the control group was exposed to traditional teaching without the software with the same time frame of that of the experimental group. In other words, the control group would solve mathematical problems manually.

After the experiment, post-test was administered to both groups to determine their attitude and academic performance towards the course. However, during the examination, the experimental group used utilized a computer with math educational software (QM for Windows) while the control group used paper and pencil test in solving some business-related mathematical problems like the linear programming problems. Both groups were given the same time frame to finish the given examination.

### 3.5 Statistical Analysis

Descriptive statistics was used to analyze the data using the frequency counts, percentages and weighted mean. T-test for two sample means was used to test significant difference between the mean performance and attitude of the control and experimental group before and after the experiment.

Weighted mean was used to determine the attitude of both participants towards the course and interpreted as follows:

Scale	Interpretation
4.20 – 5.00	Very Strongly Agree
3.40 – 4.19	Strongly Agree
2.60 – 3.39	Agree
1.80 – 2.59	Disagree
1.00 – 1.79	Strongly Disagree

The Statistical Package for the Social Sciences (SPSS) was used to perform the statistical analysis.

## 4. Results and Discussion

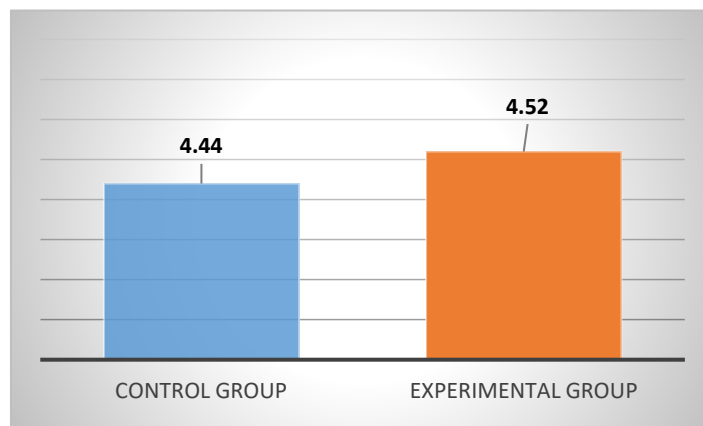


Figure 1. Mean Attitude Scores of the Control and Experimental Group before the Experiment

Figure 1 shows the mean attitude scores of the control group towards the course before the conduct of the experiment. It can be viewed on the figure that the mean of the control group is 4.44 while the experimental group is 4.52. This means that the attitude mean difference of both groups is almost the same before the conduct of the experiment. Based on data gathered, the control group had strongly agreed that mathematics is needed in their daily life, mathematics is significant to business and they

appreciate mathematics when applied to business. Meanwhile, the control group had agreed that mathematics is not easy to understand, the mathematics problem is too much difficult, and math software is essential in solving mathematics.

On the other hand, the experimental group responded very strongly agree that mathematics is also needed in their daily life, they want to develop their mathematics skills, mathematics is significant to business and when applied to business, business math is relevant to their course and calculators and computers is essential in solving a mathematics problem.

Table 3. Test of significant difference in the Mean Attitude Scores of the Control and Experimental Group before the Experiment using t-test

	Mean	SD	df	t-value	p-value	Decision
Control Group (n=147)	4.44	3.54	96	0.109	0.913	Do not reject Ho
Experimental Group (n=147)	4.52	3.70				

Table 3 shows the test of significant difference in the mean attitude scores of the control and experimental group before the experiment using t-test. It can be viewed on the table that there is no significant difference between the mean attitude scores of the control group and the experimental group before the conduct of the experiment. This means that both groups have the same attitude level towards the course before the software had been introduced to them.

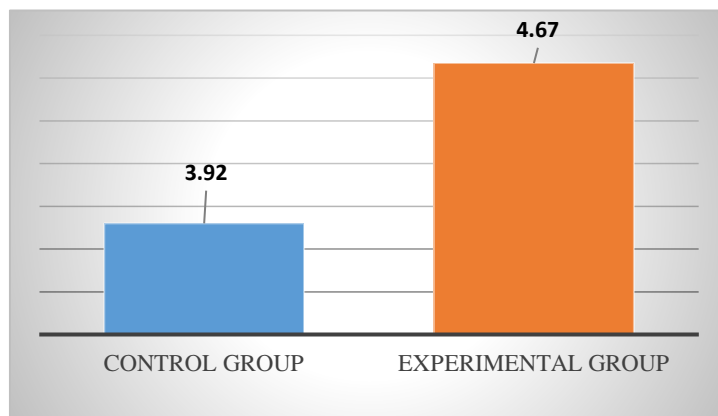


Figure 2. Mean Attitude Scores of the Control and Experimental Group after the Experiment

Figure 2 shows the mean attitude scores of the control group and the experimental group after the experiment. The mean attitude of the experimental group is 4.67 while the control group is 3.92. This shows that the mean attitude of the experimental group towards the course is higher than the control group. Also, the mean attitude of the control group had decrease gradually from 4.44 (before the conduct of the experiment) to 3.92 after the experiment. On the other hand, the mean attitude of the experimental group had improved from 4.52 before the experiment to 4.67 after the experiment. This shows that the software used in the course is an effective tool in assessing the attitude of the students towards the course.

Table 4. Test of significant difference in the Mean Attitude Scores of the Control and Experimental Group after the Experiment using t-test

	Mean	SD	df	t-value	p-value	Decision
Control Group (n=147)	3.92	3.54	96	6.62	0.000	Reject Ho
Experimental Group (n=147)	4.67	3.70				

Table 4 shows a test of significant difference in the mean attitude scores of the control group and experimental group after the conduct of the experiment using t-test. The table shows that there is a significant difference between the mean attitude scores of the control and experimental group after the experiment since the  $p < 0.05$  level of significance. This shows that the experimental group perceived a higher positive attitude towards the course than the control group after the experiment.

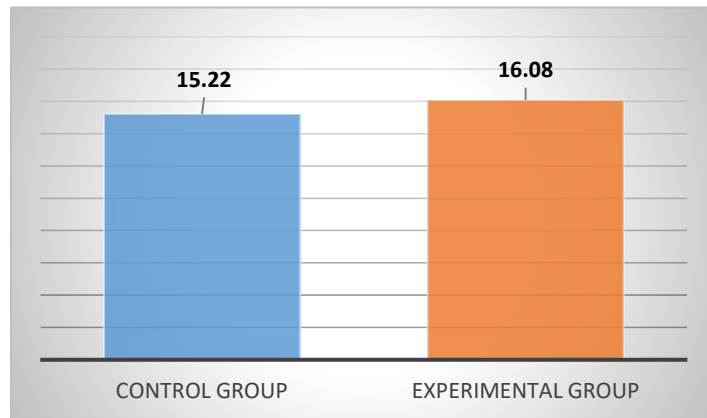


Figure 3. Mean Pretest Scores of the Control Group and Experimental Group

Figure 3 shows the mean pretest scores of the control and experiment group. The mean pretest score of the control group is 15.22 while the experimental group is 16.08 out of 30 items in the pretest questionnaire. This shows that the mean pretest score of the control and experimental group is almost the same before the conduct of the experiment. Initially, both groups did not utilize the math software in solving the 30- item examinations in the course.

Table 5. Test of significant difference in the Mean Pretest Scores of the Control and Experimental Group using a t-test

	Mean	SD	df	t-value	p-value	Decision
Control Group (n=147)	15.2245	2.939	96	1.417	0.160	Do not reject Ho
Experimental Group (n=147)	16.0816	3.047				



Table 5 shows the test of significant difference in the mean pretest scores of the control and experimental group. The table shows that there is no significant difference between the mean pretest scores of the control group and experimental group since the  $p > 0.05$  level of significance. This further shows that the level of knowledge of both groups regarding the subject matter is the same before the conduct of the experiment.

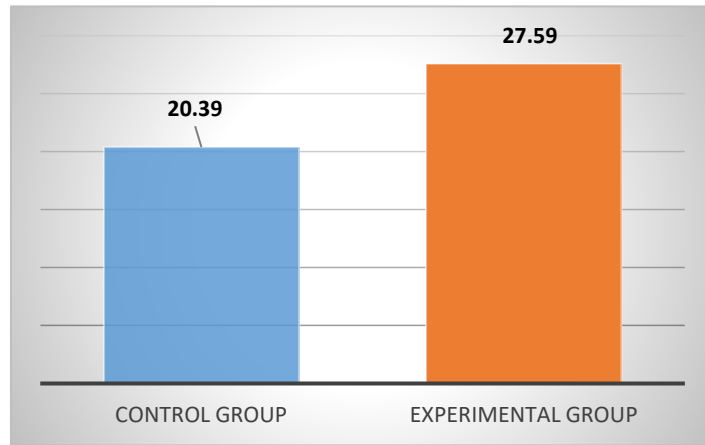


Figure 4. Mean Posttest Scores of the Control Group and Experimental Group

Figure 4 shows the mean posttest scores of the control group and the experimental group. The mean posttest score of the control group is 20.39 while the experimental group is 27.59 out of 30 items in the posttest questionnaire. It can be observed that the pretest and posttest mean difference of the control group is 5.17 while the experimental group is 11.51. Hence, the posttest score of the experimental group is higher than the control group. This shows that the experimental group performed better than the control group.

Table 6. Test of significant difference in the Mean Posttest Scores of the Control and Experimental Group using a t-test

	Mean	SD	df	t-value	p-value	Decision
Control Group (n=147)	20.388	4.172	96	7.651	0.000	Reject Ho
Experimental Group (n=147)	27.592	5.103				

Table 6 shows the test of significant difference in the posttest scores of the control and experimental group using t-test. It can be viewed on the table that there is a significant difference between the posttest scores of the control group and the experimental group since the  $p < 0.05$  level of significance. This further shows that the use of math software in teaching the course is effective on the academic achievement of the students in business mathematics course.

The result of this study is similar to the study of Colado, et al., (2017) that the use of educational software has a positive impact on the learning of the students. Moreover, regarding students' perspective, the survey shows that a high percentage of them like to use an educational software program, and they think it is easy and fun to use. Also, the study of Sevari & Falahi (2018) found out that educational software has a positive impact on the academic achievement and creativity of students by creating an interactive and dynamic environment.

## 5. Conclusion and Recommendations

Based on the results, it was concluded that educational software (QM for Windows) has a positive impact on the academic achievement of the learners in business mathematics as well as their attitude toward the course. Hence, since educational software is effective, it can be said that the necessity of educational assistance tools is one of the needs of today's education. With the use of educational software, learners become more independent and with the emphasis on learner-centered leads to students' academic achievement. Students in a learner-centered environment will experience more in-depth and more sustainable learning.

Based on the findings of the study, the following are the recommendations:

The teachers, curriculum developers, and the academic officials of the schools are recommended to have a greater emphasis on the use of educational software, especially the QM for Windows in the teaching and learning business mathematics courses and to grant some advantages for teachers. Several teachers now are more experienced and willing to integrate and use math educational software in the classroom in business mathematics courses. Besides, there a lot of available software now on the internet that can be downloaded for free access for exploration and educational purposes.

For faculty development, the administration should encourage teachers to attend training/seminars and workshops regarding the use of educational software, especially in business mathematics courses to improve teachers' knowledge and skills in teaching the course. Teachers' training programs need reconsideration to increase their effectiveness, ability to raise students' level and for professional development. Moreover, seminars and training are capable of keeping the learners and teachers to be more updated with the technologies used in the classroom.

The school administrators should allot funds for the purchase of math software as one of the priority projects in improving instructions.

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