A Study of Pre-Service Teachers' Attitudes About Computers and Mathematics Teaching: The Impact of Web-based Instruction

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This study explored the efficacy of web-based instruction in topics in elementary school mathematics in fostering teachers' confidence and competence in using instructional technology, and thereby promoting more positive attitudes toward using computers and Internet resources in the mathematics classroom. The results indicated that students who participated in the web-based instructions exhibited a significantly ($p < 0.05$) better attitude toward using computers and web-based resources in teaching mathematics than did students in the control group.

1 INTRODUCTION

A history of research and reports indicate that preservice teachers are not being adequately prepared in educational technology. In the United Kingdom, Cuckle, Clarke and Jenkins (2000) reported that relatively few student teachers (13%) had qualifications in information technology although more had experience in computer use. In Australia, Watson (1997) found that student teachers were inadequately prepared for teaching technology in schools and had low self-ratings of competency and negative feelings about it. In the USA, the Office of Technology Assessment (OTA) reported that even though the importance and increasing accessibility of technology in teacher education were notable, this technology was not central to teacher preparation in most colleges of education in the United States (Office of Technology Assessment, 1995). Pre-Service teachers are not getting the needed experience to be able to teach with technology, and upon graduation they do not feel comfortable teaching with technology (Wetzel, 1993 and ISTE, 1992). In 2000, the U.S. Department of Education published the national educational technology plan and reported that "new teachers entering the profession are still not being adequately prepared to teach with technology ... fewer than half of the nation's teacher preparation institutions require students to design and deliver instruction using technology, and that even fewer require technology use in the student teaching experience" (U.S. Department of Education, 2000, p. 14). Again, in 2003, Doering, Huffman and Hughes found that most of the pre-service teachers were unable to generate new lessons that use technology after their student teaching. In addition, they found that the pre-service teachers' lack of access to technology and ability to manage students who use it emerged as two of the issues that prevented them from integrating technology (Doering, Huffman and Hughes, 2003).

Research on technology integration in pre-service teacher education programs has examined programs such as Teaching Teleapprenticeships (TTa) (Thurston, Secaras, and Levin, 1995), technology-based lessons in elementary school classrooms (Balli and Diggs, 1996), pre-service teachers' field experience with technology (Balli, Wright & Foster 1997; McDevitt, 1996), and the creation of a structure for electronic mail (Schlagal, Trathen and Blanton, 1996).

Balli and Diggs (1996) developed a pilot project with pre-service teachers who taught technology-based lessons in elementary school classrooms at the University of Missouri. The subjects in their study were 11 pre-service teachers who enrolled in an undergraduate educational technology course and participated in the project to pilot the effectiveness of field experience in teaching with technology. The result indicated that pre-service teachers believe teaching with technology is a good way to learn how to put theory into practice. In addition, it was found that the field experience improved their knowledge of how technology can support teaching and learning.

At the University of Illinois at Urbana-Champaign, Thurston et al, (1995) developed an innovative program called Teaching Teleapprenticeships (TTa) which integrated technology into the pre-service experience of undergraduate education majors. A mathematics instructor commented, "The 101/219 students merely see the potential and are 'going ape' over the possibilities. It is the best thing we have tried. I see that if they can learn about mathematics and mathematics teaching in a new and different way, they are more apt to teach differently themselves." They also found that technology has become more than an add-on and more than just part of the curriculum they are studying; it is now an integral part of the students' personal and professional lives.

Strudler, McKinney, Jones and Quinn (1999) looked into the needs and concerns of first-year teachers including the problems they encountered, the support they received, and the degree to which they felt prepared to use technology. The first phase of this two-year study was completed in 1994. Seventy-three elementary teachers responded to a 98-item survey investigating a wide range of issues. The second phase was completed in the following year. Results indicated that (a) access to computer resources was a major problem; (b) support for technology varied greatly from school to school; (c) teachers' preparation to teach with technology lagged behind their preparation for other instructional strategies; and (d) student teaching had a minimal impact on their preparation to teach with computers.

Topp (1996) explored the recent graduates' opinions of their preparation to use technology in the classroom. The results indicated that recent graduates claim to be interested in using technology and believe that computer-related technologies are important for K-12 education. In addition, most respondents reported that their pre-service computer technology preparation was inadequate.

Marcinkiewicz and Wittman (1995) developed a longitudinal study to investigate teachers' use of computers in teaching. One hundred sixty-seven elementary pre-service teachers completed surveys during college and after one year of teaching, 97% predicted they would use computers in the classroom. However, only 61% indicated that they actually used computers in schools. Respondents' perceptions about computer use and their self-competence remained correlated and the correlation increased over time.

Kim, Sharp & Thompson (1998) investigated the effectiveness of integrating problem solving, interactive multimedia, and constructivism in teacher education. The study examined pre-service elementary teachers' decisions about teaching strategies and their attitudes toward mathematics and computer-related technologies in a constructivist-centered methods course that included the use of problem-solving multimedia. They found that these strategies developed more-positive attitudes toward computer-related technologies.

McKinney (1998) considered the evolution of electronic portfolios by pre-service elementary teachers. The author examined how they constructed and thought about electronic self-assessment portfolios. Data from portfolios, interviews, and surveys indicated that creating portfolios allowed participants to be reflective because the portfolio development built in the reflection process. They found that students believe that the experience is positive and useful.

McGee (2000) examined a new teacher's beliefs and perceptions about how and why technology can and should be used to support student learning. Findings suggest that persistence was critical to learning in the absence of pre-service or in-service training in the effective application of technology to support learning.

Gunter (2001) examined the importance of technology-enriched curricula for pre-service teacher education and described a study that evaluated, both quantitatively and qualitatively, the effectiveness of a redesigned introduction to technology course for pre-service teachers. Results showed more positive student attitudes toward computers and lessened anxiety after completion of the Web-enhanced course.

In summary, the major findings above are that there is a great need for introducing more technology into teacher education programs. Secondly, integrating technology into teacher education programs helps pre-service teachers to see the importance of developing and using computer-based lessons in their own teaching.

Research on technology integration in mathematics education has examined the effectiveness of spreadsheets and dynamic geometry software on the achievement (Isikal and Askar, 2005), computers and 2D geometric learning (Olkun, Altun, and Smith, 2005), and dynamic geometry sketches (Sinclair, 2004). The findings of the studies support computers in mathematics teaching and learning. For example, In Turkey, Isikal and Askar (2005) investigated the effect of spreadsheet and dynamic geometry software on mathematics achievement and mathematics self-efficacy. The results indicate that using technology effectively as a learning tool improves students' mathematics achievement. Olkun et al (2005) found that students who did not have computers at home initially had lower geometry scores. Therefore, Olkun et al. (2005) suggest that in schools, it seems more effective to integrate mathematical content and technology in a manner that enables students to do playful mathematical discoveries. In Canada, Sinclair (2004) found that using the Geometer's Sketchpad activities helps students notice geometric details, explore relationships and develop reasoning skills related to geometric proof.

On the other hand, research has examined preservice teachers views on instructional technology in teaching (Di, Dunn & Lee, 2000, Wang, 2001; Beyerbach, Walsh and Vannatta 2001; Albion, 2003; Goos, 2005 and Shamatha, Peressini and Meymaris, 2004). In Australia, Albion (2003) found that teachers gradating from the class of 2002 are better prepared for and, more positively disposed towards, integrating technology into their teaching. In the USA, Di (2000) examined the impact of instructional technology in an educational foundation course on student's perceptions of instructional technology. The results indicated that while utilising the Internet for research, students improved their perception of instructional technology related to confidence and comfort level, frequency of computer use, and views on instructional technology in teaching. Wang (2001) investigated student teachers' perception and practice of the teacher's role when teaching with computers. The teacher's role was measured as teacher-centredness and student-centredness, and results showed a significant difference in computer use although no difference in perception of use.

2 NEED FOR THE STUDY

This paper addresses the effect of pre-service teachers' beliefs about computers and mathematics teaching. The intent of the study is twofold. First, it provides information on pre-service teachers' attitudes toward using computers and Internet resources in elementary mathematics classrooms. The interpretation of this information will help educators understand the status of pre-service teachers' views of web-based instruction in the classroom. From this study, it is hoped that prospective educators will better understand the importance of integrating technology into the classroom. The study's information will help to enable educators to revise their curricula appropriately to reflect changes in the workplace.

The second intent of the study is to provide information concerning the role of technology in promoting effective teaching and learning of mathematics. This understanding may, in turn, provide insight and direction for improvement not only in the field of mathematics education, but also in other areas of technology education.

This research builds on NCTM's Principles and Standards for School Mathematics (2000) which states "Computers are essential tools for teaching, learning, and doing mathematics. They furnish visual images of mathematical ideas, they facilitate organising and analysing data, and they compute efficiently and accurately" (NCTM 2000, p.24).

This research paralleled the earlier work of Beyerbach et al. (2001), Goos (2005), Shamatha et al (2004) in pre-service teachers' beliefs about the instructional use of technology in mathematics education. Beyerbach et al. (2001) investigated pre-service teachers' thinking about and use of technology infusion and its role in student learning. The finding indicates that pre-service teachers changed their view of technology infusion from thinking that they would teach and learn about technology to thinking they would use technology to support student learning. Shamatha et al. (2004) found that pre-service teachers who participated in the computer program in mathematics education activities better understood mathematics and were excited about their learning.

3 THEORETICAL FRAMEWORKS

The theoretical framework of this research is based on two theories: social cognitive theory and constructivist learning theory. The social cognitive theory states that behaviour, cognition and environment co-exist in a reciprocal relationship and thereby influence each other. Self-efficacy is a central theme of social cognitive theory. It states that a person's belief in performing a behaviour or a task can lead to the successful completion of the task (Bandura, 1986). Self-reflection enables people to analyse their experiences, think about their own thought processes, and alter their thinking accordingly. One of the most important types of self-reflection is self-efficacy. Self-efficacy has received an enormous amount of attention in health-related research in the last five years. In fact, self-efficacy has become a central focus of Bandura's research, as he contends that self-efficacy is a major determinant of self-regulation. Self-efficacy is a type of self-reflective thought that affects one's behaviour (Bandura, 1977;1989). According to social cognitive theory, people develop perceptions about their own abilities and characteristics that subsequently guide their behavior by determining what a person tries to achieve and how much effort they will put into their performance (Bandura, 1977).

The second theory guiding this research is constructivism. Constructivist theory states that students' experiences, collaboration and self-construction of knowledge are relevant to instruction. Constructivist views assert that learning is the active process of constructing rather than passively acquiring knowledge, and instruction is the process of supporting the knowledge constructed by the learners rather than the mere communication of knowledge (Duffy and Cunningham, 1996; Honebein, Duffy and Fishman, 1993; Jonassen, 1999). In addition, constructivist theory encourages students to seek to make sense out of the to-be-learned information (Bruner, 1996; Jonassen, Peck and Wilson, 1999).

4 PURPOSE AND OBJECTIVES

The purpose of this study is: (a) to determine if there was a difference in attitudes of pre-service teachers instructed using web-based instruction and using non-web-based instruction, and (b) to identify whether there is a positive relationship between pre-service teachers' computer competency and attitudes toward using computers in mathematics teaching.

To complete this purpose the following objectives were established:

1 Compare pre-service teachers' attitudes toward using computers in mathematics teaching of web-based instruction approach as compared to that of a non-web-based instruction approach.

2 Determine the relationship between computer competency and attitudes toward using computers in mathematics teaching

Research Question One

Is there any significant difference in attitudes toward using computers and web-based resources in teaching mathematics between pre-service teachers who have attended web-based instruction on mathematics education and those who have not attended any such instruction?

Research Question Two

Is there a positive relationship between computer competency and attitudes toward using computers in mathematics teaching?

According to NCTM (2000), technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning. Teachers' attitudes play an important role in using technology in teaching and learning mathematics. It is very important to improve teachers' attitudes toward using computers in the classroom because it enhances mathematics teaching and learning.

Research on technology integration in mathematics education has proved that using computers in the classroom benefits students' learning in mathematics (Isikal and Askar, 2005; Olkun et al., 2005; Sinclair, 2004). Based on social cognitive theory, a person's belief in performing a behaviour or a task can lead to the successful completion of the task (Bandura, 1986). Thus, in order to help students to effectively learn mathematics with computers the improvement of teachers' attitudes towards using computers in the classroom is crucial.

5 METHODOLOGY

5.1 Setting and Subject Description

The subjects of this study were undergraduate students from a pre-service elementary education program. They were enrolled in the mathematics method course. The course offers students experience in developing mathematics lessons appropriate for elementary instruction based on an investigative approach to elementary mathematics instruction that is purposeful, inquiry-based, and meaningful. A total of 97 students were involved in this study. The treatment group contained 47 students, while the control group contained 50 students. The content of the two groups, experimental and control, was essentially the same with the exception that the students in the treatment group participated in the web-based instruction while those in the control group did not.

5.2 Variables

The independent variable in this study is the web-based instruction. The dependent variable is the pre-service teacher attitude measures.

5.3 Design

A quasi-experimental pre-test, post-test, non-equivalent control group design was used in the study. Due to the nature of the registration process and enrolment in the College of Education, randomisation was not used in this study.

5.4 Instruction

According to NCTM's Principles and Standards for School Mathematics (2000), technology not only enhances mathematics learning but also supports effective mathematics teaching. In order to encourage teachers to use technology in mathematics teaching, it is very important to improve their attitudes toward using computers in the classroom. Therefore, the present study utilised mathematics education web-based instruction in order to help pre-service teachers meet NCATE/ISTE standards. That is, the primary purpose of the instruction was to foster pre-service teachers' positive attitudes toward computers in promoting effective teaching and learning of mathematics.

The instruction was comprised of four sessions. Each session lasted proximately 30 minutes. The content of the instruction included: geometry for kindergarten to grade 2 (Session 1), geometry for grade 3 to grade 5 (Session 2), data analysis and probability for kindergarten to grade 2 (Session 3), data analysis and probability for grade 3 to grade 5 (Session 4). For each session, the learning objectives of the instruction are shown in Table 1.

1	Demonstrate basic computer/technology operations.
2	Understand the web in communicating, collaborating and problem solving and the legal use of a web-based resource.
3	Apply learning the Internet to support instruction.
4	Synthesis of web-based resource and integrate web-based productivity to support instruction.
5	Collaborate planning web-based resource and teaching with other educator.

Table 1 Web-Based Instruction Learning Objectives

The instruction for this study included four steps. In the first step, the instructor found some examples of websites related to mathematics education and presented them to the students (pre-service teachers) in the classroom. For the second step, the students were asked to find the websites that the instructor presented in the lecture. In addition, the students were asked to discuss the strengths and weaknesses of the websites. In the third step, the students were asked to find a website similar to the websites that the instructor presented. Finally, the students were asked to write a mini lesson plan based on the websites introduced in the instruction.

5.5 Instrumentation

Several survey instruments were used to collect data: a demographic information questionnaire, a computer competency level questionnaire, and a pre- and post questionnaire on attitude toward computers and mathematics teaching. The researcher designed the demographic information questionnaire and the computer competency level questionnaire. The questionnaire of attitudes toward computers and mathematics teaching was adapted from Loyd and Gressard (1984). The researcher modified this questionnaire to provide more emphasis on computers and mathematics teaching. The survey instruments were piloted with 28 pre-service teachers who were from a mathematics method course. Before the surveys were administered, the instruments were given to five people with expertise is mathematics education for review. The survey instruments were modified following their valuable comments and recommendations.

5.6 Computer Competency Level Questionnaire

This questionnaire was used to determine the students' computer competency level. The questionnaire was given at the beginning of the instruction. There are two components in this questionnaire: Networking skills and telecommunication skills. The scale ranged from 1 (which represents 'not familiar') to 5 (which represents 'proficient').

5.7 Attitudes Toward Computers and Mathematics Teaching Questionnaire

The 30 item, 5 point Likert-type questionnaire was used to investigate pre-service teachers' attitudes about using computers in teaching mathematics. Three subscales, anxiety, confidence, and liking, were used in this study. The total instrument range was 30 to 150; each subscale had a range from 10 to 50. The five possible choices for each question and the associated points used for scoring were:" strongly disagree" (1), "disagree" (2), "undecided" (3), "agree" (4) and "strongly agree" (5).

5.8 Instrument reliabilities

As shown in Table 2, internal consistency reliability indices (Cronbach's Alpha) ranged from $r = 0.73$ to $r = 0.91$ for the 3 scales and subscales examined. The coefficient alpha reliabilities were 0.76, 0.73 0.88, 0.89, 0.82, and 0.91 for the Networking, Telecommunication, Anxiety, Confidence, Liking subscales, and the Total Score, respectively. According to the guidelines provided by DeVellis (1991, p. 85), these fall in the range of "respectable" to "excellent (shortening scale would be acceptable)".

Scale	Alpha	No. Items	N
Networking	0.76	4	97
Telecommunication	0.73	5	97
Anxiety	0.88	10	97
Confidence	0.89	10	97
Liking	0.82	10	97
Total Score	0.91	30	97

Table 2 Subscales Reliabilities

5.9 Effect sizes

Table 3 reports the effect sizes for each scale. The average effect size was 0.60; that is, the average post-test mean for treated subjects was equivalent to a score 0.60 of a standard deviation above the mean for untreated subjects. This report also tells us that the outcome of the instruction is a gain on the dependent variable equivalent to a move from the mean to the 73th percentile of the control group.

Variable	Effect Size
Anxiety	0.61
Confidence	0.65
Liking	0.54
Average	0.60

Table 3 Effect Sizes

6 RESULTS

6.1 Results for Research Hypothesis 1

Research Hypothesis 1: Pre-service teachers who receive web-based instruction on mathematics education will have more positive attitudes toward integrating web-based resources into a curriculum than those who do not receive any instruction.

The first research question asks whether there is a statistically significant difference ($p < 0.05$) in attitudes between those participants who participated in web-based instruction on mathematics education and those who did not participate. In order to find out, a comparison must be made between the two groups. The items were divided into three clusters: anxiety about using computers in teaching mathematics (10 items), confidence about using computers in teaching mathematics (10 items) and liking the use of computers in teaching mathematics (10 items). For these items, the following four statistical comparisons among the groups were made: pre-control vs. pre-experimental; post-control vs. post-experimental; pre-post control; and pre-post experimental.

Pre-service Teachers' Anxiety Toward Using Computers and Mathematics Teaching

Figure 1 depicts the trend line for anxiety about computers in mathematics teaching means. A low score represents a low level of anxiety. This figure shows that anxiety levels of the subjects were at their highest mean level at the post-test observation (M = 3.86, SD = 0.39). This graph indicates the interaction between pre-test and post-test scores and demonstrates a decrease in anxiety about using computers in mathematics teaching.

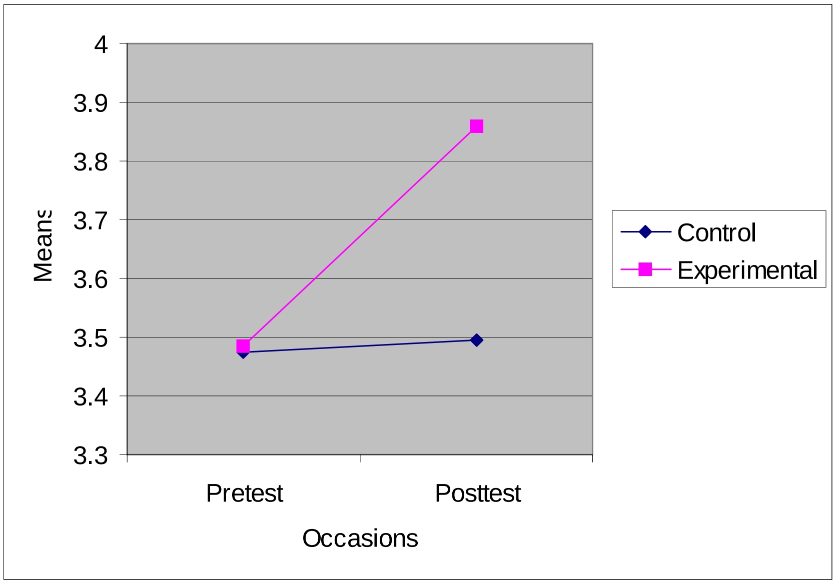

Figure 1 Anxiety about using Computers in Teaching Mathematics. A high score represents a low level of anxiety

Table 4 shows the results for pre-control versus pre-experimental comparison. An ANOVA reveals that the difference between the groups in anxiety toward computers and mathematics teaching was not significant ($p > 0.05$) at the beginning of the study.

Sources	SS	DF	MS	*F*	*p*
Treatments	6.269	13	0.482	1.493	0.172
Error	10.660	36	0.323		
Total	16.929	49			

Table 4 Pre-Control and Pre-Experimental Groups' Anxiety Toward Computers and Mathematics Teaching

The second comparison on anxiety about using computers in teaching mathematics carried out in this study was the post-control vs. post-experimental (See Table 5). The ANOVA results of the comparison indicates significant difference ($p < 0.05$).

Sources	SS	DF	MS	*F*	*p*
Treatments	8.171	10	.817	12.310	.000
Error	2.589	39	.066		
Total	10.759	49			

Table 5 Post-Control and Post-Experimental Groups' Anxiety Toward Computers and Mathematics Teaching

The third comparison on anxiety about using computers in teaching mathematics carried out in this study was pre-control vs. post-control (See Table 6). A paired samples t-test shows that the difference in the means of the anxiety toward computers and mathematics teaching on the control group was not significant ($p > 0.05$).

Variable	Group	M	N	SD	*T*	DF	*p*
Anxiety	Pre-control	3.474	50	0.451	-1.045	49	0.301
	Post-control	3.496	50	0.468			

Note. A high score represents a low level of anxiety

Table 6 Pre-Control and Post-Control Groups' Anxiety Toward Computers and Mathematics Teaching

Table 7 reports the fourth comparison between pre and post administration on anxiety about using computers in teaching mathematics in the experimental group. A paired samples t-test shows that the difference in the means of the anxiety about using computers in teaching mathematics on the experimental group was significant ($p < 0.05$).

Variable	Group	M	N	SD	*t*	DF	*p*
Anxiety	Pre-experimental	3.484	47	0.4037	-9.387	46	0.000
	Post- experimental	3.860	47	0.3902			

Note. A high score represents a low level of anxiety

Table 7 Pre-Experimental and Post-Experimental Groups' Anxiety Toward Computers and Mathematics Teaching

Pre-Service Teachers' Confidence Toward Using Computers in Mathematics Teaching

Figure 2 depicts the trend line for computers and mathematics teaching confidence means. A high score represents a high level of confidence. This figure tells us that experimental group computers and mathematics teaching confidence levels were at their highest mean level at the post test observation (M = 3.47, SD = 0.54). This graph indicates pre test and post test score interaction, which shows a gain in confidence in using computers in mathematics teaching.

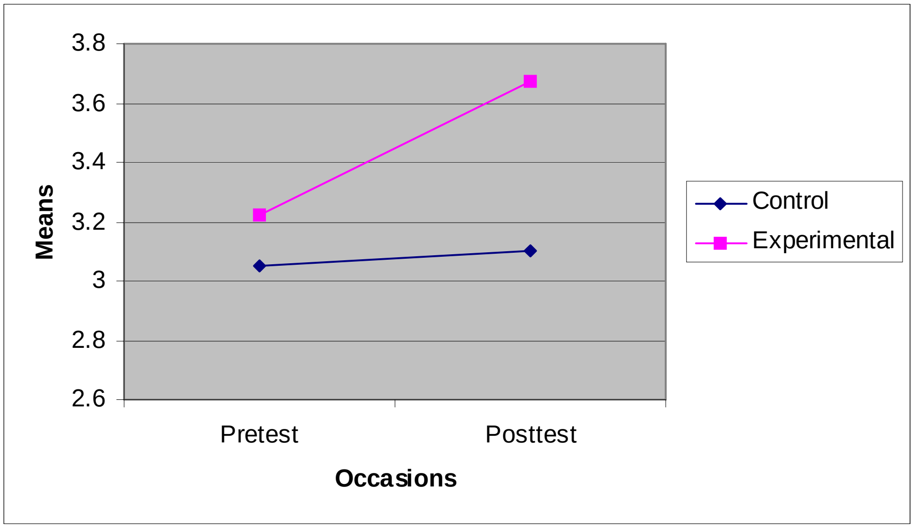

Figure 2. Computers and mathematics teaching confidence

Table 8 shows the results for pre-control vs. pre-experimental comparison. An ANOVA reveals that the difference between the groups in confidence about using computers in mathematics teaching was not significant ($p > 0.05$) at the beginning of the study.

Sources	SS	DF	MS	*F*	*p*
Treatments	8.598	13	0.537	1.405	0.205
Error	11.475	36	0.383		
Total	20.073	49			

Table 8 Pre-Control and Pre-Experimental Groups' Confidence Toward Computers and Mathematics Teaching

The second comparison on confidence about using computers in mathematics teaching carried out in this study was the post-control vs. post-experimental (See Table 9). The ANOVA results of the comparison indicates significant difference ($p < 0.05$).

Sources	SS	DF	MS	*F*	*p*
Treatments	3.588	8	0.817	10.735	0.000
Error	1.588	38	0.066		
Total	5.176	46			

Table 9 Post-Control and Post-Experimental Groups' Confidence Toward Computers and Mathematics Teaching

The third comparison on confidence about using computers in mathematics teaching carried out in this study was pre-control vs. post-control (See Table 10). A paired samples t-test shows that the difference in the means of the confidence toward computers and mathematics teaching on the control group was not significant ($p > 0.05$).

Variable	Group	M	N	SD	*t*	DF	*p*
Confidence	Pre-control	3.290	50	0.371	-0.425	49	0.673
	Post-control	3.304	50	0.349			

Table 10 Pre-Control and Post-Control Groups' Confidence Toward Computers and Mathematics Teaching

Table 11 reports the comparison between pre and post administration on confidence about using computers in mathematics teaching in the experimental group. A paired samples t-test shows that the difference in the means of the confidence toward computers and mathematics teaching on the experimental group was significant ($p < 0.05$).

Variable	Group	M	N	SD	*t*	DF	*p*
Confidence	Pre-experimental	3.312	47	0.376	-4.9	46	0.000
	Post- experimental	3.544	47	0.335			

Table 11 Pre-Experimental and Post-Experimental Groups' Confidence Toward Computers and Mathematics Teaching

Pre-Service Teachers' Liking Toward Using Computers in Mathematics Teaching

Figure 3 depicts the trend line for computers and mathematics teaching liking means. A low score represents a low level of liking. This figure shows that in the experimental group, computers and mathematics teaching liking levels were at their highest mean level at the post-test observation (M = 3.26, SD = 0.27). This graph indicates the interaction between pre-test and post-test scores and demonstrates an increase in liking computers and mathematics teaching.

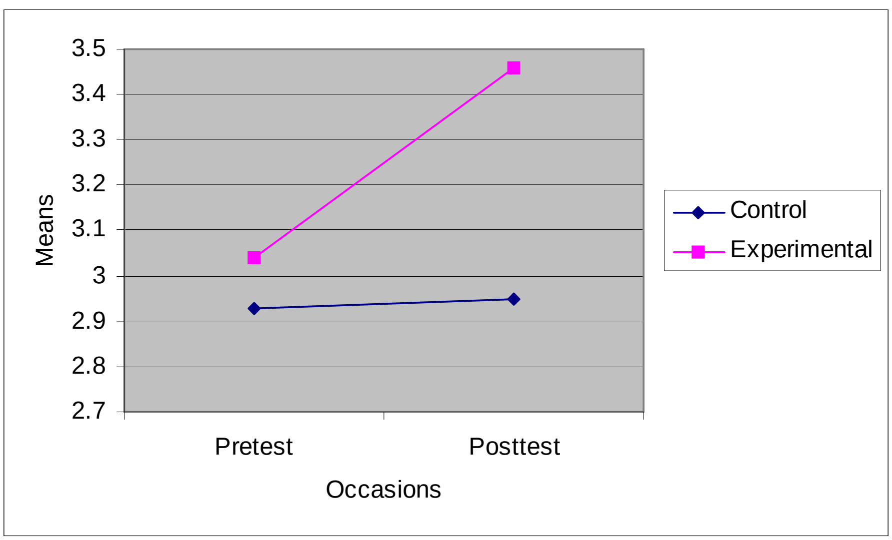

Figure3 Liking computers and mathematics teaching

Table 12 shows the results for pre-control vs. pre-experimental comparison. An ANOVA reveals that the difference between the groups in liking toward computers and mathematics teaching was not significant ($p > 0.05$) at the beginning of the study.

Sources	SS	DF	MS	*F*	*p*
Treatments	3.992	13	0.333	1.013	0.459
Error	11.161	36	0.328		
Total	15.153	49			

Table 12 Pre-Control and Pre-Experimental Groups' Liking Toward Computers and Mathematics Teaching

The second comparison on liking to use computers in mathematics teaching carried out in this study was the post-control vs. post-experimental (See Table 13). The ANOVA results of the comparison indicate significant difference ($p < 0.05$).

Sources	SS	DF	MS	F	p
Treatments	3.345	9	0.372	6.516	0.000
Error	2.111	37	0.057		
Total	5.456	46			

Table 13 Post-Control and Post-Experimental Groups' Liking Toward Computers and Mathematics Teaching

The third comparison on liking to use computers in mathematics teaching carried out in this study was pre-control vs. post-control (See Table 14). A paired samples t-test shows that the difference in the means of the liking toward computers and mathematics teaching on the control group was not significant ($p > 0.05$).

Variable	Group	M	N	SD	t	DF	p
Liking	Pre-control	3.134	50	0.329	-1.5	49	0.140
	Post-control	3.160	50	0.338			

Table 14 Pre-Control and Post-Control Groups' Liking Toward Using Computers in Mathematics Teaching

Table 15 reports the comparison between pre and post administration on liking toward using computers in mathematics teaching in the experimental group. A paired samples t-test shows that the difference in the means of the liking toward computers and mathematics teaching on the experimental group was significant ($p < 0.05$).

Variable	Group	M	N	SD	T	DF	p
Liking	Pre-experimental	3.172	47	0.372	-11.687	46	0.000
	Post- experimental	3.444	47	0.344			

Table 15 Pre-Experimental and Post-Experimental Groups' Liking to use Computers in Mathematics Teaching

6.2 Results for Research Hypothesis 2

Research Hypothesis 2: There is a positive relationship between computer competency and attitudes toward using computers in mathematics teaching.

Table 16 presents correlations between attitude subscales and computer competency for the pre-test. All subgroup correlations were significant at the $p < 0.01$ level. The data suggest that there is a positive relationship between computer competency and attitudes toward using computers and mathematics teaching.

Scale	Experimental ($n = 47$)	Control ($n = 50$)
Attitude	0.593**	0.701**
Anxiety	0.658**	0.644**
Confident	0.728**	0.642**
Liking	0.714**	0.703**

** $p < 0.01$.

Table 16 Summary of correlations between attitude subscales and computer competency for the pre-test.

Table 17 presents correlations between attitude subscales and computer competency for the post-test. All subgroup correlations were significant at the $p < 0.01$ level. The data suggest that there is a positive relationship between computer competency and attitudes toward using computers in mathematics teaching.

Scale	Experimental ($n = 47$)	Control ($n = 50$)
Attitude	0.497**	0.696**
Anxiety	0.407**	0.690**
Confident	0.490**	0.646**
Liking	0.430**	0.694**

** $p < 0.01$.

Table 17 Summary of correlations between attitude subscales and computer competency for post-test.

7 DISCUSSION

Pre-Service Teachers' Attitudes toward Teaching Mathematics with Computers

7.1 Answering the First Research Question

Is there any significant difference in attitudes toward using computers and web-based resources in teaching mathematics between pre-service teachers who have attended web-based instruction on mathematics education and those who have not attended any instructions?

Attitudes toward using computers and web-based resources in teaching mathematics were explored in this study by collecting data through a Likert scale that was administered at the beginning and at the end of the treatment, for control and experimental groups. The results indicate that students in the web-based instructions classroom revealed a significantly ($p < 0.05$) better attitude toward using computers and web-based resources in teaching mathematics than did students who did not take part in the instruction.

The questionnaire investigated the attitudes toward using computers and Internet resources in mathematics teaching. It was organised in three subscales: anxiety about using computers in mathematics teaching, confidence and liking. Each subscale rated 10 items on a 5-point Likert-type scale, with 1 equating to strongly disagree and 5 equating to strongly agree. In terms of anxiety about using computers in mathematics teaching, the experimental group and the control group exhibited a very slight difference which was not statistically significant before the instruction was given. Once the instruction was completed, the experimental group reported being less anxious about using computers and Internet resources in teaching mathematics than the control group. In terms of confidence about using computers in mathematics teaching, the experimental group exhibited more confidence in teaching mathematics with computers and Internet resources than the control group after the instruction was completed. In terms of liking to use computers in mathematics teaching, the experimental group exhibited more liking toward teaching mathematics with computers and Internet resources than did the control group.

Based on these results, it was concluded that the instruction helped pre-service teachers to be less anxious, increase their confidence about using computers and Internet resources in teaching mathematics. The surveys also revealed that the instruction helped them in using computers and Internet resources in teaching mathematics. These findings are supported by previous studies done by Balli and Diggs (1996), Thurston et al, (1995), Wetzel and Chisholm (1996) who found that the technology integration in pre-service teacher education program not only benefits their professional growth but also helps them become familiar with technology and increases their confidence in using technology in the classrooms.

7.2 Answering the Second Research Question

Is there a positive relationship between computer competency and attitudes toward using computers and mathematics teaching?

In answering this question, the correlation coefficient was used to examine the relationship between self-reported computer competency and attitudes toward using computers in mathematics teaching. The results suggest that there is a positive relationship between computer competency and attitudes toward using computers in mathematics teaching. That is, students with a high level of computer competency tend to have less anxiety and exhibit more confidence than students with lower levels of computer competency toward using computers and Internet resources in teaching mathematics. The findings of this research are in agreement with previous research done by McFarlane, Hoffman and Green (1997), Marcinkiewicz and Wittman (1995) and Kim (2003). McFarlane, Hoffman and Green (1997) used the Technology Attitude Survey (TAS) to assess teachers' attitudes toward the general use of technology as an educational tool in the classroom. They found that teachers' attitudes moderate correlations with the computer competency scale of the Teacher Effectiveness Scales. Kim (2003) found that attitudes toward computer use in education and self-perceived computer competence had a significant correlation.

7.3 Function of the Technology

The function of the technology in this project was to demonstrate how interactive web sites can be supportive in learning and teaching mathematics. The interactive web sites provide a rich environment for activities in which students put together or take apart (compose and decompose) shapes. Visual representation made possible by the dynamic interactive web sites makes it easy to make connections between a mathematical expression and the situation to which it refers. It helps students not to stick with a description in words and symbols or with a diagram in a book that can't be examined or explored. The construction web sites not only help students to do the basic geometric constructions but also help them to explain why and how they work. The use of interactive web sites helps them organise and represent their data. It allows them to organise and order a large set of data and create a variety of graphs.

8 CONCLUSIONS

This study developed instruction in mathematics education, and examined the effects of web-based instruction for pre-service elementary teachers. In particular, this study had two major goals designed to assess the effects of web-based instruction: (1) To investigate pre-service teachers' competencies in using computers or Internet resources in teaching mathematics, and (2) To investigate pre-service teachers' attitudes toward using computers or Internet resources in teaching mathematics.

Regarding whether there is any significant difference in attitudes toward using computers and web-based resources in teaching mathematics between pre-service teachers who have received web-based instruction in mathematics education and those who have not, it is concluded that students in the experimental group had more positive attitudes toward using computers in teaching mathematics. More specifically, students in the experimental group felt that they had more confidence and were less anxious about teaching mathematics with computers than students in the control group.

With respect to whether there is a positive relationship between computer competency and attitudes toward using computers and mathematics teaching, it is concluded that computer competency and attitudes toward using computers and mathematics teaching had a positive correlation. Students with a high level of computer competency tended to feel less anxious, and more confident than students with a low level of computer competency toward using computers and Internet resources in teaching mathematics.

9 LIMITATIONS AND RECOMMENDATIONS

The first limitation of this research project was the relatively short period of time of the workshops. It was just five weeks of instruction, instead of the whole academic semester. Future studies should add more time to the workshops. The second limitation of this research project was that the workshop emphasised only topics on geometry and data analysis. Future studies could add more topics such as measurement or number sense. The third limitation of this research project was that 97 subjects were used. A larger number would permit greater generalisation. Fourth, in order to control pre-test effects, future research should add an additional control group to determine whether pre-testing had an effect on participants' knowledge. Finally, subjects from only one institution and one instrument were used in the investigation. It would be possible to generalise the observed findings to other instruments or contexts by future studies which involve more institutions and compare the outcomes.

The results of this research indicate that web-based workshops foster positive attitudes toward instructional technology among elementary pre-service teachers. Their attitude toward teaching mathematics with computers is important because it can lead to the successful completion of the task (Bandura, 1986). Therefore, we recommend that mathematics teacher education programs review and take into consideration students' needs and prepare pre-service teachers to teach tomorrow's students by using technology in the mathematics classroom effectively. Finally, we recommend the provision of technology-training programs for prospective teachers that can satisfy their specific needs in tomorrow's classroom.

We suggest that mathematics education faculties promote the belief that all students are able to learn mathematics in a variety of ways. Using technology is one way to help them learn effectively. In addition, this study suggests that mathematics education faculties should encourage pre-service teachers to use computers in the classroom in order to support their teaching mathematics more effectively.

Investigations of the pre-service teachers' perception of teaching mathematics with computers are only just beginning. Further research should involve exploring the relationship between teachers' perceptions of teaching mathematics with computers and students' achievement. In addition, future research should compare pre-service teachers' and in-service teacher's perceptions of teaching mathematics with computers. The findings would be helpful for designing mathematics teacher education programs.

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BIOGRAPHICAL NOTES

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