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Integrating technology into mathematical instruction-A study of its effect on students' mathematics achievement and attitude at the eight grade in Taiwan

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Abstract:

A pretest-posttest experimental design was used to study the effect of integrating technology into instruction on students' mathematic achievement and attitude toward mathematics. The study was conducted from February to June during year 2002. Two classes of 74 eight graders taught by the same teacher were included in this study. Research results showed that there is a significant difference of students' achievement on "Parallel" unit test. No significant difference was found on either "quadratic functions" unit test or "Triangles" unit test. Problems of access and availability of computers may still be the reason to affect the research results. Students of the control group showed a negative result in their attitude toward mathematic after the experimental semester. However, there is a significant difference of experimental students' attitude toward mathematics before and after the experiment. After the treatment, only factors, enjoyment of mathematics and freedom from fear of mathematics, had a significant difference. Future efforts may need to focus on designing mathematics activities which will motivate student learning and on the recognition of importance of mathematics. Access and availability of computers as well as teacher's experiences of using technology in teaching will be possible reasons to affect the success of integrating technology in mathematics teaching.

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Introduction

What role might we expect technology to play in future classrooms? Today, computers have been popular products and are wider used than ever before. However, applications of computers in school mathematical teaching and learning are little. Possible reasons for the difficulties to the implementation in school, as pointed out by Kaput (1992), were the unavailability of equipments and software, as well as teachers' lack of abilities to use them in classroom teaching. Van de Walle (1998) argues that problems of access and availability will undoubtedly fade in the future, and useful technology will become as common in school as chalkboard and textbooks. However, research often indicated that teachers who have trained to apply technology in school teaching often fail to do so. Cuba (1986) summarized results from previous study of technology in education and concluded that technological innovations did not make sufficient changes in teacher practice. Using a meta-analysis method, Huang (2001) synthesized 22 studies that compared the effects of computer networked learning with traditional instruction and found that computer networked learning is more effective than traditional instruction on both cognitive and affective learning. But newly research results always showed that no significant difference was found either on

mathematics achievement or attitude toward mathematics. Most of the research indicated that students love this alternative approach to study mathematics and students' interests in learning was increased in general (Chen, 2001; Lian, 2001; Lin, 2001; Sha, 2001). Short period of experimental time (four to five weeks) may be a factor to affect the research result.

Purposes of this study

Researchers classified applications of technology into three categories: technology as media to present learning content, technology as learning content, and technology as learning partners (Hao and Lian, 2000). In these applications, teachers play an important role in helping student learning, so making instruction plans in advance as well as presenting learning process efficiently will be factors that affect the success of these applications. Also, most of teachers will agree that not all topics and not the whole class time need to be technology-based. As a matter of fact, teachers need to consider the appropriateness, necessity, and feasibility as they making teaching plans. Based on this recognition, this study was designed to develop a technology-based environment (what we called teacher models) that will support mathematics learning at the eight grade in Taiwan. Also, the study explored its' effect on students' achievement and attitude toward mathematics for a longer experimental time.

Research method

A pretest-posttest experimental design was used to study the effect of integrating technology into instruction on students' mathematics achievement and attitude toward mathematics. The study was conducted from February to June during year 2002. Two classes of 74 eighth graders taught by the same teacher were included in this study. One class was assigned as the experimental group-the teacher integrated technology into her mathematics instruction, and the other was the control group-no technology was used. The researcher held a research team to meet every week and discussed related resources to integrate them to teach in the experimental class. The experimental teacher also participated in this research team to design her lesson plans. During the experimental semester, there were a total of 10 classes applying technology into classroom teaching in the experimental class. Students in the experimental class were asked to write the same mathematics attitude questionnaire at the beginning and at the end of the semester. The attitude questionnaire was adopted from Tan (1989) which include factors of enjoyment of mathematics, motivation in mathematics, importance of mathematics and freedom from fear of mathematics. Since three topics (quadratic functions, Triangles and polygons, and quadrilateral and parallelogram) were covered during the semester, three achievement tests related to these topics were given to both the experimental groups and the control groups when the topic was finished and to test if

there is a significant difference after the treatment. Five students in the experimental group were interviewed during the semester and the other five students in the experimental group were interviewed at the end of the semester to collect students' responds to their teacher's teaching. All interviews were tape recorded and transcribed at the end of the study. For those lessons the teachers applied technology into their teaching were also observed by a preservice teacher, so the researcher can get information from the classroom teaching. The teacher was also interviewed at the end of the study to have a deep understanding of the teacher's attitude toward this approach and suggestions for future applications.

Research result

Since students in the experimental school were randomly assigned to each class, it was assumed that students in each group had equal performance in mathematics. However, students' mathematics performance of the two groups in the previous semester was tested to examine if there is a significant difference before the experiment. Table 1 showed that there was not a significant difference of mathematics performance between the two groups.

Table 1

T-test of mathematics performance of the previous semester

Class	Number of students	Mean	SD	df	t
Experimental group	36	75.9	17.0	72	.865
Control group	38	72.7	14.8		

Levene's Test for Equity of Variance: $F=0.90$, $p=.765$

Table 2 to table 4 showed results of t-test of students' achievement on the three tests and there is a significant difference on Test3 (*p<.05). No significant difference was found on either test 1 or test 2.

Table 2

T-test of students' achievement on Test1

Class	Number of students	Mean	SD	df	t
Experimental group	36	12.53	6.26	72	1.199
Control group	38	10.74	6.57		

Levene's Test for Equity of Variance: F=.486, p=.488

Table 3

T-test of students' achievement on Test2

Class	Number of students	Mean	SD	df	t
Experimental group	36	24.92	9.76	72	.563
Control group	38	23.58	10.63		

Levene's Test for Equity of Variance: F=.765, p=.385

Table 4

T-test of students' achievement on Test3

Class	Number of students	Mean	SD	df	t
Experimental group	36	22.91	9.23	72	1.998*
Control group	38	18.46	9.36		

Levene's Test for Equity of Variance: F=.208, p=.650

Note. *p<.05.

Table 5 showed that there is a significant difference of experimental students' attitude toward mathematics before and after the experiment. After the treatment, the students do have more positive attitude toward mathematics. However, students in the control group did not have a significant change in their attitude toward mathematics (see table 6). This result showed that integrating technology into mathematics teaching can effectively promote students attitude toward into mathematics.

Table 5

T-test of experimental students' attitude toward mathematics

Attitude	Number of students	Mean	SD	Correlation	df	t
Before	36	8.69	17.33	.908***	35	-3.144**
After	36	12.58	17.21			

Note. **p<.01.***p<.001.

Table 6

T-test of control group students' attitude toward mathematics

Attitude	Number of students	Mean	SD	Correlation	df	t
Before	38	-1.16	19.34	.471**	37	1.045
After	38	-4.21	14.86			

Note. **p<.01.

In a future analyze, table 7 to table 10 analyzed each attitude factor in this study. After the treatment, only factors, enjoyment of mathematics and freedom from fear of mathematics, had a significant difference.

Table 7

T-test of experimental students' attitude toward mathematics (Enjoyment of mathematics)

Attitude	Number of students	Mean	SD	Correlation	df	t
Before	36	2.53	4.95	.873***	35	-2.611**
After	36	3.58	4.54			

Note. **p<.01.***p<.001.

Table 8

T-test of experimental students' attitude toward mathematics (Motivation in mathematics)

Attitude	Number of students	Mean	SD	Correlation	df	t
Before	36	1.97	4.87	.823***	35	-1.729
After	36	2.78	4.40			

Note. ***p<.001.

Table 9

T-test of experimental students' attitude toward mathematics (Important of mathematics)

Attitude	Number of students	Mean	SD	Correlation	df	t
Before	36	3.47	3.98	.829***	35	-1.484
After	36	4.06	4.07			

Note. ***p<.001.

Table 10

T-test of experimental students' attitude toward mathematics (Freedom from fear of mathematics)

Attitude	Number of students	Mean	SD	Correlation	df	t
Before	36	.72	5.42	.825***	35	-2.699**
After	36	2.17	5.44			

Note. **p<.01.***p<.001.

Conclusion

In this study, the teacher searched existing web resources as well as self developed programs to teach in the experimental group. At the beginning of the study, records from classroom observations indicated that sometimes students were out of control because they were too excited to learn mathematic from the computers. Students were not familiar with the Geometric SketchPad (GSP) environment and were afraid of using it because it is English inferface. Also, the teacher argued that the problem of band-width slowed down the speed and students needed to wait delayed the learning process. The teacher tried to deal with the weakness, and learned to handle the inconvenience. When students and the problems of using computers were in control, both the observer and the teacher indicated that students enjoyed their teacher presented active contents before class and they liked to learn from the computers. This may be a reason to explain why experimental group only performed better on test 3. When integrating technology into classroom teaching, many problems

may occur incidentally, especially for those teachers they are not familiar with this approach. Although technology has been quickly developed, schools are not equipped with these modern products. This may also affect the success of applying technology-based curriculum in classes.

Research result of this study do showed that integrating technology into mathematics instruction can promote students attitude towards mathematics in a positive direction. From this study, students in the technology-based group changed their attitude on the factors of “enjoyment of mathematics” and “freedom from fear of mathematics”. Future efforts may need to focus on designing mathematics activities which will motivate student learning and on the importance of mathematics. Some students in this study indicated that they don't like mathematics at all and no matter what method their teacher used, they considered no usefulness. For those they already have a negative attitude toward mathematics, how can we help them change this stereotype is a big issue and reserves future study.

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