Using Internet: A Teaching Strategy for Sketching Graphs of Equations

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Abstract

This study considered two matched groups of 39 first year computer science majors who were enrolled in ANMATH1 (Differential Calculus) during the third term, SY 2005-2006. The experimental group was taught Sketching Graphs of Equations using Internet while the control group was taught the same topic using the traditional 'chalk and blackboard' technology. At the end of the experiment, an achievement test was administered to the two groups and a questionnaire related to the use of Internet was also administered to the respondents of the experimental group to capture their reactions regarding the use of Internet in teaching. Findings revealed that there is no significant difference in the mean achievements of the two groups in the given subject matter. The students' reactions to using the Internet as a teaching strategy were gathered from their responses to the items in the questionnaire.

1. Introduction

Recent mathematics reforms strongly endorse the use of technology in teaching. Proficiency in the use of technology and the ability to design curriculum and instruction that takes full advantage of the available technological resources is one of the main goals for mathematics teachers. Information and communication technology (ICT) may be infused into the classroom activities through the use of interactive learning objects for instruction, enrichment and remediation. Interactive learning objects engage the student by appealing to visual, kinesthetic and auditory learning styles.

Previous studies, specifically those of Cachero [1] and Cunningham and Billingsley [2], asserted that searching the Internet effectively is an important skill teachers and students need to acquire. An Internet project encourages students to work together and share information. The use of ICT empowers learners to increase their productivity and, thus, may be one of the keys to significant improvements in mathematics education.

Dreyfus and Eisenberg [3] asserted that technology can provide mechanisms to sustain assistance to mathematics teachers in implementing mathematics education reforms in their classes. Moreover, Owston [4] and Fetterman [5] indicated that educators have stated optimism with respect to the educational potential of Information and Communication Technology such as the Internet and the World Wide Web (WWW).

According to Windschitl [6], it is important to disseminate information regarding the use of Internet in the classroom for the purpose of informing practice. Undoubtedly, educators have been using the World Wide Web, the highest profile of the Internet, to develop and implement various

classroom activities. Mathematics teachers must, therefore, be provided with extended opportunities to experience and do mathematics in an environment supported by this technology.

Research should go beyond describing or prescribing ways on how Internet resources can be used in the classroom. Roschelle and Pea [7, 8] emphasized that attention and focus should be directed towards "gaining insight and directing mutual evolution of technology innovation with pedagogical and curricular innovation."

Ferrucci and Carter [9] asserted that recent literature dealing with research on the WWW has indicated the importance of using the Internet as an instructional tool, as a resource for pre-service teacher education and as a resource for projects in a mathematics classroom.

The study conducted by Manoucherhri [10] among middle and high school mathematics teachers in the state of Missouri, however, revealed that the teachers did not use computers for purposes other than drill and practice. This was due to lack of adequate knowledge and training about when and how computers could be used in mathematics instruction. Mathematics teacher educators, therefore, should engage in extensive experimentation with computers and a variety of available educational software so that they are able to appreciate their usefulness in teaching mathematics.

Technology is best learned within the context of application. Activities, projects and problems that replicate real-life situations are effective resources for learning technology. With technology, students will learn how to determine which processes, tools and techniques to use and when to use them. In fact, Ghorpade [11] cited that teaching with technology, specifically the Internet, may be used to manage large classes where a set of notes about the lesson is readily available for the students.

Provenzo [12] cited that the Internet, a vast computer network otherwise known as "Information Superhighway", is an extension of the world's communication system as it permits computers connected anywhere on the network to exchange information. It is a large collection of networks that are tied together so that many users can share their resources and communicate information. The Internet constitutes one of the most powerful resources available to anyone who has access to it.

Woodbridge [13] emphasized that technology integration means viewing technology as an instructional tool for delivering subject matter in the curriculum already in place. His study revealed that technology integration varies according to individual teaching beliefs and perceptions towards technology integration and how the teacher practiced and put technology to work in the classroom. Moreover, in the study conducted by Polevchak and Ofori-Attah [14], they concluded that the Internet has several uses for teaching and learning and the teacher's efficiency in its use depends upon the opportunity they have learned to use this tool and their access to the Internet and the World Wide Web.

2. Objectives of the study

This study attempted to (1) determine if any significant difference exists in the mean achievements of two groups of students, where one group was taught using Internet and the other group was

taught using the chalk and blackboard technology and (2) ascertain the students' reactions to the use of Internet as a teaching strategy in sketching graphs of equations.

3. Methodology

This study utilized the experimental method of research to compare the mean achievements of the two groups of respondents and to determine the merits/demerits of using Internet as a teaching strategy for Sketching Graphs of Equations.

3.1 The Respondents

Two classes of 39 students each from the College of Computer Studies, De La Salle University, who were enrolled in ANMATH1 (Differential Calculus) during the third term, SY 2005-2006 served as respondents of the study. These students were matched according to their final grades in Algebra and Trigonometry, prerequisite courses for Differential Calculus, and English 1.

3.2 Data-Gathering Procedure

The respondents in the experimental group were given the following list of websites which were used in the study of the subject matter under consideration.

1. **http://www.nipissingu.ca/calculus/tests/curves_test.html**;
2. **http://www.math.ucdavis.edu/~kouba/CalcOneDIRECTORY/graphingdirectory/Graphing.html**;
3. **http://www.ugrad.math.ubc.ca/coursedoc/math100/notes/apps/graphs.html**
4. **http://www.sparknotes.com/math/calcab/applicationsofthederivative/problems_7.html**
5. **http://archives.math.utk.edu/visual.calculus/3/graphing.3/**

They were also asked to scout for other websites on the same subject matter and to submit their lists to the teacher for consideration. The sequencing and the delivery of the course material was controlled by the teacher.

After conducting a review on prerequisites, the topic on graphing was introduced to each group, and then a preliminary discussion on sketching graphs of equations was given. During class hours, each student in the experimental group was assigned to a computer. The experimental group was instructed to keep on accessing and reading the web on all matters related to graphing and the students were also encouraged to answer related exercises presented in the web. Teacher support was very minimal. They were given the option to consult their teacher only on matters which need further explanation, that is, after repeated reading has been done and they still cannot understand the lesson. On the other hand, the control group studied the same lesson through the teacher-led strategy with the help of the chalk and board technology. Internet exercises on the topic were downloaded for the students in the control group and solutions of these were discussed in class. Throughout, the sequencing of the topics was the same for both groups.

Twelve class hours were spent to cover the topic under consideration. Classes were held on the same day, the experimental group in the morning and the control group in the afternoon, and were handled by the same teacher. Close monitoring was done by interviewing students from each group as regards their progress, comments and problems in understanding the lesson.

At the end of the experiment, the respondents from the experimental and the control groups were given an achievement test (10 items per task) on the topic under consideration. Moreover, the respondents in the experimental group were requested to complete a questionnaire for their comments and reactions on the use of Internet as a teaching strategy. Some unstructured interviews were conducted to clarify their responses to the items in the questionnaire.

4. Results and Discussion

The computed means and standard deviations of the scores of each group in the achievement test and the result of the test of significance of difference in the mean scores of the two groups are reflected in the following table:

Table 1. Achievement Test Results (Perfect score per task is 10)

Tasks	Experimental Group (n = 39)		Control Group (n = 39)		t-value ($\alpha = 0.05$)	Remarks
	Mean	Standard Deviation	Mean	Standard Deviation		
1. Finding f' and f''	7.3	2.1	7.8	2.6	-0.9343	Not Significant
2. Identifying critical number(s) and finding critical points	7.9	3.1	7.5	2.8	0.5980	Not Significant
3. Setting up intervals for investigation of the graph's behavior	6.5	2.3	7.4	2.9	-1.5185	Not Significant
4. Identifying relative extrema and portions of the graph which are increasing or decreasing, concave up or down and point of inflection	7.5	2.7	7.0	2.8	0.8028	Not Significant
5. Formulating conclusions about the behavior of the graph	7.2	2.2	7.8	3.0	-1.0072	Not Significant

It can be seen from the table that of all the tasks involved in sketching the graphs of equations, the experimental group had its highest mean score in identifying the critical numbers and finding the critical points of a graph and lowest mean score in setting up intervals for investigation of the graph's behavior. On the other hand, the control group had its highest mean score in finding the first and second derivatives and formulating conclusions about the behavior of the graph and lowest mean score in identifying relative extrema and portions of the graph for which the function is increasing or decreasing.

Based on their mean achievements, the experimental group performed better than the control group in two of the five tasks involved in sketching the graphs of equations, namely: identifying critical numbers and critical points and identifying relative extrema and portions of the graph for which the function is increasing or decreasing. In the remaining tasks involved in sketching the graphs of equations, the control group performed better than the experimental group.

After applying the t-test for independent samples, it was found that at the .05 level of significance, there is no significant difference in the mean achievements of the two groups in all tasks involved in sketching the graphs of equations. Overall, the findings indicate that the Internet and the 'chalk-blackboard technology' are equally effective teaching strategies for sketching graphs of equations. The nonsignificance of difference in the mean achievements may be attributed to the fact that students in the experimental group were using the Internet for the first time in trying to understand a lesson.

As regards their reactions on the use of the Internet as a teaching strategy, the table below shows the percentage distribution of the respondents of the experimental group with reference to each item in the questionnaire.

Table 2. Percentage Distribution of the Students' Responses to the Items in the Questionnaire of the Study (n = 39)

Items	Agree	Neutral	Disagree
1. Using the Internet enables me to accomplish my assignment more quickly.	**83%**	**-**	**17%**
2. Using the Internet improves my effectiveness in doing any assigned task.	**72%**	**13%**	**15%**
3. Using the Internet enhances my effectiveness in solving problems.	**75%**	**11%**	**14%**
4. I have fun interacting with the Internet.	**81%**	**9%**	**10%**
5. Using the web provides me a lot of enjoyment.	**86%**	**-**	**14%**
6. I believe that if I enhance my technology skills, I could enhance my learning.	**79%**	**7%**	**14%**
7. I intend to continue using the web in the future.	**74%**	**20%**	**6%**
8. Using the Internet can take up too much of my time when performing many tasks.	**40%**	**25%**	**35%**
9. I feel at ease in using new ICT in my studies.	**87%**	**10%**	**3%**
10.I cannot do well with ICT in my coursework.	**43%**	**25%**	**32%**

11 I believe that ICT can provide an interesting way of learning.	**85%**	**14%**	**1%**
12. I think that using ICT can facilitate learning.	**93%**	**7%**	**-**
13. I find using ICT a great help in understanding the lessons in class.	**88%**	**12%**	**-**
14. Using ICT would improve my academic performance.	**90%**	**7%**	**3%**
15. I think ICT will be useful in my class.	**91%**	**9%**	**-**

It is evident from the table that almost always the respondents agree that the use of ICT and the Internet improve their understanding of the lesson. They also find using the Internet enjoyable and generally useful in their coursework. The students also agree that more knowledge about the use of Internet would enable them to succeed further. It seems that the students were very much motivated while studying the lesson that some of them even said that this innovation is very much welcomed.

Moreover, the students admitted that although it is difficult to understand the lesson when no teacher is around to answer their questions regarding the lesson, reading the discussion in the Internet repeatedly and following the examples made them understand the lesson. In fact, they become a little bit independent and they realized that they have prevented themselves from being embarrassed while asking questions. Although the Internet enables the students to accomplish their assignment quickly and provides them a lot of enjoyment, there were still those who were really undecided about the other items in the questionnaire. As reflected in the table, twenty-five percent of the respondents were undecided about their feelings toward the use of ICT as seen from their responses to items 8 and 10 of the questionnaire. The interview with some respondents revealed that their heavy academic load during the term and the accessibility of the computer and the speed of the Internet server itself prevent them from staying in front of the computer all the time.

Further interview with the respondents from the experimental group revealed the following advantages and disadvantages of using Internet in Sketching Graphs of Equations:

Advantages:

1. Students appreciate having a ready-made set of lecture notes which can be downloaded from the computer.
2. With the Internet, the students find the lessons to be exciting and fun. They find it interesting and enjoyable to see how the graphs are done especially in the web on Visual Calculus.
3. The students appreciate getting the immediate feedback to the exercises given in the web and their corresponding scores.

Disadvantages:

1. The lessons are ready-made so that when the students read them, they do not have the chance to see the details of the solution and, thus, they find it difficult to comprehend the lesson.
2 . Lesson presentations are sometimes boring and monotonous.
3. There is no teacher-student interaction.
4. Some technical problems affecting the use of Internet interfere with use of technology.

5. Conclusion and Recommendation

Using the Internet to teach Sketching Graphs of Equations is an interesting experiment. Since there is no significant difference in the mean achievements of the two groups of students considered in this study, it can be concluded that the Internet and the chalk-blackboard technology are equally effective teaching strategies for sketching graphs of equations. The Mathematics department can utilize the Internet in combination with the traditional method to improve the delivery of the lessons in Differential Calculus.

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