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Preservice Teachers' Changing Perceptions of Technology Infusion — The Impact of Web-based Instruction in Mathematics Education

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This study sought to examine preservice teachers' beliefs about their intent to use computers and Internet resources in mathematics classrooms. Also, web-based instruction on topics in elementary school mathematics was used to foster teachers' confidence and competence in using instructional technology, thereby promoting positive attitudes toward use of 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.

Keywords: mathematics education, technology, web-based, preservice teacher, teacher education.

The Principles and Standards for School Mathematics (National Council of Teachers in Mathematics 2000) states that "Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning." (p. 24). The Principles and Standards play a leading role in guiding the improvement of mathematics education around the nation. The use of technology in mathematics is an essential component of the Standards. In addition, The Principles and Standards state:

> Students can learn more mathematics more deeply with the appropriate use of technology (Dunham & Dick 1994: Sheets 1993; Boers-van Oosterum 1990; Rojano 1996; Groves 1994). Technology should not be used as a replacement for basic understandings and intuitions; rather, it can and should be used to foster those understandings and intuitions. In mathematics-instruction programs, technology should be used widely and responsibly, with the goal of enriching students' learning of mathematics. (p.10)

Research on the impact of computer technologies has supported the use of computers as a thinking aid and an intellectual tool to enrich learners' mathematical explorations, facilitate student's growth of mathematical understanding, and improve their problem solving skills and concept development (Becker 1988; Hatfield & Bitter 1994; Hoyles 1991; Kaput 1992; Kulik & Kulik 1987; Niemiec & Walberg 1992; Palmiter 1986; Park 1993; Tall 1986; Wachsmuth & Becker 1986).

Over the past decade, the decreasing ratio of students to instructional computers in public schools reflects a greatly increased availability of computers. In 2003, the ratio of students to instructional computers with internet access in public schools was 4.4 to 1, a decrease from 12.1 to 1 ratio in 1998, when it was first measured NCES (2005). The percentage of elementary schools with at least one internet connection has increased rapidly, from 30% in 1994 to over 97% in 2000. The percentage of elementary classrooms with Internet access has risen from 3% in 1994 to 76% in 2000 (NCES 2001).

Despite the great growth in the number of elementary classroom computers and the increased budgets for educational technology, research on technology in teacher education indicates that computer-based technologies are not being fully utilized by the majority of teachers (Office of Technology Assessment 1995). In 1995, 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 the teacher preparation experience in most colleges of education in the United States (Office of Technology Assessment (1995). Preservice teachers are not getting the needed experience to be able to teach with technology, nor upon graduation, do they feel comfortable teaching with technology (Wetzel 1993; ISTE 1992).

According to a report from the National Center for Education Statistics, Teacher Preparation and Professional Development: 2000 (Parsad, Lewis & Farris 2001), teachers were least likely to report feeling very well prepared to integrate educational technology into the grade or subject taught (27%). Another report by the Congressional Office of Technology Assessment (1995) concluded that "overall, teacher education programs do not prepare graduates to use technology as a teaching tool."(p.184)

Most teachers graduated from teacher education institutions with limited knowledge of the ways technology can be used in their professional practice (Wetzel & Chisholm 1996). Integrating technology in teacher education programs is necessary so that preservice teachers are able to see the importance of developing and using computer-based lessons in their own teaching (Wiburg 1991).

Research on technology integration in preservice teacher education programs has examined programs such as Teaching Teleapprenticeships (TTa) (Thurston, Secaras & Levin 1995), technology-based lessons in elementary school classrooms (Balli & Diggs

1996), preservice teachers' field experience with technology (Balli, Wright & Foster 1997; McDevitt 1996).

Balli & Diggs (1996a) developed a pilot project with preservice teachers who taught technology-based lessons in elementary school classrooms at the University of Missouri. The subjects in their study were 11 preservice 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 preservice 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, Secaras & Levin (1995) developed an innovative program called Teaching Teleapprenticeships (TTa) which integrated technology into the preservice 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 math and math 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 *et al* (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 preservice computer technology preparation was inadequate.

Marcinkiewicz & Wittman (1995) developed a longitudinal study to investigate teachers' use of computers in teaching. One hundred sixty-seven elementary preservice 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) investigate the effectiveness of integrating problem solving, interactive multimedia, and constructivism in teacher education. The study examined preservice 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 preservice 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.

Di, Dunn & Lee (2000) the impact of educational foundations' courses in instructional technology on students' perceptions of instructional technology, research skills, and learning. The findings indicated that, by utilizing 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.

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 preservice or in-service training in the effective application of technology to support learning.

Gunter (2001) examined the importance of technology-enriched curricula for preservice teacher education and described a study that evaluated, both quantitatively and qualitatively, the effectiveness of a redesigned introduction to technology course for preservice 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, technology enhances mathematics learning and supports effective mathematics teaching. In addition, integrating technology into teacher education programs helps preservice teachers to see the importance of developing and using computer-based lessons in their own teaching.

NEED FOR THE STUDY

Research on educational literature addresses the importance of teacher beliefs, attitudes, and knowledge (Clark & Peterson 1986; Fennema & Franke 1992; Gann & Fried 1993; Thompso 1992). This paper addresses the effect of preservice teachers' beliefs about computers and mathematics teaching. The intent of the study is twofold. First, it provides information on preservice teachers' attitudes toward using computers and Internet resources in elementary mathematics classrooms. The interpretation of this information will help educators understand the status of preservice 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.

PURPOSE AND OBJECTIVES

The purpose of this study is to determine if there was a difference in attitudes by preservice teachers instructed using web-based instruction and using non-web-based instruction. To complete this purpose the following objectives were established:

Compare preservice teachers' attitudes toward using computers in mathematics teaching of web-based instruction approach as compared to that of a non-web-based instruction approach. Research question is as follows:

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

METHODOLOGY

Setting and Subject Description

The subjects of this study were undergraduate students from the preservice 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.

Variables

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

Design

A quasi-experimental pretest-posttest, nonequivalent control group design was used in the study. Due to the nature of the registration process and enrollment in the College of Education, randomization was not used in this study.

Instruction

According to Principles and Standards for School Mathematics (NCTM 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 utilized mathematics education web-based instruction in order to help preservice teachers meet NCATE/ISTE standards. That is, the primary purpose of the instruction was to foster preservice 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

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 (preservice 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.

Table 1. Web-Based Instruction Learning Objectives

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.

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 attitude toward computers and mathematics teaching was adapted from Loyd & Gressard (1984). The researcher modified this questionnaire to provide more emphasis on computers and mathematics teaching. The survey instruments were piloted with 28 preservice 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.

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').

Attitudes toward Computers and Mathematics Teaching Questionnaire.

The 30-item, 5-point Likert-type questionnaire was used to investigate preservice 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), "strongly agree" (5).

Instrument Reliability

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)".

Table 2. Subscales Reliabilities

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

Effect sizes

Table 3 reports the effect sizes for each scale. The average effect size was 0.60; that is, the average posttest 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 73rd percentile of the control group.

Table 3. Effect Sizes

Variable	Effect Size
Anxiety	0.61
Confidence	0.65
Liking	0.54
Average	0.60

RESULTS

Results for Research Hypothesis 1

Research Hypothesis 1: Preservice 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 instructions 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.

Preservice 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 posttest observation (M = 3.86, SD = 0.39). This graph indicates the interaction between pretest and posttest scores and demonstrates a decrease in anxiety about using computers in mathematics teaching.

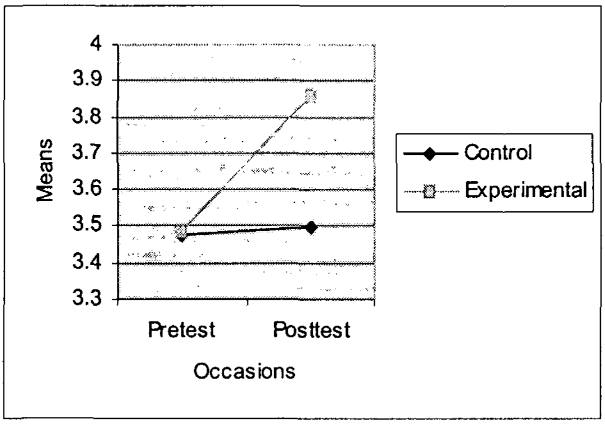

Figure 1. Anxiety about using Computers in Teaching Mathematics. A high score represents a low level of anxiety.

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.

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

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			

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 indicate significant difference ($p < 0.05$).

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

Sources	*SS*	*DF*	*MS*	*F*	*p*
Treatments	8.171	10	0.817	12.310	0.000
Error	2.589	39	0.066		
Total	10.759	49			

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 ($p > 0.05$).

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

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 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 ($p < 0.05$).

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

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

Preservice Teachers' Confidence toward Using Computers in Mathematics Teaching.

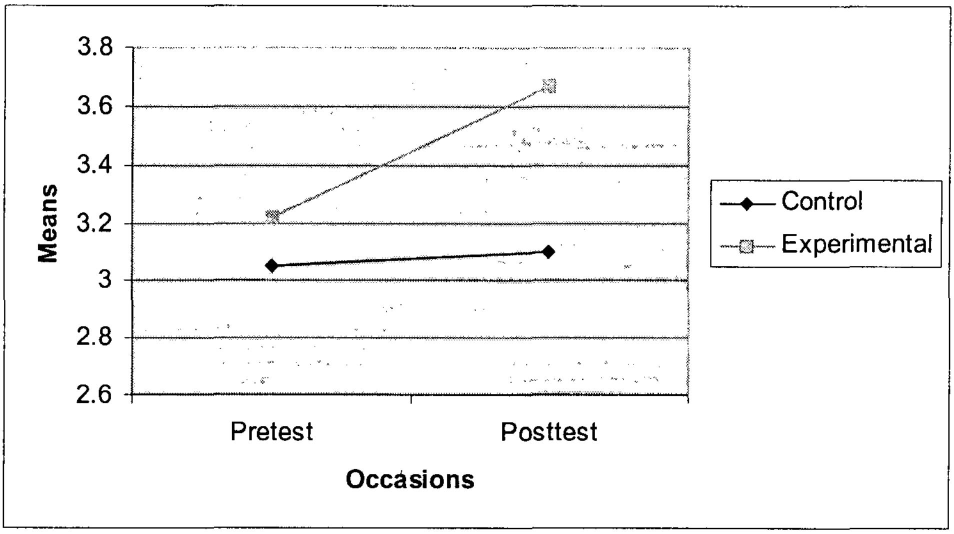

Figure 2. Computers and mathematics teaching confidence.

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 posttest observation (M = 3.47, SD = 0.54). This graph indicates pretest and posttest score interaction, which shows a gain confidence in using computers in mathematics teaching.

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.

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

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			

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 indicate significant difference ($p < 0.05$).

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

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			

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 ($p > 0.05$).

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

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 11. Pre-Experimental and Post-Experimental Groups' Confidence toward Computers and Mathematics Teaching

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 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 ($p < 0.05$).

Preservice Teachers' Liking toward Using Computers in Mathematics Teaching.

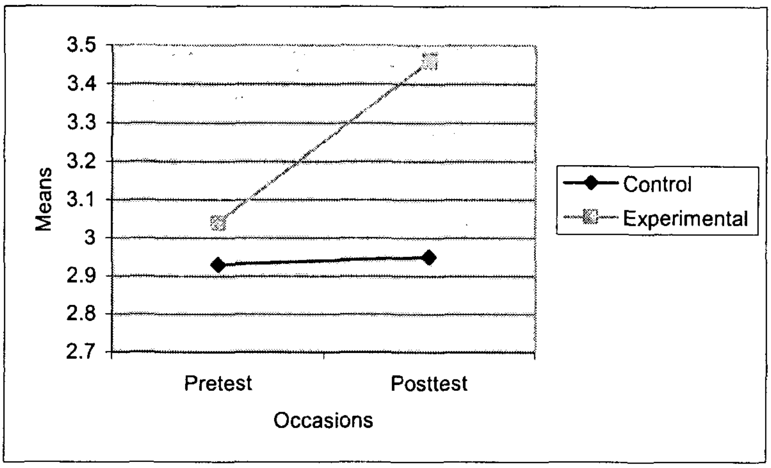

Figure 3. Liking about computers and mathematics teaching.

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.

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

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			

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 ($p < 0.05$).

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

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			

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 ($p > 0.05$).

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

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 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 ($p < 0.05$).

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

Variable	Group	*M*	*N*	SD	*t*	*df*	*p*
Liking	Pre-experimental	3.172	47	.372	−11.687	46	0.000
	Post- experimental	3.444	47	.344			

DISCUSSION

Is there any significant difference in attitudes toward using computers and web-based resources in teaching mathematics between preservice 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-type scale that was administered in 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 instructions.

The questionnaire investigated the attitudes toward using computers and internet resources in mathematics teaching. It was organized 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 equaling strongly disagree and 5 equaling strongly agree. In terms of anxiety about using computers in mathematics teaching, the experimental group and the control group exhibited a very slight difference but not statistically significant before the instruction were 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 preservice 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 & Diggs (1996), Thurston, Secaras & Levin, (1995), Wetzel & Chisholm (1996) who found that the technology integration in preservice teacher education program not only benefits their professional growth but also helps them become familiar with technology and increases their confidence using technology in the classrooms.

CONCLUSIONS

This study developed instruction in mathematics education, and examined the effects of web-based instruction for preservice elementary teachers. In particular, this study had two major goals designed to assess the effects of web-based instruction:

(1) To investigate preservice teachers' competencies in using computers or internet resources in teaching mathematics, and

(2) To investigate preservice 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 preservice teachers who have received web-based instruction in mathematics education and those who have not received any instruction, 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 in 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.

LIMITATIONS OF THE STUDY

The following section presents the limitations of this study. The first limitation of this research project was the short period of time of the instruction. Here was just five weeks of instruction, instead of the whole academic semester. Future studies should add more time to the instructions.

The second limitation of this research project was that the instruction topics focused only on geometry and data analysis. Future studies could add more topics such as measurement or number sense. Other positives findings could be expected if more topics were added to the instruction.

The third limitation of this research project was that the number of subjects in the experimental group was only 47. This number is not big enough to make a legitimate generalization.

The fourth limitation of this research project was that the subjects of this study were elementary education students. This might affect its generalizability to other preservice teacher majors.

Finally, only one institution and one instrument were used in the investigation. The generalizability of the observed findings to other instruments or contexts should be established. Future studies could investigate students in more institutions and compare the outcomes.

RECOMMENDATIONS

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

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