

The Effectiveness of a Multimedia Courseware as an Alternative for Tutoring Application of Integration

Josefina Barnachea Janier¹, Afza Bt Shafie¹, Wan Fatimah
Bt Wan Ahmad²

{[josefinajanier.afza.fatimhd](mailto:josefinajanier.afza.fatimhd@petronas.com.my)}@petronas.com.my

¹EE Department

² Computer and Information Sciences Department
Universiti Teknologi PETRONAS, 31750 Tronoh, Perak
Malaysia

Abstract: *The significant increase in enrolment in the mathematics courses at Universiti Teknologi PETRONAS (UTP) over the past semesters has resulted in an increase of teaching loads for the instructors. This has left little time for the instructors to be involved in supervision of graduate students and do research work.*

Due to this recurring problem that the instructors encounter every semester, an alternative method of tutoring is needed to help reduce the teaching load of the instructors. One of the alternatives is the use of an interactive courseware. A courseware on learning the application of integration was developed by the instructors using the Toolbook and composed of six modules. This topic forms as part of the course contents for the Engineering Math 2, a course offered during the Foundation Programme. The courseware was used as a tutoring system during tutorial sessions for Engineering Math 2 course in the January 2008 semester.

The objective of this paper is to evaluate the effectiveness of the developed multimedia courseware as an alternative tool in tutoring the application of integration. Two groups of students; the control and experimental (a total of 50) were involved in the study. Besides improvement in learning the topic, the results also showed that the experimental group had performed as well as the control group. This implies using the developed courseware is an effective alternative tool for tutoring the topic.

1. Introduction

Electronic technology has paved the way for the students to learn through the use of computers anytime and anywhere. Integrating technology in teaching has been a challenge to teachers since they need to make effective use of it in order to develop student's independent learning skills and enhance learning. By using technology into teaching, teacher helps student's increase their creativity which also promotes self-confidence [1]. It also provides an avenue for developing independent learning skills and in the process, engaging students in their learning and developing self-esteem. It is also essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances student's learning [2].

Mathematics can be taken as a creative activity for students since it involves graphs, analysis and formula writing [3]. To solve a problem in mathematics, students need time to explore ideas and see the relationship between concepts. Thus, finding a solution to a problem will further motivate the students to practice more by doing the exercises from their textbook.

On technology's impact on learning, according to Marshall [4], "educational technology complements what a great teacher does naturally, extending their reach and broadening their students' experience beyond classroom". Furthermore he said that, with several technology choices from video to the multimedia to the internet, involvement of the learner, teacher, content and the environment in which technology is used complement a success in learning.

Universiti Teknologi PETRONAS is a private institution of higher learning in Malaysia. The courses offered are engineering and technology. For the past two years the enrolment has increased especially in engineering. Students enrolled in the engineering courses are required to complete six mathematics courses, two in the Foundation Programme and four in the Undergraduate Programme. These six mathematics courses are offered every semester and each course is usually composed of 400 to 550 students. Increase in enrolment results to additional number of tutorial groups which creates to more loads given to the staff for they need to handle lectures and tutorials.

For tutorial session, the current practice in Math courses is the chalk and board method. This method needs the presence of the tutor and the students at the allocated time and place otherwise, the session needs to be replaced. Replacing one session is not easy due to clashing of schedules of activities not only for the students and tutors but also for classroom allocation. As a result, this has left little time for the instructors to be involved in supervision of graduate students and doing research. Graduate students are also assigned as tutors but some find difficulty in tutoring the course since they are not Mathematics major.

Due to this recurring problem that the instructors encounter every semester, an alternative method of tutoring is needed to help reduce the teaching load of the instructors and utilize graduate students. One alternative is the use of an interactive courseware.

In 2005, a group of mathematics instructors developed an interactive courseware for learning the application of integration using Macromedia Toolbook. The courseware is composed of six modules which concentrate on area and volume and it can be used for individual learning [5]. The framework for modules 1-5 includes the objectives, definition, procedures, practice task and quiz on the application of integration (area and volume). The items on the quiz are multiple choice type questions. The sixth module is the summative exercise.

The topic on application of integration is part of the contents of the Engineering Mathematics 2 which is Calculus a course offered to engineering students in the Foundation Programme which carries four credit hours. In 2007, initial study in UTP had indicated that students had demonstrated positive attitude towards learning this topic using the developed courseware [3]. Continuing this study, the courseware was used as a tutoring system for the Engineering Math 2 tutorial sessions during the semester January 2008.

The objective of this study is to evaluate the effectiveness of the courseware in tutoring students.

The study was limited to the following:

- Fifty (50) engineering students attending two tutorial groups (A and B). Each group consists of 25 students enrolled in Engineering Math 2 for January, 2008 semester.
- Method of tutorial:
Traditional method (chalk and board) was used by Group B the control group. A set of problems with 20 questions on the topics area and volume taken from the textbook were given ahead of time to members of the control group.
Courseware was used by Group A the experimental group.
- Instruments
The Pre test and Post test consisted of ten parallel multiple choice questions on area and volume.
Interactive developed courseware in the application of integration (area and volume).
- Time
Four hours or two tutorial sessions were used for this study.

2. Literature Review

Today's educators are concerned with how to use technology to enhance and enrich their learning environment [6]. According to Cline [1], the role of technology in the classroom is not to replace traditional educational methods, it does act as an enhancement for teaching students to think critically, communicate creatively and solve problems in analytical way. Students can learn "from" computers – where technology is used essentially as tutors and serves to increase students basic skills and knowledge; and can learn "with" computers- where technology is used as a tool that can be applied to a variety of goals in the learning process and can serve as a resource to help develop higher order thinking, creativity and research skills [7], [8].

Kachala and Bialo [9] reviewed 311 research studies on the effectiveness of technology on student achievement. Their findings revealed positive and consistent patterns when students were engaged in technology-rich environments, including significant gains and achievement in all subject areas, increased achievement in preschool through high school for both regular and special needs students, and improve attitude toward learning and increased self-esteem. Linckels et al. [10] said that e-Learning can improve school results. Furthermore, a simple multimedia presentation helped the students to better understand a subject without the help of a teacher particularly for shy and weak students.

Whatannarang [11], investigated and compared the effects of Internet-based teaching and learning systems and traditional instruction on learners in the areas of quality of students' term papers, homework, reference sources, analytical ability, synthesis and summarization of information, and time used for study. The samples were 80 graduate students randomly selected from the class of 4 subjects registered from the second semester of academic year 2000 to the first semester of academic year 2002. They were divided into 4 control groups and 4 experimental groups. The control groups studied with traditional instruction. The experimental groups studied with teacher-prepared instruction programs on the Internet-based system. Data were analyzed by using a one-way t-test for independent samples. The Pretest and Post test results indicated that there was no negative effect on the learners. The scores of experimental groups were not significantly higher than the scores of the control groups in the area of quality of students' term papers, homework, reference sources, and analytical ability, synthesis and summarization of information. However, the experimental groups spent significantly less time [10].

According to Ali and Elfessi [12], the significant role of technology in teaching and learning is limited as an instructional delivery medium and not a key determinant of learning. It can only support the classroom learning.

3. Methodology

A pretest with 10-item multiple choice question in the application of integration was given to students from Groups A and B and they were required to finish in one-hour. It was done in one of the tutorial rooms. For this study, one of the researchers acted as the facilitator and tutor for Group A and Group B respectively. After the four-hour sessions on area and volume, the students from both groups were given the post test.

Control group (Group B)

One week before the conduct of the study, a problem set taken from the textbook was given to Group B for the students to solve and be ready for discussion. On the first session (2 hours) the tutor recalled the concepts on area before showing two examples. Afterwards, students showed the solutions for the given set of problems. Some members of the class asked questions from the presenter for clarity on the solution. Sometimes, the tutor gave additional comments concerning

the student's solutions on the board. During the second session, concepts on volume and three examples were discussed by the tutor and then the students' presentation of problems solved on the board followed by question and answer

Experimental group (Group A)

The students in this group made use of the courseware installed in the computer laboratory. The tutor acted only as facilitator for the next four-hour sessions (equivalent to two meetings). During the whole process, the facilitator took note of students' comments and reactions using the courseware.

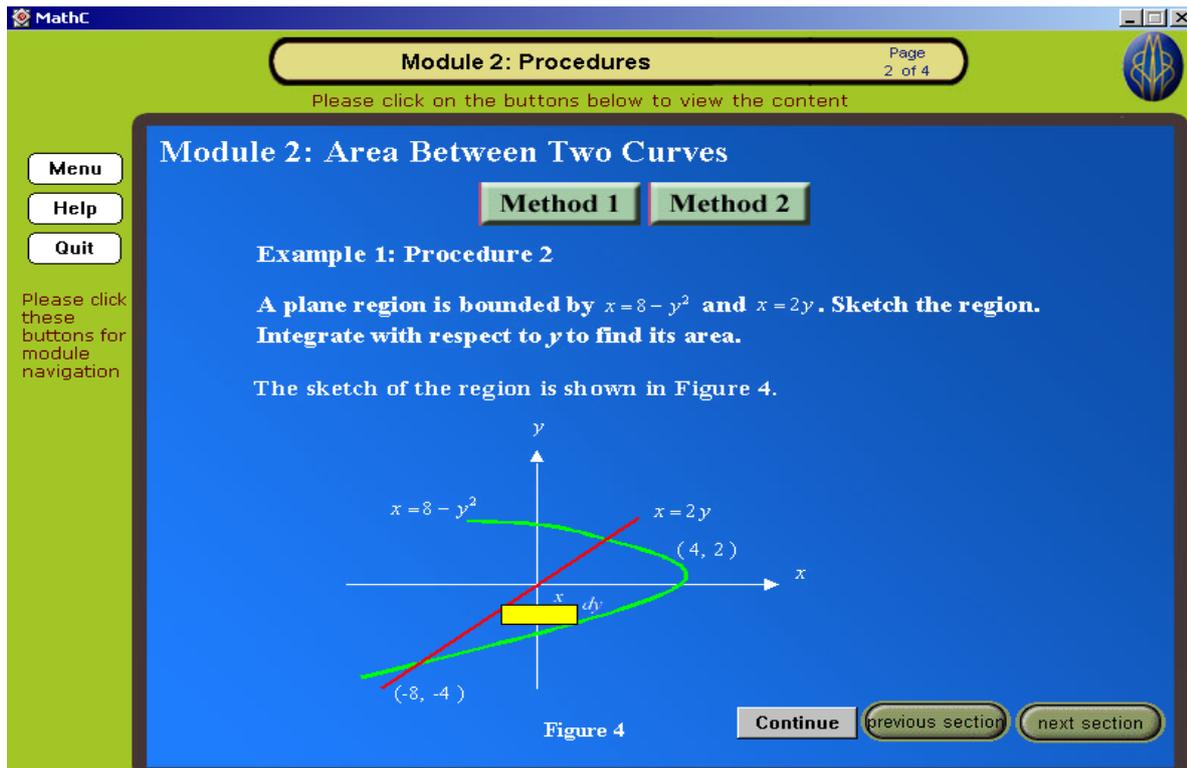


Figure 1. An example to visualize the area between two curves

Figure 1 is part of the courseware used by the student where they could read and visualize for better understanding a step by step calculation in finding the area between two curves. In addition, it has audio and help buttons. At the end of each module the students needs to take the quiz before proceeding to the next module. Once they have completed the quiz, a score will be given. The student will not be able to proceed to the next module if the score is below 70%.The quiz item in each module is a multiple choice type questions with four choices see Figure 2.

Module 5: Question 1 Page 1 of 4

Please click and answer all questions in the quiz section

Menu
Help
Quit

Please click these buttons for module navigation

Using the figure below, what is the integral formula for the volume?

$y = \frac{1}{4}(x^2 - 10x + 33)$

R

1 8

a. $V = 2\pi \int_1^8 (x^2 - 2x + 33) dx$ b. $V = \frac{\pi}{2} \int_1^8 (x^3 - 10x^2 + 33x) dx$

c. $V = \pi \int_1^8 (x^3 + 4x - 10) dx$ d. $V = \pi \int_1^8 ((x-5)^2 + 2) dx$

next question

Figure 2. An example of quiz item on volume

4. Results and discussions

The results of the scores of the pre and post tests of the two groups are given in Table 1. The analysis was carried out at level of significance $\alpha = 0.05$. Out of 10 items, the pre-test mean score for Group A and Group B are 4.28 and 4.48 respectively while the post test mean for each group is 9.0 and 8.48 respectively.

Table 1: Pre- test and Post test Results

GROUP	N	Mean	Standard Deviation
PRE			
A	25	4.28	1.400
B	25	4.48	0.963
Post test			
A	25	9.0	1.607
B	25	8.48	1.896

From Table 2, the pre and post test difference in the means for both groups is highly significant (p-value is 0.0 for both pairs). This indicated that they had understood the application of integration better after the tutorial session. This also implied that tutorial sessions are helpful and beneficial to students regardless of the tutoring method employed.

Table 2: Mean Difference between Pre-test and Post-test results
(within the group)

		Paired Differences		
		Mean	T	p-values
Pair 1	Group A	-4.72	-15.875	0.0
Pair 2	Group B	-4.00	-14.142	0.0

However, the t-test carried between the difference in means for the pre-test and post-test between Group A and Group B is not significant, refer to Table 3, p-value is 0.559 and 0.301 respectively. This result implies that students in the experimental group perform as well as those in the control group. This result also indicates that the interactive courseware is as effective as the traditional chalk and board method in tutoring the students on this topic. This also suggests that the students can do independent study using the courseware during tutorial session.

Table 3: T-test for mean between group A and Group B

	t-test for Equality of Means	
	t	p-value
PRE	-0.589	0.559
POST	1.046	0.301

The percentage (%) of number of student with correct answers per topic was determined and given in Table 4. In general, the Pos-test results had shown that students using the courseware had scored higher than the control group. The Pre-test results for topics on area and volume by washer method in Group A are lower than Group B. Both groups had scored zero for topic on volume by Shell method. The average increment in % between the pre and post-test in area for experimental group is 20% compared to control group is 10.4%. As for the topic in volume, the experimental and control has an average increment of 70% and 66% respectively. These further highlighted that the courseware could be considered as an alternative method for tutoring the topic thus helping to ease the workload of the instructors and the use of graduate assistants.

Table 4: The % of number of students with correct answers per topic

Topic	A		B	
		Posttest	Pre-test	Post- test
Area	78.4	98.4	85.6	96
Volume by Disk method	32	92	28	96
Volume by Washer method	2	88	8	74
Volume by Shell Method	0	70	0	64

5. Conclusions and Recommendation

The results of the study have shown that the interactive courseware is as effective as chalk and board in tutoring the students in this topic. The contribution of this study is that the courseware can be used as a basis to relieve the instructors as tutors for the topic. In addition, it can also be used by the student for independent study. It is recommended that a complete courseware for Engineering Math 2 should be developed for tutoring purposes.

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