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Preservice Teachers and Computers: A Survey of Attitudes and Experiences

by

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ABSTRACT

The primary objectives of this study were to examine the impact of an introductory computer course on preservice teachers' experience with and attitudes toward computers. The relationship between preservice teachers' route and/or major area of study and their computer experience and their attitudes toward computers was also investigated. Finally, the relationship between experience and attitudes toward computers was explored.

The preservice teachers (n=101) completed computer experience and computer attitude surveys. Experience and attitude data was analyzed descriptively and inferentially. A multivariate MANOVA was conducted on experience data and an exploratory factor analysis and MANOVA was conducted on attitude data. A four factor solution was found.

Results of the study indicate that subjects entered the course with little or no experience on several types of computer applications, but increased their experience by the end of the course. Subjects entered the course with generally positive attitudes toward computers and were more positive upon completion of the course. The expectation that students in certain major areas of study would be more comfortable and/or like computers more was not supported by the results of this study. Implications for further research are considered.

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CHAPTER ONE

INTRODUCTION

Hunt & Bohlin (1991) estimate that only one half of all classroom teachers report that they have used computer technology in their classroom instruction and fewer still have yet to discover the potential interactive technologies. They suggest that the major factors in this under-use are teacher knowledge and attitudes. The present study seeks to explore preservice teachers' computer experience and their attitudes toward computers prior to and after completing an introductory computer course for educators. The purpose of this study is to investigate the experience levels and attitudes held by preservice teachers and to determine if an introductory course has an impact on these areas.

There are several reasons for pursuing research into the nature of preservice teachers' attitudes toward and experience with computers. Teachers' attitudes toward computers are essential to the successful implementation of technology in the classroom. Furthermore, those teachers who have a broad range of computer skills, who are comfortable with computers and who are confident in their abilities will be more effective in using computers in their teaching careers (Loyd & Loyd, 1985). Those teachers who possess positive attitudes and are confident in using computers will act as positive role models for students who are more likely to use computers themselves (Bandura, 1977). Educating preservice teachers in the philosophy and implementation of technology is a prerequisite to any successful implementation.

Because of the current proliferation and widespread use of computers in education, coupled with the changing nature of computer technology and entry level computer skills of preservice teachers, a current study of preservice teachers' attitudes and experience is warranted. The vast majority of research into the area seems to suggest that computer experience and attitudes can be influenced by participation in a computer applications course. This study attempts to identify those attitudes and measure the degree to which these attitudes can be influenced by an introductory course by using a pre/post-test design.

The present study is based on a theoretical framework of research that has examined the prior computer experience preservice teachers possess, the attitudes held by preservice teachers during their teacher training programs, the underlying factors that may describe preservice teachers' attitudes toward computers and the experiential and attitudinal differences between sub-groups of education students. Several studies have investigated the experience that preservice teachers have with computers; however many of them have not examined the specific types of computer applications that are currently available to preservice teachers. Cohen (1979, cited in Baylor, 1985) suggests that if teachers are to use computers, their educational experiences should begin from their point of view. The information gained in this study may have an influence in future development of computer literacy courses for educators.

Some researchers have suggested that some specific groups of preservice teachers have more positive attitudes toward computers and/or make use of computers more than other preservice teachers. Researchers in the social sciences have examined the attitudes and experiences of preservice teachers in different major areas of study and found that students in certain major areas of study may view computers differently from others. Additional studies have reported differences between those students planning to teach at the elementary level versus those planning to teach in higher grades. Because participants in this study are from different areas of study and are intending to teach at a variety of levels of the educational system, the course from which the subjects in this study were drawn provided an opportunity to examine any differences that may exist among them.

Students' attitudes toward working with computers are important indicators of their future use in an instructional setting and therefore should be evaluated on an on-going basis. A model of preservice attitudes toward computers has been proposed to gain a better understanding of the nature of preservice teachers' attitudes toward computers (Violato, Marini & Hunter, 1989). The authors suggest that further studies involving preservice teachers should be conducted in order to replicate the model in order to demonstrate any generalizability of the underlying factor structure.

The present study addresses preservice teachers' experience and attitudes using two survey instruments in a pre/post design. This study explored the following research questions:

1. What is the entry-level computer experience of preservice teachers and what impact does a course have on their computer experience?
2. Can the four factor solution proposed by Violato, Marini & Hunter (1989) be replicated with this group of preservice teachers?
3. What impact does a required, semester-long introductory course in computer applications in education have on the attitudes of preservice teachers toward computers?
4. What is the relationship between preservice teachers' route and/or major area of study and their attitudes toward computers?
5. What is the relationship between experience with and attitudes toward computers?

CHAPTER TWO

REVIEW OF THE LITERATURE

Introduction

The application of computers in an educational setting is not just another educational fad that will soon disappear, but is likely to be judged as having had the greatest impact on education in modern history (Learning86, 1986). Computers have infiltrated the schools at an alarming pace (Hess, 1991). Hess (1991) reports that twenty-five years ago, public schools were only able to gain access to mainframe computers located at larger institutions for administrative uses, such as student schedules, report cards, attendance records and counseling statistics. Schools have taken advantage of decreasing costs and the increased capabilities of the computer as well as special programs and technology initiatives put forth by governmental agencies. The result is that the number of computers in the classroom has increased substantially. For example, Wright (1984) reported that in 1982, 38% of schools had computers; six years later, Ordvanksy (1988) reported that 91% of schools in the United States had computers in their classrooms. Morsund (1980) predicted that by the year 2000, 50 percent of instruction will be computer related.

In order for students to function successfully in whatever occupation or profession they may select, they must be computer literate and they must have experience interacting with computers (Brown, 1986). Because of the

proliferation of computer technology in the schools, children are being given the opportunity to gain knowledge about computers, to use them efficiently and creatively and to become confident computer users. The school setting provides an environment for all students to access this technology. The use of computers in the classroom can increase individualized instructional opportunities and can improve student attitudes toward learning (Koontz, 1991).

If today's students require these skills, then today's educators must be skilled in the application and delivery of such a technology. As technology is set to become a normal part of everyday learning, teachers will need a considerable amount of knowledge of the capabilities and limitations of computer technology. Today's educator must be prepared to understand and use computers in a variety of learning environments

Teachers' Attitudes toward Technology

Despite the heavy investment in computer technology, its potential will never be realized unless the classroom teacher is prepared to use it. It is the teacher who makes decisions about instruction. Therefore, it is the teacher who has the primary responsibility for the implementation of technology in the classroom, usually without the assistance of a computer specialist to provide assistance and/or advice.

The success of the use of computers can be highly dependent upon the teacher's attitude toward computers (Lawton & Gerschner, 1982). How teachers

view technology and the degree to which they are comfortable in using such technology to instruct, manage and evaluate are critical to the use of computers in the classroom. What may appear to be a desirable goal in principle, must be viewed as desirable by the teachers concerned before it can be implemented into classroom practice. The value that teachers place upon the computer may also be an important factor in the successful implementation of computers in the classroom (Violato, Marini & Hunter, 1989). The development of positive attitudes is necessary in successfully changing any educational practice.

Attitudes make certain behaviors more or less probable and have a powerful influence on how we act (Gagne, 1985). Fishbein and Ajzen (1980) suggest that the intention to act a certain way is determined, in part, by the attitudes toward that action that will lead to certain outcomes. The Theory of Reasoned Action (Fishbein and Ajzen, 1980) suggests that people usually consider the implications of their actions and then act consciously and deliberately - that we eventually do what we intend to do. According to their theory, the single best predictor of behavior is the intention to act that way. In relation to technology specifically, Davis, Bagozzi & Warsaw (1989) suggest that attitudes toward use directly influence the intention to use a computer and ultimately lead to actually using the computer.

Presumably if attitudes are positive toward computers, it will be easier to integrate them into the classroom (Kay, 1989). Positive attitudes toward

computers will promote increased computer literacy and will act to enhance positive and enjoyable educational computing experiments for both educators and students. If teachers are to prepare students for this computerized society, then both the teachers and the students must develop and maintain positive attitudes toward the use and value of computers in the classroom (Woodrow, 1987).

The attitudes held by a teacher may be an important element in teaching students about computers in addition to the promotion and acquisition of computer literacy by those students. If teachers are competent and positive role models, students will be much more likely to use computers as student attitudes, acceptance and sense of importance can be powerfully influenced by a teacher's attitudes. Negative attitudes held by teachers, on the other hand, may not only be adopted by the students in the classroom but also may deprive students of the opportunity to gain the necessary skills and competencies. It is unlikely that computer skills will be transferred to students and encouraged by teachers unless the teachers themselves have positive attitudes toward the use of computers (Okinaka, 1992).

Schools are not purchasing, for the most part, large-scale comprehensive software curricula developed by a single publisher, offering sequenced and standardized mode of instruction (Balajthy, 1988). Instead, a wide variety of software is available, ranging from drill and practice sub-skill exercises to word

processors to managerial tools such as spreadsheet and database applications. Therefore, it is particularly important to recruit school personnel who not only have the knowledge to use computers, but also have the confidence and willingness to explore computer technology to invent and implement new models for instruction (Troutman, 1991). It would seem critical that in order to improve the prospects of graduating a future crop of teachers who are comfortable with computer as well as computer literate, efforts must be made to increase preservice teachers' attitudes toward and experience with computers.

Preservice Teacher Training Courses

It has long been recognized that attitudes are established and organized by learning (Allport, 1935); therefore, courses for preservice teachers in computer technology in the classroom can play a crucial role in developing positive attitudes toward technology. Courses for preservice teachers are designed to provide "hands-on" experience on the assumption that teachers must feel comfortable with the computer and in their own abilities to use the computer before they will use computers effectively. In the United States since 1979, states have been implementing requirements that their teacher preparation courses include a course in using technology in the classroom (Koontz, 1992). In response to a perceived need in the school systems of Alberta, a compulsory course for all undergraduate education students was first offered in the spring term of 1984 (Bright & Clark, 1986). The philosophy of this

and other similar introductory computer courses for preservice teachers is to expose students to a range of software and investigate uses of the existing software rather than to focus on specific classroom implementations of computers (Bright & Clark, 1986).

It is important to evaluate the attitudes held by preservice teachers toward computers because the role of teachers and their attitudes is so important in the successful implementation of computer technology in the classroom. Attitudes toward computer technology held by preservice teachers are of interest to researchers based on the belief that attitudes toward technologies may influence their effective and innovative use (Savenye, 1993). Stevens (1982) suggests that preservice teachers' attitudes toward computers be evaluated prior to and periodically during the early stages of their introduction. In evaluating students' attitudes toward computers, we can also measure the effectiveness of an introductory course in computer applications for educators. This information can lead to further modifications to existing courses using computer technology for preservice teachers.

Preservice Teachers' Attitudes Prior to and After an Intervention

Several studies have examined the attitudes of preservice teachers prior to and after a required or elective introductory computer course for educators. Generally, the findings indicate that education students enter these courses with a relatively positive attitude. After the intervention of a computer literacy course,

students' attitudes show some significant improvement. Preservice teachers have indicated that they are more confident in their ability in using a computer, and in some cases, feel more comfortable in integrating computer technology into a subject area or typical classroom environment.

Saveyne, Davidson & Orr (1992) examined the effects of a required educational computing course on the attitudes of preservice teachers toward computers. They found that students' attitudes toward computers were significantly more positive after completing the computer literacy course. On the post-test, most students (84.5%) agreed or strongly agreed that they enjoyed using the computer. A majority of students (82.7%) indicated that they believed that computers could help their future students learn better and believed that using a computer would make them more efficient teachers. Almost all (91%) of the participants in the study indicated that they planned to use computer in their own teaching.

In a more recent study, Savenye (1993) also examined the attitudes of college preservice teachers after the intervention of a required introductory computer course for educators. Survey items were related to factors of liking computers, valuing computers for education and society, anxiety about using computers, confidence in using computers and perceptions of gender appropriateness of computers (Saveyne, 1993). Significant differences were found in students' attitudes from the pre- to post-test. Students indicated that

they were significantly less anxious about using computers at the end of the course than they were initially. Moreover, they indicated that they liked using a computer more at the end of the course. Savenye (1993) also found that these preservice teachers valued what computers could offer society generally and education specifically.

Koontz (1992) measured the attitudes of two groups of preservice teachers toward instructional media available for use in the classroom. Computers were used most often by both groups. He found that preservice teachers had a more positive attitude toward the selection and use of instructional media after having received formal training (Koontz, 1992). No significant differences in attitudes were found between the preservice teachers involved in a formal course and those students who were involved in student teaching who had previously completed the course. Based on these results, Koontz (1992) suggests that positive attitudes developed through the intervention of a course on the selection and utilization of instructional media are maintained throughout student teaching. Koontz (1992) goes on to suggest that the lapse of time between the instructional media course and student teaching does not diminish the positive attitude gains, but rather reinforces the positive attitudes attained in formal training.

McDermott (1985) surveyed preservice teachers enrolled in an elective computer literacy course prior to and directly after completing the course. His

results indicate that students entered the course with relatively positive attitudes toward computers and that those attitudes were slightly better on leaving the course. Student responses were more positive on the post-test in all three sub-categories: (a) Intimidation and Anxiety Level, (b) Confidence and Satisfaction, and (c) Support of Implementing Computers in Education. The greatest change was in the Confidence and Satisfaction subscale (from slightly negative to fairly positive). However, McDermott (1985) cautions that "the extent to which the course has been effective for students who have had prior experience cannot be ascertained by using the MCLAA [Minnesota Computer Literacy and Awareness Assessment, 1980], because it does not discriminate sufficiently among those students in most of the areas measured" (McDermott, 1985).

Thompson (1985) asked students in an elective computer course to rate their attitudes toward computing and computers. The most significant gains were found in areas where students were asked to assess their own abilities in using the computer. When compared to the responses obtained at the beginning of the course for each of these items, the attitudes of these preservice teachers were markedly more positive after completing the course. The greatest average change was found in students' response to the question, "Compared to other students you associate with at the University, how do you rate your own interest in computers?" (Thompson, 1985). Mean scores rose from 1.96 on the pre-course survey to 4.08 on the post-test (on a five-point Likert scale, where 1 was a very low rating and 5 was a very high rating).

Balajthy (1988) surveyed education students enrolled in a required course in elementary reading with an emphasis on computer-based instruction. The questionnaire administered to the participants was composed of three sections: (a) Attitudes Toward Computers, (b) Importance of Computers, and (c) Knowledge of Computers. Mean scores on the initial administration of the survey indicated that students entered the course with mildly positive attitudes (Balajthy, 1988). Students' attitudes were significantly more positive upon completion of the course. Only one statement, "Excellent software is available on the market today" did not yield in any statistically significant improvement from the initial administration to the post-test. However, the initial rating on this statement was fairly high on the pre-test. Balajthy (1988) suggests that one reason that could account for the insignificant difference may be because "the software demonstrated contained no special revelations of high quality" (Balajthy, 1988).

When asked to indicate how important computers are to education, students' responses indicated that they were "convinced of the importance of computers" (Balajthy, 1988) prior to entering the course. On the post-test, subjects indicated that they believed that computers would play an increasing role in the classroom and society in general. They also believed that computers would be important in the areas of reading and language arts education. However, participants reacted less favorably to the statements, "Every teacher

should learn to use computers "and "School systems must integrate computers into all curricular areas as quickly as possible" (Balajthy, 1988) on the post-test than they did on the initial administration of the survey. These slightly lower scores, although not significant, may indicate that some students were more aware of the limitations and deficiencies in computer technology after completing the course.

Attitudes of Preservice Teachers during Teacher Training Programs

Several studies have been conducted into the attitudes held by preservice teachers at some point during their teacher training. Similar to the results obtained by the pre-test/post-test studies, most of these "one-shot" studies have found that preservice teachers posses relatively positive attitudes toward computers.

Several of the studies have utilized various versions of the Computer Attitude Scale (CAS), developed by Gressard & Loyd (1984, 1985); Loyd & Loyd (1985); Gressard & Loyd (1986) and modified by others (Loyd & Loyd, 1989; Violato, Marini & Hunter, 1989). The CAS includes at least three attitude subscales to assess factors associated with attitudes toward computers: a) *Computer Anxiety*, b) *Computer confidence*, and c) *Computer Liking*. Other researchers have expanded the CAS to include a fourth subscale by a) dropping *Computer confidence* and adding two new categories: *Attitudes Toward Computers in Education* and *Computers as an Aid or Tool for Teachers* (Loyd &

Loyd, 1989) or b) adding a new category: *Sex Differences* (Violato, Marini & Hunter, 1989).

Hignite & Echternacht (1992) looked at preservice teachers who planned to teach business education at the secondary or post-secondary level for a relationship, if any, between the attitudes held by these preservice teachers and their computer literacy levels. Attitudes toward computers were assessed using the CAS. Computer literacy levels were measured using the Standardized Test of Computer Literacy (STCL) developed by Simonson, Maurer, & Montag (1984). STCL is composed of three sub-categories, a) *Computer Systems* - the knowledge and use of hardware and software, b) *Computer Applications* - the evaluation, selection and implementation of a variety of computer applications, and c) *Computer Programming*. Because computer programming was not necessarily a part of these prospective business teachers' training, the authors decided to omit this subcategory from the instrument.

Participants indicated that they had positive attitudes toward computers in education and positive attitudes toward computers as a tool for teachers. The strongest relationships were found between *Computer Anxiety* and a) *Computer Liking* (r=.77) and b) *Attitudes Toward Computers as a Tool* (r=.56). In terms of computer literacy, the authors found that the mean scores for the two computer literacy subscales were relatively low (slightly more than 50% of the possible maximum scores). The researchers suggest that this result was not surprising

given research performed by Newman (1982) which indicates that computer knowledge and literacy levels among practicing educators are often low (Hignite & Echternacht, 1992). The *Computer Systems* and *Computer Applications* variables were significantly correlated with one another.

When examining the relationships between the attitudinal variables and the literacy variables, the authors found that there were significant relationships between each of the four attitudinal variables and the *Computer Systems* variable. There were no significant relationships between any of the four attitude variables and the computer applications variable. Analysis of the data indicated that there was no significant overlap between the set of computer attitude variables as measured by the CAS and the set of computer literacy variables assessed using the STCL. The authors caution against inferring that their findings lend support to those studies reporting little or no relationship between attitude and literacy "due to this study's approach of investigating the relationship between linear combinations of attitudes and literacy variables" (Hignite & Echternacht, 1992). Hignite & Echternacht (1992) acknowledge that the relationship between attitudes toward computers and computer literacy is neither simple nor direct, as an individual's attitude and level of computer literacy may be comprised of several related attitudinal variables that may be correlated to some degree.

Woodrow, 1991 examined the attitudes of students enrolled in an elective computer literacy course for educators. Participants were undergraduate and graduate education students, all of whom were preservice teachers. Using the CAS, she found that the group as a whole was positive in their attitudes toward computers. This was expected as the subjects elected to take this course from a selection of many options, not necessarily because they liked computers, but perhaps because they believed that it was important to their future careers as teachers. When reported attitudes were compared with age, gender, computer experience, computer literacy and computer achievement, the only significant correlation found was the relationship between the amount of word processing experience and computer attitudes. This finding suggests that the more experience one has with computers, the more positive one is toward computers. Somewhat surprisingly, computer literacy was not correlated with positive computer attitudes, suggesting that prior knowledge of computers and how they operate was no guarantee of a positive attitude toward them and their use among this group of subjects (Woodrow, 1991). Contrary to results reported in other studies (see Lockheed & Mandinach, 1986), even programming experience was not significantly correlated with attitudes toward computers.

McEneaney, Soon, Sprague & Linek (1992) also used the CAS to survey preservice teachers from two public universities in Texas on their attitudes toward computers. The authors argue that given the tendency for computer

education courses to be separate from the core methods courses, a truer picture of preservice teachers' attitudes could emerge from their methods courses. Therefore, participants were solicited from a non-computer education methods course that did not emphasize the role of technology in the classroom.

Factor analysis of the data suggested a possible three factor solution: a) positive feelings for computers, b) utility of computers, and c) negative feelings for computers. The results of this survey were compared to results obtained by Woodrow (1991) to determine what attitudinal differences, if any, existed between the two groups of preservice teachers. Findings indicate that contrary to expectations, the means of the students in the non-computer course were higher than those reported by Woodrow (1991) for students in the elective computer course. McEneaney et al. (1992) indicate that the preservice teachers in the computer course had more positive scores on the *Computer Liking* scale of the CAS only, whereas the methods course students had significantly more positive scores on every other measure.

In one of a series of studies done outside the United States, Summers (1988) surveyed elementary education students in Britain about their attitudes toward, experiences with and knowledge about computers. He found that a substantial portion of the students (42%) expressed 'very negative' or somewhat negative attitudes, while a third of the students (30%) indicated that they had 'fairly positive' or 'very positive' attitudes toward computers. Analysis of written

explanations for the negative feelings revealed that nearly half of the students felt nervous about learning to use computers, with 10% of that group indicating that they were very nervous. Other reasons for the negative attitudes were: concerns about programming, lack of keyboarding skills, associations with mathematical skills, worries about making mistakes, and being intimidated by new terminology (Summers, 1988). Despite these negative attitudes, almost all of these preservice teachers (99%) rated it important for teachers to know about computers, with more than 50% of the group indicating that it was very important.

Based on data gathered from this group of preservice teachers, the vast majority of students had little or no experience with computers (75% indicated that they had no experience or had used a computer 'once' or 'twice'). Over half of the sample (55.8%) did not have a computer at home. Among those who did have a computer at home, more than a third of them (34%) reported that they had never used it or only used it once or twice. Thirty percent of the students surveyed indicated that they had used a computer at a friend's or at their place of work versus in a school setting. Summers speculates that the negative attitudes expressed by these students was a feeling of inadequacy which stemmed from the lack of experience combined with the importance that students placed on computer technology. Similar results were obtained in a study conducted by Summers (1990b).

Wilson (1990) extended Summers (1988) work by duplicating the study with first year preservice teachers in Australia. When compared to Summers (1988) findings, Wilson found that the participants in his study had more positive attitudes toward computers. Only 24% of the participants in this study expressed negative sentiments toward computers. Furthermore, he found that 41% of the students had positive or very positive reactions to computers. Wilson (1990) found that the number of students who indicated that they were nervous or very nervous was considerably less than that found by Summers (1988); only 22% of the students in the Australian study indicated that they were nervous or very nervous about using computers. Analysis of written responses for the reasons for the Australian subjects' nervousness revealed similar results to those obtained by Summers (1988) with two notable exceptions: students in the Australian study indicated that their attitude was marred by the complexity of computers and that computers were a male-dominated area.

Participants in the Australian study generally had more computer experience than those in the British study, although 59% indicated that they had little or no experience with computers. This may have been the result of an increasing availability of computer technology between the two studies (Fall, 1987 and Fall, 1989). Wilson (1990) suggests that this increased availability of computers may also account for the more positive attitudes displayed by the Australian students. However, results indicate that the majority of the Australian

students did not obtain their experience at home. Considerably fewer students in Wilson's study had a computer at home (29% compared to 44% of the British students). Furthermore, of those who owned a computer in Australia, more of these students (56%) indicated that they rarely, if ever, used it. Most students indicated that they had obtained their computer experience at school (53%) or in previous employment (20%).

Summers (1990a) surveyed students who intended to become secondary school teachers in Britain enrolled in an information technology course. None of the students had completed student teaching. He found that that these students were mixed in their attitudes toward computers. Nearly half of the students (47%) indicated that they held positive attitudes toward computers; however, 34% of the students reported negative attitudes. Among the responses given for the negative feelings, almost half of the reasons fell into two categories: 1) the lack of knowledge and/or experience and 2) responses expressing insecurity, lack of confidence, nervousness or fear. Summers (1990) asserts that given that the majority of negative attitudes stemmed from a lack of knowledge and/or experience with computers, it is reasonable to hypothesize that these attitudes may be experience-dependent and could be changed with an appropriate intervention strategy.

Stevens (1982) conducted a study in which she compared the perceptions of educators toward computers in 1979 and 1981. Two large samples of

practicing teachers and preservice teachers were compared to determine significant changes in attitudes toward computers. She found that both groups from 1981 were significantly more knowledgeable about computers and using computers in the classroom than those in 1979. No significant changes in attitudes were found for the 1979 and 1981 teachers; however, student teachers' attitudes in 1981 were significantly higher than those in the 1979 group. The majority of teachers and preservice teachers from 1979 and 1981 agreed that high school students should understand the role of computers in society, with teachers indicating the greatest change (70% in 1879; 98% in 1981). There was a significant increase in the attitude that computers could be advantageous to education between the two studies in both groups. In 1981, over 80% of teachers indicated that a computer could be a useful instructional aid in almost any subject area, as compared to 37% in 1979. The responses from student teachers indicated that although more of them in 1981 thought having a computer could be advantageous, they were generally less enthusiastic (40% in 1979; 53% in 1981). In terms of perceived levels of expertise, both groups in the 1981 survey demonstrated an improvement. However, a significant portion of both groups (68% of teachers, 48% of student teachers) reported that they could not run a computer and many still considered their expertise as inadequate. All of the groups in 1981 indicated that they were more receptive to more training, with none of the teachers in the 1981 sample indicating that they were not interested in receiving additional training. Finally, the majority of subjects from both surveys indicated that teacher training should include computer courses,

with the exception of preservice teachers in 1981. Stevens (1982) suggests that perhaps the reason for this unexpected result was the inclusion of the word 'courses' in the question "rather than using instructional module components to represent the acquisition of computer knowledge" (Stevens, 1982), which may have influenced student teachers' decisions.

Woodrow (1987) extended Stevens' work by comparing the attitudes of the preservice and practicing teachers in 1981 to those from a group identified as computer-positive practicing and preservice teachers in 1985. She found that the teachers who were in the classroom and the preservice teachers reported more positive attitudes than the two groups from 1981. The exception was in the teachers from the 1985 sample who indicated that they "felt less at ease around computers than did the teachers in the 1981 sample" (Woodrow, 1987); they were also uncomfortable to some degree in their ability to teach computer literacy skills. All four groups indicated that they would like to pursue further training in educational computing. These results are not just the product of training according to Woodrow (1987), but reflect an attitude that computer-based instruction is desirable and that prospective and practicing teachers are willing to retrain themselves in order to implement computers into the curriculum. Similar to the responses gathered by Stevens (1982), Woodrow (1987) found that both preservice and practicing teachers overwhelmingly favor the inclusion of computer instruction in the curriculum.

A number of studies have surveyed potential teachers' attitudes toward computers over a significant period of time in order to examine the changes that may have occurred. Price & Brunson (1986) set out to examine the differences, if any, in the attitudes of preservice teachers enrolled in three classes of the same undergraduate computer literacy course between 1984 and 1986. Participants completed the "Computer Values Survey" in which respondents were asked to choose one word from a pair of words used to describe computers that best described their feelings toward computers (i.e., "solution...puzzle") . The data collected suggest that students' attitudes toward computers were highly positive (Price & Brunson, 1986). In all five pairs of description words, students consistently chose the positive descriptions more frequently than the negative (Price & Brunson, 1986). When asked to rank applications in order of importance, students indicated that the computer as a tool for the classroom teacher was the most important. Educational applications were rated as second in importance and games were ranked as the least important application of computers in education.

Von Holzen & Price (1990) investigated preservice teachers' entry-level attitudes and skill levels over a five year period, starting in 1986, which included over 1300 participants. The researchers found that over the five years, there was a development of more positive attitudes toward computers on the part of participants enrolled in the course. When asked to rate their own skills in using

a computer for classroom management, students skills increased significantly. Results obtained in 1987 indicated that 62% of participants rated themselves as having little or no skill in the area of computer applications; in 1990, only 36% considered themselves below a moderate level of skill. Participants over the five year period also indicated that their confidence in being able to plan and carry out the successful use of the computer in the classroom increased. In 1987, only 27% of the respondents rated themselves as able to successfully participate in an activity using a computer, compared to 53% in 1990.

Participants also indicated that they were entering this course with increasingly more computer experience during the five year period. In 1986, for example, over half of the students (55.2%) indicated that they had little or no skill using a disk operating system (DOS). By 1990, less than a third (29%) of the students rated themselves as having little or no skill using DOS. Over the five year period, computer usage held fairly steady from 1986 to 1989. In 1990, however, there was a sharp increase, from 14.4% of students in 1989 using a computer on a regular basis to 30% in 1990. The authors attribute this increase to the significant rise in the percentage of students using computers for word processing. The authors contend that the overall increase in positive attitudes among preservice teachers and the rise in their perception of their own skills is a net effect of the increased computer experience that students are increasingly bringing to university-level courses.

Wright & Campbell (1987) surveyed preservice teachers at the beginning of a required early childhood computer education course over a three year period. Their results reflect a change in attitude by preservice teachers toward computers from 1984 to 1986. Analysis of students' responses indicated that students in 1984 seemed to focus on fear and frustration, whereas in 1986 students' negative responses were often accompanied by a statement of awareness, but not resignation to computers being a part of the educational system (Wright & Campbell, 1987). Negative attitudes decreased from 52% in 1984 to 21% in 1986. In addition, those students who entered the course with positive attitudes indicated that they had used computers in school or at work and found them to be "useful" and a "time-saving device" (Wright & Campbell, 1987).

In an attempt to determine what factors promote the initial positive computer attitudes, Woodrow (1990) examined the relationship between locus of control and student teacher attitudes toward computers. She examined the computer attitudes of undergraduate and graduate students, all of whom were preservice teachers, enrolled in an elective computer applications in education course. All students considered themselves novices. Participants were classified as internally oriented (field independent) or externally oriented (field dependent) based upon the results of the Multidimensional-Multiattributional Causality Scale (Lefcourt, von Baeyer, Ware & Cox, 1979 cited in Woodrow,

1990). Contrary to the expected result, she found that more positive attitudes were reported by the externally oriented students than those who were identified as internally oriented. She suggests that this result is consistent with the fact that attitudes toward computers by novices may be formed outside of the classroom in social contexts (Woodrow, 1990). She speculates those students who are externally oriented may be more aware of the growing appreciation and importance of computers in education and their attitudes are influenced accordingly.

Computer Anxiety among Preservice Teachers

One of the contributing factors to preservice teachers attitudes toward computers is the anxiety that they may possess toward the medium. Studies have suggested that anxiety toward computers can interfere with the successful integration of computers into the classroom (see Zelman, 1986; Howard & Smith, 1986; Roub, 1981), and the performance of tasks involving the computer and may result in the development of negative attitudes (Honeyman & White, 1987). Computer anxiety or "computerphobia" has been described as "the fear of using computers as measured by physiological changes or responses on self-report instruments" (Cambre & Cooke, 1987 cited in Piña & Harris, 1993). Researchers have suggested that computer anxiety can include elements such as confidence, fear and comfort (Cambre & Cooke, 1987) and the combination of fear and apprehension toward interacting with the computer (Howard, Murphy & Thomas,

1987). Research has suggested that educators have been shown to exhibit a certain degree of anxiety toward technology in general, and computers specifically (Baylor, 1985; Clement, 1981; Lichtman, 1979; Mahmood & Medewitz, 1989; Honeyman & White, 1987). Preservice teachers may be particularly anxious about the technology if they believe that any future employment as a teacher is dependent upon their computer expertise (Violato, Marini & Hunter, 1989) or that their future students may know more about the technology than they do (Summers, 1990). A number of studies have investigated the existence and nature of computer anxiety among preservice teachers.

Savenye, Davidson & Orr (1992) found that a required computer literacy course for educators can significantly lower the anxiety of preservice teachers toward computers. When asked on the pre-course survey how they felt about taking a computer literacy course, participants indicated a high level of anxiety, with 45%) indicating that they were nervous or "scared to death" (Savenye, Davidson & Orr, 1992). Twenty-two percent of the students participating in the pre-course survey indicated that they were afraid to touch a computer and 20% indicated that they were afraid they might break the computer. On the post-course survey, however, none of the participants agreed with either of these statements. Savenye, Davidson & Orr (1992) conclude that an intervention, such as a computer literacy course can significantly affect the attitudes of preservice teachers toward computers.

Okinaka (1992) also examined preservice teachers enrolled in a required computer literacy course for educators in order to investigate the factors that affect attitudes toward computers. He found that the majority of the students surveyed felt relatively comfortable with computers. These students indicated that they felt that computer instruction was beneficial to students. Yet even with these beliefs, these preservice teachers did not feel that the computer played an important instructional role (Okinaka, 1992). When asked to rank the topic areas they felt should be emphasized in an educational computing course, the participants indicated (from most important) that teachers should be taught how to use instructional software packages in their subject area, that they should be taught how to use word processing software and they should be taught about the latest uses of technology in the classroom. These students felt that the least important was the knowledge of how to write instructional software. Regression analysis indicated that the comfort that a student felt was affected by a) the students' intention and interest to pursue other courses, b) the number of years the student had used a computer, and c) whether or not the student owned a computer.

Hunt & Bohlin (1991) surveyed preservice teachers enrolled in an elective educational computing course for classroom teachers. They found that most students (77%) were slightly anxious or very anxious about taking a computer course and 76% of the students indicated that they were uneasy taking a

computer class. However, most students (69%) indicated that they felt that they would need a firm mastery of computers for future work. The vast majority of students (90%) indicated that they believed knowledge about computers would increase their job possibilities. Although these students recognized the importance of computers in the classroom, almost all of them (96%) indicated that they could not think of any way to use computers in their careers. Furthermore, 88% of the participants indicated that working with computers would not be useful in their work. These results may have been due, in part, to the survey having been administered in the first week of class. It seems reasonable to assume that during the course, students would have been exposed to the integration of computers into a variety of subject areas and the usefulness of the computer for classroom management techniques (i.e., record keeping, diagnostic testing, individualized learning, etc.)

Liu, Reed & Phillips (1990) examined teacher education students enrolled in an educational psychology course which included a mandatory module on computer awareness. Over a four year period, findings consistently indicated that almost half of the students had no computer experience and were highly apprehensive toward computers. Based on post hoc tests for sources of effect, Liu et al. (1990) found significant differences in anxiety levels across the four years. They found that students enrolled in the course in 1986 were significantly less anxious than those in 1987, 1988 and 1989. This finding was unexpected; given the on-going increase of computers, it would have been reasonable to

assume that results would be more favorable in the later years. These findings may be related to the amount of computer programming experience students had entering the course. Students in 1986 indicated that they had more programming experience as a group than those in the following three years, whereas students in the later years indicated more experience with computer assisted instruction (CAI) and computer managed instruction (CMI). The authors speculate that "CAI and CMI uses involved higher anxiety than programming experience" (Liu et al., 1990).

Overbaugh & Reed (1990) studied a small group of preservice teachers enrolled in a similar introductory psychology course which included a shortened computer awareness module (6 hours). Subjects were asked to identify their previous computer experience as: none, CAI, CMI, or programming experience. There were non-significant differences across the four groups of computer experience at the beginning of the instruction (Overbaugh & Reed, 1990). Post-test results indicate that there was a significant decrease in computer anxiety of all of the participants from the pre- to post-course survey. However, those students with no prior computing experience were significantly more anxious at the end of the course than those students entering the course with CMI experience. According to the researchers, these findings may suggest that CMI experience may be the most beneficial prior experience to have when enrolled in a brief computer course.

However, in a very similar study, Reed & Overbaugh (1993) reported very different results regarding pre- and post-course computer anxiety. Where Overbaugh & Reed (1990) found no significant differences between groups on the pre-course survey, Reed & Overbaugh (1993) found that those students with no prior computer experience indicated significantly higher computer anxiety than those with prior CMI, CAI and programming experience. In addition, Reed & Overbaugh (1993) found that students with prior CAI experience were significantly more anxious than those with programming experience. Unlike the results obtained at the end of the computer module by Overbaugh & Reed (1990), subjects with no prior computer experience in the Reed & Overbaugh (1993) study indicated that they were significantly more anxious than those with CAI and programming experience, but not significantly more anxious than those with CMI experience. It appears that students with previous CAI experience reduced their anxiety from pre- to post-test more than those with prior CMI experience did.

In one of the few qualitative studies that examined preservice teachers' anxiety toward computers, Simmons & Wild (1991) found that students' initial reactions were mostly negative. Based on analysis of journal entries, the researchers found that the most common reason for possessing negative attitudes about the computer was an earlier experience with computer technology. Students wrote of deep fear, mistrust of computers and

apprehension coupled with a "belief that they could not use them correctly and...never would be able to" (Simmons & Wild, 1991). Subjects felt inferior being surrounded by others in the class who possessed more computer experience or skills. Some students expressed unease at consulting with peers or tutors "because it would have made them feel stupid and less able than other students" (Simmons & Wild, 1991).

When comparing the anxiety of K-12 teachers and preservice teachers, Stevens (1982) found that the teachers in 1981 were much less anxious about computers than their counterparts from 1979. In 1979, over a third of teachers (38%) indicated that they were uneasy around a computer, whereas in 1981 only 11% indicated the same uneasiness and a substantial portion of the 1981 sample (64%) indicated that they felt little or no anxiety toward computers. However, this significant decrease was not found for the student teachers involved in the study. In 1979, 26% of education students felt uneasy around computers as compared to 1981, where 21% felt uncomfortable around computers. Stevens (1982) suggests that this may be because many of the student teachers in 1981 were in the "generation gap that has been trapped in the speed of technology" (Stevens, 1982). It would seem reasonable to assume that these student teachers may have attended high school when there were no computers available in schools, thereby making it difficult for these prospective teachers to absorb the reality of teaching with and about computers in their perceptions of teaching (Stevens, 1982).

In contrast, when comparing results from Stevens' 1981 sample to a similar group in 1985, Woodrow (1987) found that the teachers in 1985 were more anxious than their counterparts in 1981. In 1985, 30% of teachers did not feel at ease with computers and only 44% were not anxious about them. Woodrow (1987) speculates that the unexpected result may have been due to the imminent implementation of a computer based course in the teachers' school in 1985. This uneasiness may have been a reflection of the uncertainties of developing, implementing and maintaining the new course in the school rather than anxiety toward computers specifically. Unlike the findings by Stevens (1982) there was little difference between the 1981 and 1985 groups of students teachers regarding their anxiety toward computers (21% and 20% respectively were not at ease with computers).

Attitude Differences Between Groups of Preservice Teachers

Jones (1983) suggests that historically, computers have been associated with the Mathematics curriculum, often to the extent that learning about and working with computers is considered a basic skill in mathematics (cited in Gressard & Loyd, 1984). Noran & Estes (1985) have reported that among the different content areas, computers are integrated most frequently into the Math and Science subject areas. This association has prompted some researchers to examine the differences among preservice teachers in relation to their major area of study.

On the pre-course survey, Balajthy (1988) found that students rated the importance of a computer substantially higher for Math and Science education than they did for reading and Language Arts instruction. Although the importance of a computer in Language Arts and reading rated slightly higher on the post-test, the subjects maintained the attitude that a computer was still more important to Math and Science education. Subjects were not as convinced as to the importance of these applications generally within the classroom, even after instruction that focused on the integration of computers into the Language Arts and reading curriculum (Balajthy, 1988).

Over a four year period, Liu et al. (1990) found significant differences in computer anxiety of almost one thousand preservice teachers based on major area of study. They found that Math and Science majors were consistently less anxious toward computers than those students who were majoring in Elementary Education, English Education, Physical Education, Special Education or Social Studies.

In conjunction with attitudinal differences, Liu et al. (1990) reported that those students who were majoring in Mathematics reported consistently higher levels of computer usage than any other subject area. In terms of specific computer experience, Math majors were more likely to have programming experience (61.36%) than Science (42.42%) or Social Studies majors (38.67%). Approximately 20% of the students majoring in Elementary Education, English

Education, Physical Education and Special Education reported having had any programming experience. Similar results were reported by Summers (1990). These findings support those in Noran & Estes (1985) who reported that computer use is typically found in Math and Science classes at the pre-collegiate level (cited in Liu, Reed & Phillips, 1990).

In addition to the differences found between preservice teachers of differing subject areas, some research has been conducted into the attitudes of preservice elementary and secondary teachers as to where within the K-12 curriculum computers belong. Stevens (1982) reported that the majority of student teachers in 1979 and 1981 felt that it was the responsibility of the secondary school teacher to teach computer literacy skills. However, the opinions of practicing teachers shifted noticeably from 1979 to 1981. In 1979, the vast majority of teachers (94%) felt that it was the sole responsibility of the secondary school teacher; however, in 1981, teachers indicated that computer literacy was the responsibility of both elementary and secondary school teachers.

Woodrow (1987) reports that although teachers and preservice teachers agreed as to the inclusion of computer literacy in the curriculum, the two groups differed as to their attitudes in relation to teaching computer literacy skills. Preservice teachers in 1985 agreed with their counterparts in 1981 and 1979 that computer literacy had little place in the elementary grades. However, the

attitudes of practicing teachers were significantly different in this regard. In 1981, 68% of practicing teachers agreed that computer literacy should be taught in the elementary grades while in 1985 only 43% of teachers agreed or strongly agreed with that statement. Okinaka (1992) reported that the preservice teachers he surveyed felt that the computer was more important to high school teachers and somewhat less useful to primary or intermediate grade teachers.

Differences Between Male and Female Preservice Teachers' Attitudes

Several researchers have investigated the difference between male and females in their anxiety levels and general attitudes toward computers. For example, Chen (1985) found that "boys typically have lower anxiety toward and greater confidence and interest in computers" (cited in Liu et al., 1990). However, results for preservice teachers have been mixed, with some studies indicating some significant differences between male and female student teachers. Others, like Koohang (1987), have found that male preservice teachers showed a lesser degree of anxiety and greater degrees of computer confidence and computer liking that did the female subjects in the study, although the differences were not significant.

Liu et al. (1990) found that male subjects in their study had, on the average, lower anxiety than did female subjects. This finding is all the more interesting as more males in the study had no prior computer experience. A higher percentage of females had CMI experience (17.1%), mostly word

processing, than did males (9%). Liu et al. (1990) indicate that word processing may be viewed as a female skill "because of its close association with writing, a skill perceived as female oriented" (Liu et al., 1990). However, more males in the study had programming experience (34%) than did female participants (29%) which may help to explain the difference between the two genders. Results from their study indicate that programming experience was closely related to lower anxiety.

McInerney, McInerney & Sinclair (1990) examined the differences between male and female subjects' anxiety levels based on previous computer experience. As expected, they found that males who described themselves as beginners were significantly more anxious than males who classified their computer experience as advanced. There appeared to be little difference in the level of computer anxiety between beginner and advanced female participants. Females who described themselves as advanced were more anxious than males who considered themselves advanced. When examining only the subjects who classified themselves as beginners, McInerney et al. (1990) found that male participants were more computer anxious than the female subjects. One explanation offered by the researchers is that the male subjects in the study were not necessarily representative of males who generally enroll in other university faculties. They assert that qualities associated with primary teaching include nurturing and care, which are typically "characteristics of a stereotypically female sex-role identity" (McInerney et al., 1990).

Violato, Marini & Hunter (1989) found that the Sex Differences factor correlated with the Comfort and Value factors. The authors suggest that the relationships may reflect the negative affect toward computers based on the extent to which they are valued as tools and perceived as a male domain. Results for individual items on the survey indicate that the subjects did not view computers as a solely male domain. However, more males agreed that computers are a male domain than did females. Violato et al. (1989) suggest that the differences between males and females reported in this sample are reflective of the degree of comfort with and value of computers rather than sex differences. They suggest that it is probable that those who feel comfortable with computers and value them do not see computers as a male domain, whereas the opposite is true for those who are uncomfortable with computers or find little value in them (Violato et al., 1990).

Results reported by Woodrow (1990) suggest that, based on the results obtained from the preservice teachers she surveyed, computer attitudes are governed more by computer experience than by gender. When experience is controlled, as was the case in Woodrow's study (she surveyed computer novices only), the author suggested that gender differences in attitude toward computers tend to disappear. When Woodrow (1990) investigated the relationship between gender and computer attitudes, she found that gender was not a significant contributor toward computer attitudes among the student teachers she surveyed.

Entry-level Computer Experience of Preservice Teachers

Several studies have surveyed preservice teachers as to their computer experience in a variety of applications. It is not uncommon to find that computer application courses for preservice teachers are becoming more prevalent, if not a mandatory component of teacher training. During the first few years of offering introductory computer courses, students enrolled had virtually no exposure to computer uses in education (Bright & Clark, 1986).

Price & Brunson (1986) and Von Holzen & Price (1990) monitored the incoming computer experience of preservice teachers over several years. Their results indicate that more education students are entering university-level introductory computer courses with increasing experience. In 1984, 46% had some prior computer experience; in 1986, 53% indicated that they had used a computer before. In addition, students' perceptions of their skills also increased. In 1986, 32.8% rated themselves as somewhat skilled to proficient. By 1990, half of the students indicated that they were somewhat skilled to proficient computer users.

Liu et al. (1990) reported that over a four year period, 44.7% of subjects indicated that they had no computer experience. Of those that did have some computer experience, most students had experience with word processing, spreadsheet and databases (32.7%). Similar results have been reported by

Wilson (1990), Summers (1988), Summers (1990a), Hunt & Bohlin (1991) and Okinaka (1992). Liu et al. (1990) report that a relatively substantial number of students with previous computer experience indicated that they had used CAI (27.6%). However, Simmons & Wild (1991) found that among British preservice teachers 68% had never formatted a disk; 69% had never backed up their work on a disk, and 64% had never copied a file.

In one of the most recent studies, Chen & Brown (1994) report that the vast majority of students entering the teacher education program at the University of Connecticut had some computer experience (78.8%) with the greatest number of students using the computer as a personal productivity tool (49.6%). Students indicated that they used a computer often (56%), although many seldom used electronic mail (49.6%) or not at all (37.2%). Students indicated that they had the most confidence in using word processing and the least confidence in using database software.

Effect of Computer Experience on Preservice Teachers' Attitudes

There is considerable evidence to support the view that prior knowledge is a crucial factor influencing learning (Summers, 1988). With experience, it is believed that anxieties and fears tend to decrease and confidence increases. When the benefits of computer utilization are experienced, negative feelings usually start to disperse (Wilson, 1990). Perceptions of the potential usefulness of computers also influence computer attitudes. Several empirical studies

(Koohang, 1986a, Koohang, 1986b, Loyd & Gressard, 1984) have suggested that computer experience significantly relates to a more positive attitude toward computers by preservice teachers (Koohang, 1987). As their knowledge of computers increases, their attitudes toward computers become more positive (Woodrow, 1990). Particular types of computer experiences can change attitudes toward computers (Hunt & Bohlin, 1991), not always for the positive. For example, Lockheed & Mandinach (1986) have suggested that an emphasis on programming skills at the high school level may actually contribute to a decrease in interest in computer science among university freshman (cited in Woodrow, 1987).

Koohang (1987) classified students by the amount of computer experience they reported for a) observation only and/or computer games, b) word processing and data entry, c) software evaluation and d) programming and/or instructional applications at the university level. He then examined the relationship between the level of experience and Computer Anxiety, Computer Confidence and Computer Liking. His results suggest that students who had programming and/or instructional applications experience had significantly higher scores on all three subscales than those who had less experience.

McInerney et al. (1990) examined the effects of computing experience on the computer anxiety of preservice education students before and after completing a compulsory course in computers in education. In terms of the level

of experience, they found that 64.4% classified themselves as beginners. Almost half of the students surveyed (49%) indicated that they had never used a word processor and only 3% had played any computer games. When the effects of computer experience and computer message anxiety were examined, results indicate that those students describing themselves as advanced were significantly less anxious than the students who classified themselves as beginners. Among the advanced students, those who owned a computer were less anxious than those who did not own a computer. The authors speculate that computer confidence may be linked to the ownership of a computer because the advanced students who owned a computer gained competence through private experimentation in their own homes and therefore experienced the least anxiety (McInerney et al., 1990).

Hunt & Bohlin (1991) found that previous computer experience was highly correlated with student attitudes toward computers. They suggest that the positive relationships indicate that early successful experiences (word processing and recreational games) foster a student's sense of accomplishment. Similar results were reported by Durndel, Macleod & Siann (1987) (cited in Von Holzen & Price, 1990).

The Present Study

Computer technology is constantly changing. Preservice teachers are entering introductory courses with differing sets of skills, experiences and attitudes. Loyd & Gressard (1984) suggest that as students become more

familiar with computers, computer anxiety will decrease and computer liking and computer confidence will increase. Conversely, Bitter & Davis (1985) suggest that the type of prior experience may actually increase computer anxiety and decrease positive attitudes toward computers.

A number of researchers have suggested that a formal course in computer applications may play an important role in forming attitudes and that these formal training courses should be effective (i.e., Hunt & Bohlin, 1991; Koontz, 1992; Monaghan, 1993). Although research into attitudes toward computers has been conducted since 1976 (Savenye, 1993), it is important to evaluate preservice teachers' attitudes toward and experiences with computers on an ongoing basis.

The purpose of the present study is to determine the specific experiences with which preservice teachers enter an introductory course and what impact an introductory computer course may have on their computer experiences. In addition, the incoming attitudes of preservice teachers toward computers and the impact of a required, semester-long course may have on their attitudes toward computers are investigated. Few studies have attempted to empirically examine a relationship between the attitudes held by preservice teachers and their route of study and/or major area of study. This study seeks to find out if certain groups of preservice teachers differ on the initial and later attitude profile. Hunt & Bohlin (1991) suggest that experience can change attitudes toward computers.

Further to that, this study attempts to determine the relationship of experience to preservice teachers' attitudes toward computers.

The present study utilizes survey data collected from preservice teachers enrolled in a compulsory introductory computer course for educators. One of the survey instruments employed in this study was previously used with preservice teachers enrolled in a non-computer course. A further goal of this study is to administer and examine this instrument with a different population in order to demonstrate any generalizable factor structure.

CHAPTER THREE

METHODOLOGY

Subjects

Participants for the study were volunteers from an education undergraduate course at the University of Calgary. Subjects were recruited from a thirteen week introductory course to computers for educators in the Fall, 1995 semester. All students, except those in the Early Childhood Education route, are required to take this course as part of their Bachelor of Education degree. The course is offered as two sections; one for students enrolled in the elementary route and one for those in the secondary route. Most students register in the section for their programme; however, a small number of students register in the other section, usually because of scheduling difficulties. The course consists of two, one hour lectures and one, three hour hands-on laboratory component each week.

Students complete assignments using a graphical user interface. Students in the elementary section use the Macintosh platform, whereas students in the secondary section use the Windows platform. They learn fundamentals of word processing, spreadsheets and databases using an integrated software package. Students also learn to use electronic mail. Those in the elementary section are required to develop a multimedia presentation

using HyperCard. Students in the secondary section are required to develop a multimedia project for the World Wide Web.

Subjects were recruited in the lecture by the experimenter in September 1995 during the first week of classes and during the second week of classes in the laboratory. The experimenter briefly explained the purpose of the study and the measurement instrument. Prospective participants were given an estimate of the time involved by the experimenter who assured participants that their responses would remain anonymous. Interested subjects were asked to read a letter that explained the nature and purpose of the study (Appendix A) and sign a letter of consent (Appendix B) before being given the questionnaire. Those students who were under 18 years of age were asked not to participate in the study. Of the 160 students registered in both sections of the course, 147 participated in the pre-course survey in September and 112 completed the post-course survey in November, 1995. The decrease in participation from the pre- to post-course survey was most likely due to lack of attendance in the laboratory in late November 1995. When the two surveys were matched, 63% of the students in both sections completed the pre- and post-course surveys (n=101).

Instruments

Subjects were asked to complete a total of 45 open-ended and Likert scale questions about their educational and computing background (demographic information), previous computer experience and attitudes toward computers.

Demographic Information

Part I of the survey consisted of demographic information (Appendix C). Participants were asked to complete ten questions about their educational background, area(s) of study, any previous computer courses taken at university, the type of computer they owned (if any), how many times per week they used their computer and where they obtained their computer experience (if any).

Previous Experience Using Computers

Participants were asked to describe their experience with computers based on fifteen applications in Part II of the survey (Appendix D). These items were chosen by the experimenter based on research that indicates that these applications are typical of those available to post-secondary students. Participants were asked to indicate the amount of their experience with the application or situation using a five point scale (never, 1-2 times, 3-5 times, 6-10 times, 11 times or more).

Attitude Survey Questions

In Part III, subjects were asked to indicate their attitudes toward computers. The attitude survey is a five point Likert-type instrument (strongly disagree to strongly agree) consisting of 25 items. This scale was based on the Teacher Computer Attitude Scale developed by Violato, Marini & Hunter (1989). Permission to use and modify the scale was granted by the authors. Based on their results, three items were removed from the attitude survey. Item 11 on the

Teacher Computer Attitude Scale (Violato, Marini & Hunter, 1989) was re-worded from "Computers make me feel stupid" to "Computers make me feel inadequate" (item 26) on the instrument used for this study. Item 27, which read "Working with computers is more for males than females" on the Teacher Computer Attitude Scale (Violato, Marini & Hunter, 1989) was changed to "Working with computers is more male-oriented than female-oriented" (item 42 on the scale used in this study). Two items, "Integrating computers into my/a subject area would be difficult" (item 37) and "I feel comfortable in being able to integrate computers into my/a subject area" (item 45) were added to the instrument used in this study.

Validity and Reliability. The Teacher Computer Attitude Scale (Violato, Marini & Hunter, 1989) was administered to 401 education undergraduate students. Using a linear structural relationship analysis (Violato, Marini & Hunter, 1989), the data were fit to a four-factor model of attitudes toward computers: 1) Sex differences, 2) Comfort, 3) Liking, and 4) Value. The Comfort factor accounted for the greatest proportion of the common variance (64.8%) and correlated with Liking (r= 0.62). Liking accounted for 15.5% of the variance and was strongly correlated with Value (r= 0.72). This was expected, as something which is valued also tends to be liked and vice versa (Violato, Marini & Hunter, 1989). Sex Differences accounted for 14.6% of the variance and Value accounted for 5.1% of the common variance.

Cronbach's alpha coefficient was computed for the total scale and each of the four subscales. The following reliability estimates were derived: total scale = 0.93 on 32 items, Comfort scale = 0.92 on 10 items, Liking scale = 0.88 on 11 items, Sex Differences = 0.80 on 5 items and Value scale = 0.81 on 6 items. These reliabilities are high and satisfactory for research purposes (Violato, Marini & Hunter, 1989).

Based on the recommendation that future editions of the instrument should be modified (Violato, Marini & Hunter, 1989), three items which did not fit the model very well were eliminated from the instrument administered in September and November 1995. Two items (37 and 45) were added by the experimenter for further study.

Data Collection

The Preservice Teacher Computer Experience and Attitude Scale was administered to subjects in the first and second weeks of September and again in the last week of November 1995. Participants were asked to complete Part I, the demographic information, in September 1995 only. Participants completed the previous experience and attitude toward computers sections in September 1995 (pre-course survey) and in November 1995 (post-course survey).

On both occasions, the researcher distributed the survey and asked subjects to identify their responses by providing their mother's surname at birth on the ScanTron forms provided by the researcher. This allowed the researcher to match responses from the pre- and post-course surveys. Demographic

information was matched to the subjects' pre- and post-course experience and attitude survey responses by numbers written on Part I of the survey and on the ScanTron form used in the pre-course survey. Surveys were completed by most subjects in approximately 20 minutes, with no subject requiring longer than 30 minutes to complete the three sections.

Data from the previous computer experience and the computer attitude survey questions were recorded on ScanTron forms which were optically scanned and written to a computer file. Demographic information was re-coded and added to the computer file by the researcher.

CHAPTER FOUR

RESULTS

Introduction

In order to answer the five research questions, results of an exploratory factor analysis, MANOVA, simple effects and post hoc tests are presented. In an attempt to answer the first research question, descriptive statistics for experience with several software applications were collected from participants. A two-way repeated measures MANOVA was conducted using four groups of experience variables (Where, Productivity Tools, Programming/Authoring and Edutainment) and three independent variables: Time, Population and Major. To determine if the four factor solution proposed by Violatio, Marini & Hunter (1989) could be replicated with this sample, exploratory factor analyses were conducted on responses from the pre- and post-course administration of the Preservice Teacher Computer Attitude Scale. In order to answer the third research question, descriptive statistics from the Preservice Teacher Computer Attitude Scale were examined. In addition, a MANOVA was conducted on the four attitude factors as the dependent variables using Time, Population and Major as independent variables. Simple effects analyses were conducted to determine at what level on the dependent variable differences were occurring. Post hoc analysis was conducted to determine where differences existed. In an attempt to determine the relationship between subjects' route or major area of study and

their attitudes toward computers, a MANOVA was conducted using Major as the independent variable and the four attitude factors as the dependent variables. Finally, a correlation matrix was generated to examine the relationship between experience and attitudes. Demographic information was collected from subjects, and is presented below.

Demographic Information

Demographic information was collected from participants in the study (see Appendix C). Participants were asked to respond to ten open-ended questions, of which responses from two of those questions were used for further analyses only. Responses to the remaining eight questions are summarized below.

Educational Background. Participants were asked to indicate how many years they had studied full-time at the university level. Most of the participants were in their first or second year of university (31.7% and 22.8% respectively) with a small percentage of students who had studied at university five years or longer (13.9%). A small portion of the sample indicated that they had a previous university degree (20.8%); 79.2% indicated that they were enrolled in the B.Ed. degree program. The vast majority of the subjects in this study had not completed student teaching (90.1%).

Computer Background. Demographic information collected indicates that most participants had not taken a previous computer course at the university level (70.3%). A majority of students (67.3%) indicated that they owned a computer. Of those who did own a computer, 83.8% indicated that they owned a DOS or

Windows-based computer; 16.2% indicated they owned a Macintosh or Apple computer. The majority of computer owners indicated that they used their computer 1 to 5 times per week (59.4%), with a small percentage indicating that they never used their computer (3.0%) or used it more than 6 times per week (5.0%). When asked to rate their current computer knowledge, most students felt that they knew little about computers (73.3%) while a small percentage indicated that their knowledge was "quite good" (22.7%). None of the 101 participants indicated that they considered their knowledge of computers as being "very good". When asked where they had gained their computer experience, most students indicated that they had learned how to use a computer at school or at a friend's house (43.6%). Other places that subjects had learned a computer included their place of employment (24.8%) or in their home (24.8%).

Population and Major Area of Study. Information gathered from responses to two questions in the demographic portion of the pre-course survey were used as independent variables in later analyses: the population students planned to teach and their major area of study. The populations subjects in this study planned to teach are summarized in Table 1. Those subjects who indicated that they planned to teach more than one of the categories provided were placed in the highest category indicated.

Table 1 Population Participants Plan to Teach

Population	Number	Percent
Elementary	53	52.5
Secondary	37	36.6
Post-secondary	11	10.9
Total	101	100.0

Participants' major areas of study are summarized in Table 2. The largest category, Humanities, included those participants majoring in History, English, Language Arts, French and Social Studies. The second largest group, Science, was composed of subjects majoring in Science, Biology, Math, and Physics.

Table 2 Major Area of Study

Major	Number	Percent
Humanities	45	44.6
Science	21	20.8
Generalist	14	13.9
Special Education	9	8.9
Arts	5	5.0
Social Sciences	4	4.0
None	3	3.0
Total	101	100.0

Students who indicated that they were elementary Generalists, Early Childhood Education specialists and Physical Education majors were combined to form the Generalist category. Drama and Art majors were combined to form the Arts category. The Social Sciences category included participants who were majoring in Psychology, Sociology and Political Science. Three participants did not indicate a major area of study.

Computer Experience

Descriptive Statistics

To determine the entry-level computer experience of preservice teachers, the Previous Computer Experience scale (Appendix D) collected pre- and post-course data about the number of times participants had used a variety of computer applications using a five-point Likert-type scale. Items were recoded (1 = Never, 2 = 1-2 times, 3 = 3-5 times, 4 = 6-10 times, 5 = 11 or more times) for descriptive statistical analysis. Frequencies for item of computer experience pre- and post-course survey are summarized in Table 3.

Initial examination of the data indicates a decrease in the 'never' category from the pre- to post-course administration for all fifteen software applications, although not all of these were part of the course. Experience increased in the '11 + times' category on all fifteen items with the exception of 'Computer Games' from the pre- to post-course administration. Use of computer games remained relatively stable across the pre- and post-course administration with a notable increase on the post-course administration on '1-2 times' and a noticeable decrease in the percentage of participants indicating that they had used that application '6 - 10 times'.

Table 3 Preservice Teacher Computer Experience Survey
Previous Computer Experience - Pre- and Post-course (%)
September and November, 1995

Likert Item Description		never	1-2 times	3-5 times	6-10 times	11 + times
1. Trained to use in job	Pre	45.5	27.7	14.9	5.9	5.9
	Post	29.7	26.7	17.8	9.9	13.9
2. Used for learning	Pre	31.7	30.7	12.9	11.9	12.9
	Post	5.0	17.8	15.9	19.8	40.6
3. Word processing	Pre	10.9	6.9	6.9	8.9	66.3
	Post	0.0	3.0	2.0	13.9	80.2
4. Desktop publishing	Pre	73.3	12.9	5.0	4.0	5.0
	Post	40.6	20.8	14.9	8.9	12.9
5. Spreadsheets	Pre	48.5	27.7	8.9	5.9	8.9
	Post	6.9	41.6	27.7	12.9	9.9
6. Library search - DOBIS	Pre	26.7	17.8	9.9	11.9	33.7
	Post	9.9	10.9	12.9	10.9	54.5
7. Library search - CD-ROM	Pre	41.6	30.7	10.9	5.9	10.9
	Post	14.9	32.7	19.8	13.9	17.8
8. Databases	Pre	57.4	20.8	9.9	5.0	6.9
	Post	5.0	36.6	25.7	12.9	18.8
9. Electronic Mail	Pre	67.3	11.9	5.0	15.8	0.0
	Post	5.0	5.9	10.9	13.9	63.4
10. Computer-aided design	Pre	76.2	14.9	1.0	3.0	5.0
	Post	42.6	22.8	17.8	9.9	5.9
11. Graphics	Pre	67.3	11.9	5.9	5.9	8.9
	Post	18.8	23.8	23.8	11.9	19.8
12. Authoring	Pre	95.0	4.0	0.0	0.0	1.0
	Post	24.8	26.7	14.9	11.9	20.8
13. Programming	Pre	56.4	22.8	10.9	5.0	5.0
	Post	45.5	30.7	7.9	5.9	8.9
14. Games.	Pre	9.9	5.9	22.8	11.9	49.5
	Post	8.9	13.9	20.8	6.9	48.5
15. Simulations	Pre	76.2	14.9	5.0	3.0	1.0
	Post	37.6	25.7	12.9	14.9	6.9

Software Applications Taught in the Course. Of the fifteen items on the Previous Computer Experience scale, eight applications were part of the course content: word processing, spreadsheets, library search - DOBIS, library search -

CD-ROM, databases, electronic mail, graphics and authoring. The largest percentage of subjects' responses on the pre-course survey are in 'never' (spreadsheets, CD-ROM search, databases, electronic mail, graphics and authoring) or in the category of 11 times or more (word processing, DOBIS search). On the post-course survey, the largest percentage of subjects' responses can be found in the category of '1-2 times' (spreadsheets, CD-ROM search, databases, graphics and authoring) or in 11 times or more (word processing, DOBIS search and electronic mail).

Software Applications Not Taught in the Course. Although five items on the Previous Computer Experience scale were not part of the course content, noticeable changes occurred in the amount of experience subjects had between the pre- and post-course surveys. Although for both the pre- and post-course survey the largest percentage of participants' responses can be found either in the 'never' category (desktop publishing, computer-aided design, programming and simulations) or in the '11 + times' category (computer games), the percentage decreased in every category from the pre- to post-test administration.

Where Subjects Obtained Their Computer Experience. In addition to items addressing experience with specific types of software applications, participants were asked how many times they had been trained to use a computer at their place of employment. On the pre-course survey, almost half of the students (45.5%) indicated that they had never been trained to use a computer on the job.

On the post-test, however, the percentage of students not receiving training on a computer at work decreased to 29.7%. The largest increase from pre- to post-course surveys was found in the category of 11 times or more (5.9% to 13.9%).

Subjects in this study also indicated that they were using computers more for learning content at university on the post-course survey. On the pre-course survey, 31.7% of the participants had never used a computer to learn content material; on the post-test 5.0% of this sample had never used a computer to learn content material. Furthermore, the number of participants in this study who indicated that they had used a computer to learn content material 11 times or more increased substantially from the pre- to post-course survey (12.9% to 40.6% respectively).

MANOVA

Items regarding previous computer experience were recoded (0 = Never, 1 = 1-2 times, 2 = 3-5 times, 3 = 6-10 times, 4 = 11 or more times) for the multivariate analysis. Items on the Computer Experience Survey were combined to form four dependent variables for the multivariate analysis: a) *Where* subjects learned to use a computer (Items 1 and 2), b) subjects' previous experience with *Productivity Tools* (Items 3, 4, 5, 6,7, 8, 9, 10 and 11), c) subjects' previous experience with *Programming Languages* and/or *Authoring Tools* (Items 12 and 13) and d) subjects' previous experience using *Edutainment* software (Items 14 and 15).

It was decided to compare the responses on the previous experience survey based on a) the pre- and post-course survey, b) the population they planned to teach, and c) their major area of study. The three categories that described what population students were planning to teach (see Table 1) were reduced to two categories by combining those planning to teach at the secondary and post-secondary level into one category, 'Secondary'. The categories for major area of study (see Table 2) were collapsed into three categories for further analyses: a) 'Science', b) 'Humanities', which include those in Humanities and Social Sciences, and c) 'Other', which included those in the Generalist, Arts and Special Education categories. Those subjects that did not specify a major area of study were excluded from any further analysis.

All participants provided responses on the pre-course administration (n=101); however, on the post-course survey, six subjects did not respond to all of the experience items. Therefore, these subjects' pre- and post-course responses were excluded from any further analysis. It was determined that the missing responses could be excluded from any further analyses without significantly affecting any results. Means for pre- and post-course surveys were added to form a combined mean for analysis purposes.

Correlation coefficients were generated using SPSS for the four experience (dependent) variables. The correlation matrix revealed moderate correlations between the four experience variables for the pre- and post-course survey (see Table 4).

Table 4 Correlation Coefficients for Experience Variables

Experience Variable		Where	Productivity Tools	Programming/ Authoring	Edutainment
Where	Pre	-	.4569	.3671	.4252
	Post	-	.3047	.3832	.3878
Productivity Tools	Pre	.4569	-	.5642	.5717
	Post	.3047	-	.5248	.3558
Program/Authoring	Pre	.3671	.5642	-	.3722
	Post	.3832	.5248	-	.2028
Edutainment	Pre	.4252	.5717	.3722	-
	Post	.3878	.3558	.2028	-

Given the potential interdependence of the experience variables, a two-way repeated measures MANOVA with Time (pre- and post-course survey results) and Major (Science, Humanities and Other) as the independent variables was conducted using SPSS. The four types of experience (i.e., Where, Productivity Tools, Programming/Authoring and Edutainment) were the dependent variables. The possibility of conducting a three-way MANOVA (Time x Major x Population) was rejected due to the lack of sufficient data.

The multivariate effects for Time ($F(4,86) = 53.70$, $p \leq .0001$) were significant for all dependent variables. Univariate results indicate that significant differences were found for all of the experience variables with $p \leq .0001$ and $F(1,89)$ (Where $F = 75.61$, Productivity Tools $F = 169.67$, Programming/Authoring $F = 81.48$ and Edutainment $F = 21.54$). Multivariate effects for Time by Major were not significant ($F(8,172) = 0.28$, $p = 0.9708$) for the four experience

variables. Univariate analysis revealed no significant differences for any of the four experience variables (Where $F(2,89) = 0.44$, $p = .6453$, Productivity Tools $F(2,89) = 0.54$, $p = .5831$, Programming/Authoring $F(2,89) = 0.30$, $p = .7414$ and Edutainment $F(2,89) = .0.05$, $p = .9500$), so simple effects analysis was not conducted. Means for the pre- and post-course surveys across all four majors are summarized in Table 5.

Table 5 Pre- and Post-course Means for Experience by Major Area of Study

Experience Variable	Major Area of Study	Pre-course	Post-course
Where	Science	2.84	5.00
	Humanities	2.58	4.24
	Other	2.00	3.93
Tools	Science	13.10	21.79
	Humanities	11.69	20.16
	Other	8.50	18.50
Programming/Authoring	Science	1.32	3.16
	Humanities	0.96	2.71
	Other	0.46	2.57
Edutainment	Science	4.21	5.05
	Humanities	3.16	4.07
	Other	2.50	3.29

The multivariate effects for Major were not significant ($F(8,172) = 1.51$, $p = .1565$. However, univariate results for Edutainment were significant ($F(2,89) = 5.65$, $p = .0049$). Post hoc tests (using BMDP) revealed that there were significant differences between Science and Humanities majors ($F(1,89) = 4.59$, $p \leq .0348$) and Science and Other majors ($F(1,89) = 11.30$, $p = .0011$) on the use of simulations and computer games with Science majors having more experience

with this type of software than the other two groups. There were no significant differences between Humanities majors and Other majors ($F(1,89) = 2.94$, $p = .0899$) on the use of edutainment software. Univariate results for the other types of experiences were not significant (Where $F(2,89) = 1.45$, $p = .2403$, Productivity Tools $F(2,89) = 2.80$, $p = .0660$, Programming/Authoring $F(2,89) = 1.64$, $p = .2003$).

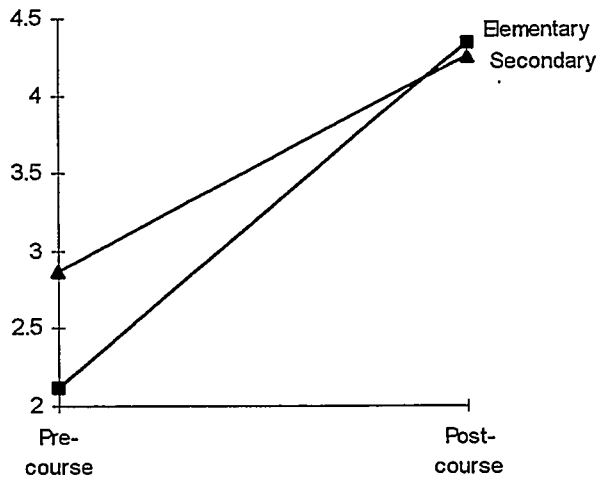
A two-way repeated measures MANOVA was conducted with Population (the population subjects planned to teach) and Time (pre- and post-course survey) and the four experience variables (Where, Productivity Tools, Programming/Authoring and Edutainment) as the dependent variables, given the potential interdependence of the dependent variables (see Table 4). The multivariate analysis revealed that the effect for Time was significant ($F(4,90) = 66.08$, $p \leq .0001$. Univariate analysis indicates that there was a significant Time effect for all four experience variables with a $p \leq .0001$ and $F(1,93)$ (Where $F = 84.55$, Productivity Tools $F = 201.66$, Programming/Authoring $F = 106.05$ and Edutainment $F = 25.10$). Means for the pre- and post-course surveys broken down by those planning to teach at the elementary and secondary levels are summarized in Table 6.

Table 6 Pre- and Post-course Means for Experience by Population

Experience Variable	Population	Pre-course	Post-course
Where	Elementary	2.12	4.34
	Secondary	2.87	4.27
Tools	Elementary	9.96	19.88
	Secondary	12.11	20.00
Programming/Authoring	Elementary	0.64	3.18
	Secondary	1.13	2.24
Edutainment	Elementary	2.94	3.58
	Secondary	3.47	4.49

Multivariate effects for Time x Population were significant ($F(4,90) = 5.12$, $p = .0009$). Univariate results for the Time by Population interaction effect were not significant for Productivity Tools and Edutainment ($F(1,93) = 2.62$, $p = .1087$ and $F(1,93) = 1.33$, $p = .2523$ respectively). A significant interaction effect for Time by Population was found for Where students learned how to use a computer ($F(1,93) = 4.34$, $p = .0400$). Testing of simple effects using BMDP was performed to determine at what level of the dependent measure differences were occurring. On the pre-course survey, those students planning to teach at the elementary level had a lower mean than those planning to teach at the secondary level; however, after the course, the results were opposite (i.e., those in elementary had a *higher* mean score than those in secondary; see Figure 1) which explains why there was a significant Time by Population interaction on Where.

Figure 1 Time x Population Interaction on Where Subjects Obtained Their Computer Experience

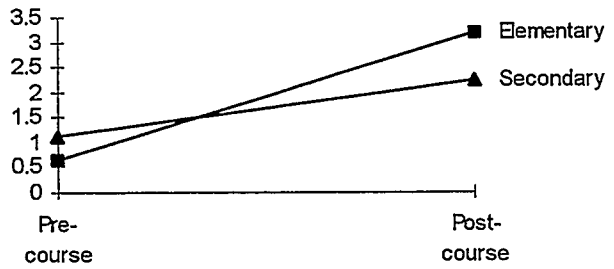


Simple effects results for the pre-course survey ($F(1,93) = 3.41$, $p = .0681$) and for the post-course survey ($F(1,93) = 0.03$, $p = .8742$) indicate there is a slightly significant Population effect (not significant at the .05 level, but significant at the .10 level) during the pre-course survey and non-significant Population effect on the post-course survey.

A significant interaction effect for Time by Population was also found for Programming/Authoring experience ($F(1,93) = 16.24$, $p \leq .0001$). Simple effects were performed to determine at what level of the Programming/Authoring variable differences were occurring. Like the situation found on the Where variable, those students planning to teach at the elementary level had a lower mean than those planning to teach at the secondary level when it came to Programming and/or Authoring experience (see Figure 2). After the course, however, the results were again found to be opposite to those found on the pre-

course survey (i.e., those in elementary had a *higher* mean than those in secondary). Again, this explains why there was a significant Time by Population interaction on Programming/Authoring. Simple effects results for the pre-course survey ($F(1,93) = 3.81$, $p = .0540$) and for the post-course survey ($F(1,93) = 5.74$, $p = .0186$) indicate there is a significant Population effect during the pre-course survey (not significant at the .05 level, but significant at the .10 level) and on the post-course survey.

Figure 2 Time x Population for Programming/Authoring Experience



The multivariate results for Population were non-significant ($F(4,90) = 1.81$, $p = .1333$); and there were no significant differences between Population on the use of Productivity Tools ($F(1,93) = 0.85$, $p = .3582$) or on Edutainment ($F(1,93) = 3.89$, $p = .0517$). Due to the significant Time by Population interaction effect on the variables of Where and Programming/Authoring, all we can conclude is that *on the average*, there is no significant Population effect.

Impact of an Introductory Course on Attitudes of Preservice Teachers

Descriptive Statistics

Descriptive analysis was conducted on the responses to the Preservice Teacher Computer Attitude Scale (Appendix E). Item responses were recoded (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4= Agree, 5 = Strongly Agree) for analysis. Mean responses and standard deviations are reported by item in Table 7.

An initial examination of the results for the Preservice Teacher Computer Attitude Scale indicate that this group of preservice teachers value the use of computers, like using computers and feel fairly comfortable with them. Participants indicated that they felt that using computers is not gender-biased. Individual statements which elicited a strong agreement or disagreement on the pre- or post-course survey are described in detail below.

Among the items that elicited the strongest agreement, most loaded on the Value Factor in Violato, Marini & Hunter's (1989) study. For example, participants strongly agreed with items such as, "Learning about computers is a worthwhile and necessary subject for all prospective teachers" (Item 19: Pre-course Mean = 4.48, SD = .878; Post-course Mean = 4.66, SD = .621) and Item 21, "It is important to know how to use computers in order to get a teaching position" (Pre-course Mean = 4.10, SD = .878; Post-course Mean = 4.19, SD .868). This group also agreed with two other Value items, "Knowing how to use computers is a worthwhile and necessary skill" (Item 1: Pre-course Mean = 4.63,

SD = .72; Post-course Mean = 4.72, SD =.65) and Item 29, "I will probably need to know how to use a computer if I leave university" (Pre-course Mean = 4.29, SD = .931; Post-course Mean = 4.44 SD = .805).

Table 7 Means and Standard Deviations (n=101 m=14 f=84 missing = 3) Preservice Teacher Computer Experience and Attitude Survey Attitude Survey Questions - Pre- and Post-course Surveys September and November, 1995

Likert Item Description	Pre-course		Post-course	
	Mean	SD	Mean	SD
1. Knowing how to use worthwhile & necessary skill	4.63	.720	4.72	.650
2. Like using computers	3.47	1.06	4.07	.765
3. Confident about ability to learn about computers	3.44	1.13	4.15	.780
4. Working with a computer makes me nervous.	2.85	1.21	2.15	.974
5. Use my knowledge in many ways as a teacher	3.02	.938	3.39	.095
6. More important for males than females	1.21	.725	1.32	.774
7. Like using computers in my school work	3.73	1.01	4.17	.813
8. Wish I could use more frequently at the university	3.51	1.21	3.61	1.09
9. Get a sinking feeling when I think of trying to use	2.51	1.31	1.85	.910
10. Once I start I find it hard to stop	2.83	1.05	3.22	1.10
11. Make me feel inadequate	2.55	1.15	1.85	.932
12. More men than women computer scientists	1.45	.889	1.32	.631
13. Job using computers would be very interesting	3.31	1.02	3.45	1.07
14. Don't expect to use when finished university	1.65	.910	1.54	.886
15. Look forward to using at university	3.62	.978	3.76	.918
16. Not the type to do well with computers	2.33	1.01	1.92	.924
17. Working with computers is boring	2.32	.927	1.89	.811
18. More enjoyable for males than females	1.30	.729	1.26	.594
19. Worthwhile & necessary for prospective teachers	4.48	.966	4.66	.621
20. Make me feel uncomfortable	2.67	1.18	1.97	.921
21. Important to know to get a teaching position	4.10	.878	4.19	.868
22. Integrating into subject area would be difficult	1.99	.806	1.97	.984
23. Females do as well as males in learning about	4.64	.901	4.78	.576
24. Make me feel uneasy and confused	2.61	1.17	1.95	.994
25. Both enjoyable and stimulating	3.60	.982	3.85	.865
26. Using a computer is difficult for me	2.49	1.12	1.84	.891
27. More male-oriented than female-oriented	1.46	.867	1.32	.774
28. Able to do as well as fellow students	3.29	1.20	3.99	1.00
29. Need to know how if I leave university	4.29	.931	4.44	.805
30. Able to integrate into subject area	3.63	1.09	4.09	.789

Items that loaded on the Liking factor on the Violato, Marini & Hunter's (1989) study also elicited agreement among these preservice teachers. These include the responses to Item 2, "I like using computers" (Pre-course Mean 3.47, SD 1.06; Post-course Mean = 4.07, SD = .765) and Item 7, "I like using computers in my school work" (Pre-course Mean = 3.73, SD = 3.73; Post-course Mean = 4.17, SD = .813).

Participants also agreed with items that loaded on the Comfort factor (Violato, Marini & Hunter, 1989), such as responses to Item 3, "I feel confident in my ability to learn about computers" (Pre-course Mean = 3.44, SD 1.13; Post-course Mean = 4.15, SD = .780) and Item 28, "I am able to do as well working with computers as most of my fellow students" (Pre-course Mean = 3.29, SD 1.20; Post-course Mean = 3.99, SD 1.00). Responses to Items 9, "I get a sinking feeling within I think of trying to use a computer" (Pre-course Mean = 2.51, SD. = 1.31; Post-course Mean = 1.85, SD = .910) and Item 24, "Computers make me feel uneasy and confused" (Pre-course Mean = 2.61, SD = 1.17; Post-course Mean = 1.95, SD = .994) were neutral on the pre-course survey; however, participants disagreed with both statements on the post-course administration.

Items that loaded on the Sex Differences factor on the Violato et al. (1989) study also generated strong responses. Subjects indicated a strong agreement with Item 23, "Females can do just as well as males in learning about computers" (Pre-course Mean = 4.64; SD = 4.64; SD = .901; Post-course Mean

= 4.78, SD = .576). In addition, when examining items with which participants disagreed most strongly, subjects were more likely to disagree with items that loaded on the Sex Differences factor. For example, Item 6, "Using a computer is more important for males than females" generated the strongest disagreement of all thirty items on the pre-course survey (Pre-course Mean = 1.21, SD .725; Post-course Mean = 1.32 SD = .774). Items, such as, "Using computers is more enjoyable for males than females" not only generated disagreement on the pre-course survey (Item 18: Mean = 1.30, SD = .729), but elicited a somewhat stronger disagreement on the post-course survey (Mean = 1.26, SD = .594).

Factor Analysis

In order to determine if the four factor solution proposed by Violato et al. (1989) could be duplicated (the second research question), a factor analysis was conducted on the Preservice Teacher Computer Attitude Scale to examine the emerging factor structure and how it compared to the four-factor solution proposed by Violato et al. (1989). Prior to conducting the factor analysis, attitude items were examined to assess directionality. Items 4, 6, 9, 11, 12, 14, 16, 17, 18, 20, 22, 24, 26 and 27 were corrected for directionality.

An initial exploratory factor analysis was conducted on the pre-course survey using a varimax rotation with no preset factor criteria. Varimax rotation maximizes the variance explained by each factor (Norman & Streiner, 1986). The initial analysis yielded a six factor solution which accounted for 68.3% of the variance (Table 8). Item loadings on each factor were examined to determine

interpretability and it was determined that a four factor solution, similar to that proposed by Violato et al. (1989) would be appropriate.

Table 8 Initial Exploratory Analysis - Six Factor Solution Preservice Teacher Computer Attitude Scale

Factor	Eigenvalue	Pct of Variance	Cum Pct	Items Loading
1	10.36148	34.5	34.5	3, 4, 9, 11, 16, 20, 24, 26, 28, 30
2	3.8587	12.8	47.4	2, 7, 8, 10, 13, 15, 17, 25
3	2.60453	8.7	56.0	1, 14, 19, 21, 29
4	1.40250	4.7	60.7	7, 12, 18, 27
5	1.23470	4.1	64.8	22, 23
6	1.04759	3.5	68.3	5

A second exploratory factor analysis was performed on the 30 attitude items on the pre-course survey using a four factor solution. The varimax rotation on this second analysis yielded a four factor solution which accounted for 60.7% of the variance. Item loadings on each factor were then examined to determine interpretability of each factor. Factor 1, Comfort, accounted for 34.5% of the variance and consisted of ten items (3, 4, 9, 11, 16, 20, 24, 26, 28 and 30). Factor 2, Liking, accounted for 12.8% of the variance and consisted of nine items (2, 5, 7, 8, 10, 13, 15, 17 and 25). Factor 3, Value, accounted for 8.7% of the variance and consisted of six items (1, 14, 19, 21, 22 and 29). Factor 4, Sex

Differences, accounted for 4.7% of the variance and consisted of five items (6, 12, 18, 23 and 27).

A factor analysis was performed on the post-course survey using the same four factor solution. The post-course survey responses were forced to the same four factors in order to match the pre-course survey factor analysis. The varimax rotation of this third factor analysis accounted for 56.7% of the variance. Similar results of item loadings were observed with the exception of Item 1 and Item 14 which loaded on Value factor from the pre-course survey and loaded on the Liking factor from the post-course survey. Item 2 loaded on the Liking factor from the pre-course survey and loaded on the Comfort factor on the post-course survey. Item 25 loaded on the Liking factor from the pre-course survey and loaded on the Value factor from the post-course survey. It was determined that this was acceptable based on relatively high correlation between the Comfort, Value and Liking factors by Violato et al. (1989).

MANOVA

To address the third and fourth research questions, two, two-way MANOVAs were conducted using the results of the factor analysis (i.e., Comfort, Value, Liking and Sex Differences) as the dependent variables with Time (pre- and post-course survey results), and a) the Population the students planned to teach (elementary or secondary), and b) Major area of study (Science, Humanities and Other) as the independent variables across subject responses to the Preservice Teacher Computer Attitude Scale.

In answering the question regarding the impact of an introductory course on attitudes of preservice teachers (the third research question), results of the multivariate analysis indicated a main effect for Time and the Comfort factor ($F(1,99) = 72.06$, $p \leq .0001$) with a significant increase from the pre-course survey (Mean = 34.327) to the post-course survey (Mean = 40.693).

A main effect for Time and the Liking Factor ($F(1,99) = 27.94$, $p \leq .0001$) was also revealed by the MANOVA. Similar to the results above, there was a significant increase from the pre-course survey mean (30.772) to the post-course survey mean (33.634) for this dependent variable. There were no significant main effects for Time and the Value factor ($F(1,99) = 0.43$, $p = .515$) or for Time and the Sex Differences factor ($F(1,99) = 0.09$, $p = .763$).

Relationship between Population or Major on Attitudes Toward Computers

In regard to the fourth research question, that of exploring a relationship between the population that these subjects plan to teach or their major area of study and their attitudes toward computers, a main effect was found for Major and the Value factor ($F(2,95) = 3.84$, $p = .025$). Post hoc analysis revealed no significant differences between Science and Humanities ($F(1,95) = 0.42$, $p = .5181$) and Science and Other majors ($F(1,95) = 2.82$, $p = .0967$) on the Value factor on the pre- and post-course surveys. However, significant differences were found between Humanities and Other majors ($F(1,95) = 7.61$, $p = .0070$) for the Value attitude factor (see Table 9) with those in the Humanities category valuing computers more than the other two groups.

Table 9 Combined Pre- and Post-course Survey Means - Major x Value

	Mean
Science	26.3095
Humanities	26.7857
Other	24.9464

There were no main effects found for Major and the other three attitude factors: Comfort ($F(2,95) = 0.65$, $p = .525$), Liking ($F(2,95) = 1.64$, $p = .200$) and Sex Differences ($F(2,95) = 1.69$, $p = .191$).

An examination of the univariate results for the Population variable indicated that responses from subjects who planned to teach elementary or secondary students did not differ on any of the four attitude variables (Comfort ($F(1,99) = 0.06 = .805$), Liking ($F(1,99) = 0.07$, $p = .794$), Value ($F(1,99) = 0.43$, $p = .515$) and Sex Differences ($F(1,99) = 0.09$, $p = .763$).

There were no significant interactions for Population by Time for any of the four attitude factors (Comfort ($F(1,99) = 0.24$, $p = .623$), Liking ($F(1,99) = 1.02$, $p = .314$), Value ($F(1,99) = 0.01$, $p = .941$) and Sex Differences ($F(1,99) = 0.86$, $p = .357$). A significant interaction for Major by Time was found for the Comfort factor ($F(2,95) = 3.58$, $p = .032$) only. Simple effects yielded no significant differences between the Science, Humanities and Other majors on the pre- and post-course surveys for the Comfort factor ($F(2,95) = 1.63$, $p = .2018$). However, there were significant differences on the Comfort factor within each major (Science $F(1,95) = 35.63$, $p \leq .0001$, Humanities $F(1,95) = 21.95$, $p \leq$

.0001 and Other $F(1,95) = 34.59$, $p \leq .0001$) from the pre-course survey to the post-course administration. Table 10 summarizes pre- and post-test means for each of the three majors.

Table 10 Pre- and Post-course Survey Means - Major x Comfort

	Pre-course	Post-course
Science	33.000	42.333
Humanities	36.041	40.837
Other	32.536	40.500

It appears that all students, regardless of their major area of study, were significantly more comfortable with computers at the end of the course than they were prior to the course. There were no significant interactions found for Major by Time on the Liking factor ($F(2,95) = 0.83$. $p = .440$), the Value factor ($F(2,95) = 1.84$, $p = .164$) or the Sex Differences Factor ($F(2,95) = 0.63$, $p = .534$).

Relationship between Experience and Attitudes

As part of the investigation into the relationship between the experience of these preservice teachers and its effect on their attitudes toward computers a correlation matrix was generated. The four factors that emerged from the exploratory factor analysis on the Preservice Teacher Computer Attitude Scale (Comfort, Liking, Value and Sex Differences) were correlated with the four types of computer experience from the previous computer experience survey (Where, Productivity Tools, Programming/Authoring and Edutainment). The correlation matrix revealed no significant correlations; it does not appear that there is a

relationship between these four attitude factors and these four experience variables.

Summary

A number of significant findings were revealed by the data collected from this group of preservice teachers. A summary of these are presented below.

Experience

Multivariate effects for Time were significant for all four experience variables. Multivariate effects for Time by Major were not significant for the four dependent variables. Multivariate effects for Major was not significant, however, univariate results indicate that Science, Humanities and Other majors differed significantly on the use of computer games and simulations. Those subjects majoring in Science had more experience than the other two groups.

Significant interactions were found for those students planning to teach at the elementary and secondary levels as to Where they learned to use a computer and experience with Programming languages and/or Authoring tools. In both situations, those students planning to teach at the elementary level entered the course with less experience than those planning to teach at the secondary level. Upon leaving the course, however, the students planning to teach elementary grades had more experience than those planning to teach secondary students.

Attitudes

The exploratory factor analysis seemed to confirm the model proposed by Violato et al. (1989) with four factors emerging (Comfort, Liking, Value and Sex Differences). Significant differences were found on the Comfort and Liking factors; significantly increasing from the pre- to post-course survey. A main effect was found for Major and Value, with significant differences found between Humanities and Other majors, with those in the Humanities group valuing computers more. An interaction effect was found for Major by Time on Comfort, with all groups increasing comfort levels from the pre- to post-course administration.

CHAPTER FIVE

DISCUSSION

The purpose of the present study was to examine the impact of a required, semester-long introductory computer course for educators in order to answer five research questions: 1) What is the entry-level computer experience of preservice teachers and what impact does a course have on experience levels of preservice teachers; 2) Can the four factor solution proposed by Violato et al. (1989) be replicated with this group of preservice teachers; 3) What impact does a required, semester-long introductory course in computer applications in education have on the attitudes of preservice teachers toward computers; 4) What is the relationship between preservice teachers' route and/or major area of study and their attitudes toward computers; 5) What is the relationship between experience with and attitudes toward computers. The following is a discussion of the results from this study.

Computer Experience

Software Applications Taught in the Course

An initial examination of the results obtained from the Computer Experience Survey indicates that a substantial percentage of students entered the course with no experience with applications such as spreadsheets, CD-ROM searches at the library, databases, electronic mail, graphics and authoring tools. Two applications in which students had a substantial amount of experience (11

times or more) were word processing and using the computerized library catalogue system.

As expected, students' experience with all of the applications increased on the post-course administration of the survey. In contrast to the pre-course survey where the largest percentage of responses were found in 'never' for six of the eight applications taught in the course; the largest percentage of participants' responses on the post-course survey were found in '1-2 times' for the use of spreadsheets, CD-ROM, databases, graphics and authoring. The already substantial portion of those students using word processing quite often (11 times or more) increased to 80.2% on the post-course survey, with all of the participants having some experience with word processing at the end of the course. The percentage of students using the computerized library search system also increased from the pre-course survey to the post-course survey, 33.7% to 54.5%, respectively. These increases were not unexpected because students were required to use a word processor for their lab assignments and use the computerized library system for a lecture assignment.

One of the most surprising results was the increase in the number of times participants used electronic mail. Upon entering the course, the vast majority of students had never used electronic mail (67.3%); however, on the post-course survey, the majority of students indicated that they had used it 11 times or more (63.4%). A marked increase in the use of the application was expected as the lecturer and lab instructor for the secondary section regularly

used this tool to notify students of important announcements such as open lab times, revised due dates for assignments and mid-term exam questions. It would seem reasonable to assume that these students may have been using electronic mail in their other university courses for similar purposes. However, the use of electronic mail for coursework may not be the only reason for the prolific use of electronic mail by such a large portion of students in both classes. One reason may be students' enthusiasm in using electronic mail to communicate with friends and family around the world. Several students indicated to one of the lab instructors that they used electronic mail regularly for that purpose. This enthusiasm suggests that this is one area which teachers might pursue in their subsequent teaching careers. Possible implications of this will be discussed in the final chapter of this thesis.

Although the use of spreadsheets and databases increased from the pre-course survey, it is interesting to note that a small percentage of students indicated that they had not used these two applications on the post-course survey (6.9% and 5.0% respectively). What makes this interesting is that not only were these applications taught in the course, but that participants in both sections were required to complete assignments using these two applications.

Software Applications Not Taught in the Course

Five of the fifteen applications on the Computer Experience Survey were not taught as part of the introductory course participants were enrolled in. Responses to four of the five items (desktop publishing, computer-aided design,

programming and simulations) indicated that the largest percentage of subjects had never used these four applications on both the pre- and post-course surveys. Computer games was the exception, with the largest percentage of respondents indicating that they had played computer games 11 times or more on the pre-and post-course administration of the survey.

Although the largest percentage of responses can be found in the 'never' category for desktop publishing, computer-aided design, programming languages and simulations for the pre- and post-test, it is interesting to note that the percentages decreased from the pre- to post- administration. There could be a number of reasons for this occurring. Obviously, participants could have gained their experience with those applications within or outside of the course. For example, simulations, although not part of the laboratory component of the course, is a common application within educational software and subjects may have had an opportunity to view and use these applications. Because some students may have been gaining experience with some applications that they may have already been familiar with, they may have been experimenting with other software applications that were available to them. Furthermore, it seems reasonable to suppose that some of these participants were enrolled in other university-level courses that made use of applications such as programming languages or simulations. Finally, there may have been some confusion of terminology on the survey that led to the decrease in the 'never' category on the post-course survey. Although every effort was made to make the survey as clear

as possible and provide examples whenever possible, some students may have confused desktop publishing with word processing; computer-aided design software with designing multimedia projects; and programming with authoring.

Where Subjects Obtained Their Computer Experience

The first two items on the Computer Experience Survey asked students where they had obtained their experience using computers. Responses to these two questions yielded some interesting and unexpected results. First, when asked if they had been trained to use a computer on the job, 45.5% on the pre-course survey answered 'never'; however, on the post-course survey this decreased to 29.7%. This shift could be a reflection of the current employment situation which may require more computer-based skills on the part of employees. Another reason may be that as subjects gained more computer experience in the course, they were willing to train to use a computer at their place of employment.

The second item on the survey asked subjects to indicate how many times they had used a computer to learn content material at school, college and/or university. Responses to the pre-course survey indicated that almost a third of students had never used a computer to learn material (31.7%), yet on the post-test only 5.0% of participants indicated that they had never used a computer for this purpose. On the other hand, only a small percentage of students indicated that they had used a computer for learning material 11 times or more (12.9%) on the pre-course survey as compared to the 40.6% post-course survey. This is

most likely due to the availability of on-line learning materials for the applications taught within the course. Students in the Macintosh sections are encouraged to learn about the Macintosh computer using a program called "Macintosh Basics" and later in the course, students were made aware of a HyperCard tutorial which was available on every computer in the Macintosh lab. For those participants in the Windows-based section of the course, they were encouraged to explore an on-line tutorial on mouse skills and Windows operations. Furthermore, those students in the Windows-based section were required to use the World Wide Web to find on-line guides to HyperText Markup Language commands and web page design principles and ideas. In addition, both sections used ClarisWorks, which has a tutorial for the general operation of the software, plus on-line help for each of the software applications contained within it. In addition, a number of faculty members at this university have designed and used computer assisted learning tools in their courses, therefore, these results may be a reflection of participants being required to use a computer to learn content material in other university-level courses.

Computer Experience and Teaching Route and/or Major

In order to answer the question of the relationship between experience and preservice teachers' route and/or major area of study, a two-way repeated measures MANOVA was conducted with Time and Major as the independent variables and the four experience types (i.e., a) Where subjects learned to use a computer, b) Productivity Tools, c) Programming/ Authoring and d) Edutainment

software) as the dependent variables. Results for the multivariate analysis indicated a main effect for Time, but no main effect was found for Major. No interaction effect was found for Time by Major on the four experience variables which indicates that the effect of the course did not change from Major to Major. Results indicate that the course was effective in improving experience for all students, regardless of their major area of study.

An examination for the univariate results for the Major variable indicate differences were found on the amount of use of Edutainment software by those participants majoring in Science (which includes Math, Science, Biology and Physics majors) and those majoring in Humanities and Other subject areas. Post hoc tests revealed significant differences between Science and Humanities majors and Science and Other majors, with those in Science having more experience using simulations and/or computer games. This may be due to the abundance of computer simulations that are designed for use in the Science curriculum. In addition, computer games are a common type of software for Math and may explain why this group had more experience using this type of software than the other two groups.

A second two-way repeated measures MANOVA was conducted using Time and the Population subjects planned to teach as the independent variables and the four types of experience as the dependent variables. Results of the multivariate analysis revealed a main effect for Time. Examination of the univariate analysis revealed significant differences on all the dependent

variables, which indicates that there were increases in all four experience variables from the pre- to post-course administration of the survey.

On the average there were no significant main effects found for Population. There were no significant interaction effects found for Time by Population on Productivity Tools. Productivity Tools includes most of the applications taught in the course (word processing, spreadsheets, library searches, databases, electronic mail and graphics). Because subjects were enrolled in two sections of the course with each having a different lecturer and lab instructors, it was entirely possible that one group would have significantly difference experience levels on these Productivity Tools. The non-significant result based on Population illustrates the importance of maintaining consistent course content between the two sections of the course and constant communication between lab instructors to ensure compatibility between the lab sections.

A significant interaction effect was found for Time by Population on Where subjects learned to use a computer. Simple effects tests indicate a significant Population effect on the pre-course survey and a non-significant effect on the post-course survey. Examination of the data indicates that those planning to teach at the elementary level had less experience learning to use a computer on the job and/or using a computer to learn content material on the pre-course survey than secondary subjects. However, on the post-course survey, the elementary subjects indicated more experience in these two areas

than those planning to teach at the secondary/post-secondary level, although not significantly. Although nothing in the data points to a reason for the difference, it seems reasonable to presume that the difference would lie in using a computer to learn content material, since there should be no reason why the two populations would differ on using a computer on the job.

There was also a significant Time by Population interaction effect on the Programming/Authoring variable. Simple effects testing revealed that those in the elementary group had significantly less experience using programming languages and/or authoring tools on the pre-course survey than those planning to teach at the secondary or post-secondary level. On the post-course survey, however, subjects planning to teach at the elementary level had significantly higher experience with this type of application than those in the secondary/post-secondary group. This difference may be the result of the wording of the Computer Experience Survey. Item 12 on the survey, which read "Authoring languages (HyperCard, LinkWay, etc.)" may have mislead some of the subjects in the secondary section who did not recognize producing a multimedia project on the World Wide Web is also considered using an authoring language whereas an example (HyperCard) was provided for those in the elementary section, which may have helped clarify the statement for that group.

Factor Analysis of the Preservice Computer Attitude Scale

The second research question explored the factor structure of the Preservice Computer Attitude Scale and compared it to the model proposed by

Violato et al. (1989). Whereas Violato et al. (1989) measured the attitudes toward computers of undergraduate education students enrolled in a non-computer course, one of the purposes of this study was to examine the possibility of replicating their factor structure with students enrolled in an introductory computer course for educators.

An exploratory factor analysis initially yielded a six factor solution, which was examined for interpretability. The results suggested that a four factor solution, similar to that proposed in the Violato et al. (1989) study was appropriate. The four factors that emerged (i.e., a) Comfort, b) Liking, c) Value and d) Sex Differences) accounted for 60.7% of the variance on the pre-course survey and 56.7% on the post-course survey. Survey items from the post-course survey loaded on the same factors from the pre-course survey, with the exception of Items 1, 2, 14 and 25. Upon examination of these items it was determined that the differences were acceptable based on the relatively high correlation between the Comfort, Value and Liking factors on the Violato et al. (1989) study. Therefore, the present study replicates the model proposed by Violato et al. (1989) in a pre/post-test design.

Impact of an Introductory Course on Attitudes of Preservice Teachers

In order to determine the impact of an introductory computer course on the attitudes of preservice teachers descriptive statistics summarizing the responses to the pre- and post-course administration of the Preservice Teacher Computer Attitude Scale were examined. Statistical analyses were conducted

using the four factors that emerged from the factor analysis (i.e., Comfort, Liking, Value and Sex Differences) as the dependent variables and Time and Major as the independent variables.

Preservice Teachers' Computer Attitude Scale

Responses to the survey items that loaded on the Comfort factor indicated that subjects were generally comfortable with computers upon entering the course. On the post-course survey, participants indicated that they felt more comfortable using computers and more comfortable learning about computers. Subjects indicated that they were less nervous, felt less inadequate and less uncomfortable around computers. Also, students indicated that they were more comfortable with their abilities to learn about computers as well as others (in the class) from the pre- to the post-course survey. This may be a result of students working collaboratively in the computer lab and recognizing their own skill levels.

Seven of the nine of the items that received a neutral mean rating (2.0 - 3.0) on the pre-course survey loaded on the Comfort factor. However, on the post-course survey, only one item, "Working with computers makes me very nervous" (Item 4) elicited a neutral response. On the pre-course survey, participants seemed to be somewhat neutral about items such as "I get a sinking feeling when I think of trying to use a computer" (Item 9, Pre-course Mean = 2.51) and "Computers make me feel uneasy and confused" (Item 24, Pre-course Mean = 2.61). However, on the post-course survey, participants clearly disagreed with those statements (1.85 and 1.95 respectively).

Two items on the survey which tapped into the Comfort factor dealt with the issue of being able to integrate computers into a subject area. Students' responses indicated that integrating a computer into their subject area would not be difficult (Item 22, Pre-course Mean = 1.99; Post-course Mean = 1.97) and that they would be able to integrate computer technology into their subject area (Item 30, Pre-course Mean = 3.63; Post-course Mean = 4.09). This was an interesting finding because subjects' responses indicated that they were fairly convinced about the ease of integrating computers into a chosen subject area before completing the course. Furthermore, most of these students had not completed their student teaching and therefore had not taken any methods courses in which some, if any, integration of computers occurs. Perhaps this was a result of students having observed the ease in which their teachers at high school, college and/or university integrated computer technology into their classes.

Most of the items that received the strongest agreement loaded onto the Value factor. The strong agreement with these items seems to indicate that this group of preservice teachers believes that possessing some knowledge about computers will prove to be valuable to them as future teachers. However, subjects also agreed with items that did not pertain to the teaching profession directly, such as Item 1, "Knowing how to use computers is worthwhile and necessary skill" and Item 29, "I will probably need to know how to use a computer if I leave university." These responses may indicate that no matter

what profession these students choose, they value the ability to use computers effectively.

Responses to items that loaded on the Liking factor indicate that on the pre-course survey students liked using computers as a tool in their school work, expressed a desire to use them more at the university and looked forward to using computers. In addition, subjects seemed to enjoy using computers and found them stimulating. Responses on the post-course survey indicate that students liking of computers increased from the pre- to post-course administration.

The strongest reactions were found for items that loaded on the Sex Differences factors. Subjects disagreed with all of the statements that suggested that males were more suited to work with computers than females and strongly agreed females could do as well as males in learning about computers. Although Violato et al. (1989) indicate that a disproportionate number of females in a sample should not affect the factor structure and correlations, it should be noted that this sample was comprised of largely females (84%) as compared to males (14%).

Attitudes toward Computers and Teaching Route and/or Major

A two-way MANOVA was conducted with Time (pre- and post-course surveys) and Major (Science, Humanities and Others) as the independent measures in order to explore the relationship between preservice teachers' major area of study and their attitudes toward computers. A second MANOVA

was conducted using Time and Population the students planned to teach (elementary or secondary) in order to examine the relationship between preservice teachers' route and their attitudes toward computers. In both MANOVAs, the four factors that emerged from the factor analysis (i.e., Comfort, Liking, Value and Sex Differences) were the dependent variables.

Results indicate some interesting findings for the influence of Time on preservice teachers' attitudes. A main effect for Time on the Comfort factor was found. This suggests that based on responses by subjects on the Preservice Teacher Computer Attitude Scale, these preservice teachers were significantly more comfortable with computers at the end of the course. This result may be due to the structure of the course and more specifically, the laboratory component of the course. Loyd & Loyd (1985) suggest that courses designed with substantial "hands-on" experience are based on the assumption that subjects must feel comfortable with computers before they will be able to use them effectively. The hands-on experience, which is an integral part of the course, provides students with access to technology for a substantial period of time every week (three hours). The laboratory is designed to provide participants with time to learn new skills and practice those skills in an environment which encourages exploration of new computer applications while still having a knowledgeable instructor present. In addition, because graded assignments are part of the laboratory component, students who would not

otherwise spend significant amounts of time using a computer, do so in order to complete assignments.

There was also a main effect found for Time on the Liking factor. Violato et al. (1989) define Liking as "the willingness to actually use computers" as compared to how comfortable one is using a computer. The results indicate that subjects liked using computers significantly more over time. It seems that as subjects learned more about computers and became more comfortable with them, they liked using them not only as a university student but also as a future teacher. Finally, it seems reasonable to suggest that prior to the course some students may not have been willing to use a computer because they felt the tool did not lend itself to their interests or meet their needs. Through the demonstration of a wide variety of computer products in the course, these students may have found computers to be useful to them.

An interesting finding was that there was no main effect for Time on the Value factor, that is, students did not seem to value a computer any more (or less) at the end of the course than they did at the beginning of the course. It had been expected that upon learning how valuable computers can be for teachers and students, there would have been a significant increase on this factor from the pre- to post-course surveys. This absence of a significant difference may be attributed to a variety of reasons. Balajthy (1988) asserts, most preservice teachers are convinced of the importance of computers prior to instruction because of the widespread coverage in the media and most have received some

limited exposure to computers prior to entering university. Another reason may be that because most of these subjects indicated that they were in the first or second years of a four-year program, a classroom situation may be too far removed for them to value the use of a computer to the teacher or his/her students. The importance of computer technology in the classroom may not be relevant to these subjects' current situations. Finally, the course may simply not emphasize the value of computers in the classroom. Because this is an introductory computing course, it is reasonable to suggest that the emphasis of this course may be on learning how to use a computer and mastery of basic computer skills rather than on the importance of using a computer. It may be that only those students who had a wealth of computer experience and who did not need to focus on skill development may have been the only members of this group who stood to benefit from any concentration on the value of using a computer.

There was no main effect found for Time on the Sex Differences factor.

A main effect was found for Major on the Value factor. Post hoc analysis revealed the only significant difference found among the three groups was between those students categorized as majoring in Humanities and those in the Other group. It would appear that those in Humanities valued computers slightly, but not significantly, more than the subjects in Science and significantly more than those subjects in the Other category. This finding somewhat

contradicts findings reported by Balajthy (1988) in which all students rated a computer more important for Math and Science education.

The difference may lie in a closer examination of what specific major areas of study were combined to form the Humanities category. Humanities included those students majoring in History, English, Language Arts, French, Social Studies, Psychology, Sociology, and Political Science . It may be that this group may value a computer more because of the value of a computer for writing compositions, which may be commonly used by students in these areas of study more than the other two groups. Specifically, this group may value software such as a word processor for such functions as the spell checker, a dictionary, a thesaurus and/or a grammar checker, all of which are available in popular word processing packages and to a limited extent in integrated software packages. Furthermore, subjects in this category may have valued a computer more than the other two groups because of the amount of information applicable and available to them on the World Wide Web (used by those in the secondary section of the course) or developing HyperCard projects such as interactive stories, drill and practice software for spelling and grammar skills and second language learning (HyperCard was used by those in the elementary section).

There were no main effects found for Major on the other three attitude factors, Comfort, Liking or Sex Differences. Although it was expected that there would be no differences found for Major on the Sex Differences factor, it was surprising to find no differences on either Comfort or Liking by Major. It was

expected that those people classified as Science majors (Science, Biology, Math and Physics) would be significantly more comfortable with computers and like computers more because of the plethora of computer software packages such as computer assisted instruction that have been historically used in these subject areas (Holznagel, 1987, Noran & Estes, 1985). This finding contradicts the findings reported by Liu et al. (1990) in which Science and Math majors were more comfortable with computers than those in other subject areas.

The possibility of an interaction between the independent variables (i.e., a) Time by Population and b) Time by Major) was also explored. Results from the MANOVA revealed a significant interaction effect of Time by Major on the Comfort factor only. Simple effects testing yielded no significant differences between the three groups of Majors. However, there were significant differences from the pre- to post-course survey for each major. It appears that across time all subjects were more comfortable with computers.

There was no interaction effect found for Time by Population on all four attitude factors.

Relationship between Computer Experience and Attitudes

In order to explore the possible relationship between computer experience and attitudes toward computers, a correlation matrix was generated using the four experience variables (Where, Productivity Tools, Programming/Authoring and Edutainment) and the four attitude variables (Comfort, Liking, Value and Sex Differences). Based on previous research

(Koohang, 1986a, Koohang, 1986b, Loyd & Gressard, 1984, Woodrow, 1990), it was expected that attitudes would improve as experience levels increased. However, results from the correlation matrix generated indicate no significant correlations. It does not appear that there is a relationship between the four experience factors and four attitude factors identified in this study. It seems that these two measures may be tapping into two different aspects of this issue.

Summary

A number of interesting findings were discussed based on preservice teachers' responses the pre- and post-course administrations of the Computer Experience Scale and the Preservice Teacher Attitude Scale. A summary of these are presented below.

Preservice Teachers' Experience With Computers

Entering the course, the majority of students had little or no substantial experience with software applications that were taught as part of the course. Upon completing the course, subjects' experience increased, with the most dramatic increase found in the use of electronic mail. Participants' experience also increased for applications that were not part of the course which may be the result of students' use of computers in other university courses.

It appears as if the course was effective in improving experience levels for all of the participants in the study, regardless of the population they plan to teach or their major area of study. It appears that those subjects majoring in Science had more experience using computer simulations and games. Results

indicate that elementary and secondary subjects benefited equally well from the course. Even so, subjects who planned to teach at the elementary level had less experience on using a computer on the job/learning content material using a computer and on using programming/authoring languages at the beginning of the course, but had more experience on the post-course survey.

Factor Structure of the Preservice Computer Attitude Scale

The exploratory factor analysis indicates that four attitude factors emerged (Comfort, Liking, Value and Sex Differences) and suggests the model proposed by Violato et al. (1989) can be extended to this sample of preservice teachers.

Preservice Teachers' Attitudes Toward Computers

Students' attitudes toward computers on all four attitude factors increased from the pre- to post-course administration of the Computer Attitude Scale. Subjects indicated that they possessed positive attitudes toward computers on the pre-course survey and were more positive on the post-course survey. It appears that subjects in this introductory course did not view computers as more valuable, easier or appropriate for males or females.

It appears that the course was effective in improving attitudes of all of the participants of the study. Results indicated that subjects were more comfortable with computers and liked computers more at the end of the course. It seems that those in Humanities may value computers more than subjects in either Science or Other majors, which may indicate that Humanities majors may have valued

some specific software application that was part of the course. For all three groups of majors, significant differences were found on the pre- and post- course administrations of the survey. It was expected that certain groups would be more/less comfortable with computers and like them more/less than the others, however, the results of this study do not support that contention.

CHAPTER SIX

CONCLUSION

General Conclusions

The present study attempted to answer five specific research questions that arose from related research into preservice teachers' experience with and attitudes toward computers. It would appear that the introductory computer course was effective in increasing subjects' computer experience in a variety of software applications that were not only part of the course, but outside of the course scope as well. Moreover, the factor analysis replicated the four factor solution proposed by Violato et al. (1989). Although participants' attitudes toward computers were positive upon entering the course, it appears that the course was effective in promoting more positive attitudes toward computers by preservice teachers. The relationship between computer experience and attitudes was not established in this study.

Educational Implications

Based on the results of this study, an introductory computer course for preservice teachers should be adopted by all teacher preparation programs. In addition, consideration should be given to the possibility of making such a course a pre-requisite to student teaching for a number of reasons. The computer skills that students gain by completing an introductory computing course would be a worthwhile skill and valuable tool for preservice teachers while student teaching. While student teaching, preservice teachers act as role

models and can be responsible for the successful implementation of computers while in the classroom. For this reason, it can be argued that student teachers should enter student teaching with positive attitudes toward computers which may be transferred to their students.

If an introductory course is to be divided into a number of sections, as was the case in the present study, it is important that the lecturers and lab instructors develop course objectives and activities that have similar goals. Regardless of how sections are divided (by major areas of study or by the population students plan to teach) consistency between the sections should be emphasized to ensure that all students benefit from similar experiences. Computers are not solely the responsibility of a certain group of teachers nor are computer software applications designed for use by only one kind of user, therefore all preservice teachers should feel comfortable with computers and confident enough to integrate them into their subject area.

Several researchers (i.e., Liu et al., 1990, Fulton, 1988) have suggested that a single introductory computer course for educators should be replaced with courses in computer education that are major driven; that is English majors would have an introductory computer course designed for them (Liu et al., 1990). However, results from this study suggest that a single introductory computer course for educators is effective regardless of preservice teachers' route and/or major areas of study. Most of the results based on Major or Population alone were not significant indicating that the course benefited all of the participants

and not one group only. Furthermore, integrating computer education into subject matter methods courses could mean that coordinating computer instruction may be more difficult to do, thereby actually increasing the possibility of differences occurring based on route and/or major area of study.

The enthusiasm for electronic mail may suggest the possible use of this application in these preservice teachers' subsequent teaching careers in a variety of ways. Through the use of electronic mail and the Internet, these students may be making contact with other preservice and/or practicing teachers throughout the world in the future. By participating in electronic discussions, these preservice teachers can expand their repertoire of teaching methodologies, ideas and knowledge of issues facing education. In addition, these preservice teachers can access databases of lesson plans, teaching strategies and materials that they would find difficult to do otherwise. Finally, the enthusiasm that these preservice teachers demonstrated in using electronic mail may be transferred to their future students, thereby expanding those horizons as well.

Limitations of the Study

There were a number of limitations of the present study that should be recognized. All of the subjects were enrolled in the introductory computer course, therefore a there was no control group for comparative data analysis. The use of data from a control group comprised of students not enrolled in the introductory computer course may have provided some useful information as to

whether the course was affecting attitudes toward computers and computer experience rather than any other outside factors (i.e., another course, university-wide computer initiatives, access to new computer labs/equipment, etc.).

The exploration of the relationship of computer experience and attitudes toward computers may have been thwarted by the four experience and attitudes factors. Perhaps by examining an individual experience item from the Computer Experience Scale and its relationship to computer attitudes, a relationship between experience and attitudes may have emerged. For example, an examination of word processing experience specifically, rather than Productivity Tools (which included several software applications) and one of attitude factors may have lead to the identification of certain types of experience that may influence attitudes.

The present study did not have enough participants to conduct a rigorous and robust factor analysis. It has been suggested that the minimum number of subjects for a factor analysis on the Computer Experience Scale (consisting of 15 items) and the Preservice Teacher Computer Attitude Scale (consisting of 30 items) would be 450; or 10 subjects per item (Norman & Streiner, 1986). Therefore, the factor analysis in the present study was exploratory rather than confirmatory.

Finally, the experimenter was one of the laboratory instructors in this course from which subjects in this study were drawn. Although every effort was made to assure subjects that their responses could not be identified to them, it is

possible that subjects' responses may have been affected by the relationship between the participants and the lab instructor/researcher.

Implications for Future Research

Based on the results of the present study of preservice teachers' attitudes toward and experience with computers, a number of suggestions can be made for further research into this area. Although this study suggests that preservice teachers are more positive in their attitudes toward computers after completing an introductory computer course, an investigation should be conducted to determine if these attitudes persist into their teaching careers. Extending this study into an examination of the use of computers in the schools by these fairly computer-positive preservice teachers would be of interest as well.

A further study in which the attitudes of this group of preservice teachers, most of whom had not completed student teaching, should be compared to a sample of preservice teachers who had completed the introductory computer course and student teaching. It would be interesting to determine if there are any attitudinal differences between preservice teachers who had not completed student teaching and those who had and where those differences may lie. Responses from this sample should be compared to a sample of university students who are not preservice teachers but who are enrolled in an introductory computer course for that discipline (i.e., business or engineering). Such a study may be useful in attempting to identify attitudes that may be specific to education

students. It would be useful to investigate if some of the results be replicated by using a different sample.

A future study of the effectiveness of an introductory computer course for educators could also attempt to gather qualitative data, building upon the findings of Simmons & Wild (1991) study with education students in Britain. Qualitative data may provide some insights into some of the quantitative results obtained by this study. For example, personal interviews may have helped to explain why students planning to teach at the elementary level indicated that their experience training to use a computer on the job and/or learning content material using a computer increased dramatically on the post-course survey.

Responses from this study could be compared to those obtained by preservice teachers who are enrolled in a subject matter methods course into which computers were integrated. Although this study does not suggest this as being more beneficial in terms of attitude or experience, several researchers (Liu et al., 1990; Fulton, 1988; Von Holzen & Price, 1990) have suggested such an implementation in order to reduce preservice teachers' anxiety toward computers.

Finally, although a number of studies have been conducted into the attitudes toward and experience with computers, further research should be conducted in order to determine changes in preservice teachers' attitudes and/or computer experience. Although experience, knowledge and feelings in regard to computer technology are likely to change, we cannot be sure unless the

situation is monitored. Summers (1990) suggests that this will allow teacher preparation courses to concentrate more fully on the educational potential of computers rather than the development of basic skills.

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APPENDIX A

Letter To Participants

To EDTS 325 University Student:

A research study is being conducted of the experience with and attitude toward computers of preservice teachers by a graduate student in the Department of Educational Psychology at the University of Calgary. Sylvia Ott will be conducting this research study under the supervision of Dr. Anthony Marini, of the Faculty of Education at the University of Calgary as part of the requirements towards a M.Sc. degree. The study is entitled "Preservice Teachers and Computers: A Survey of Attitudes and Experiences."

Your consent is needed in order for you to participate in this study. Your participation would involve completing two surveys, each of which will involve approximately 30 minutes of your class time.

Your participation is completely voluntary and you can withdraw from this study at any time. Your identity will not be revealed from the collected data. The results of this research may be published or reported to government agencies, funding agencies or scientific groups, but your name will not be associated in any way with any published results.

Please take the time to fill out the attached consent form which will allow you to participate in this research study.

Should you have any additional questions regarding this study, please feel free to contact the researcher, Dr. Marini at 220-5375, or the Office of the Associate Dean, Chair of the Joint Ethics Review Committee, Faculty of Education at 220-5626, and the Office of the Vice-President (Research) at 220-3381. A summary report of the study's findings will be made available to any interested party at the conclusion of the study.

Sincerely,

Sylvia M. Ott, B. Ed., Dip. Ed.
Graduate Student
220-6884

APPENDIX B

Participant Consent Letter

FACULTY OF EDUCATION
PRE-SERVICE TEACHERS ATTITUDE AND EXPERIENCE RESEARCH STUDY

CONSENT FOR RESEARCH PARTICIPATION

I understand that by participating in this study I will be completing two surveys, each of which will take 30 minutes to complete.

I understand that this research will be conducted during class time.

I understand that this study will not involve any greater risks than those ordinarily occurring in daily life.

I understand that my participation is completely voluntary, and that I can withdraw from the study at any time.

I understand that my identity will not be revealed from the data collected.

I understand that my participation in this study will not, in any way, affect my grade in this course.

I understand that the results of this research may be published or reported to government agencies, funding agencies or scientific groups, but that my name will not be associated in any way with any published results.

I understand that I can contact the researcher, Dr. Marini at 220-5375, or the Office of the Associate Dean, Chair of the Joint Ethics Review Committee, Faculty of Education at 220-5626, and the Office of the Vice-President (Research) at 220-3381.

I, _____, agree to participate as a subject in the research study conducted by Sylvia Ott, under the supervision of Dr. Anthony Marini, of the Faculty of Education at the University of Calgary.

Date: _____ Name: _____
Signature

Thank you for your participation in this research study.

_____
Sylvia M. Ott, B. Ed., Dip. Ed.
220-6884

APPENDIX C

Preservice Teacher Computer Experience and Attitude Scale - Demographic Information

"Preservice Teacher Computer Experience and Attitude Scale"

1. Please do not fill out **your** name. This is to be an anonymous survey.
2. Last Name: Please fill in your mother's surname at birth.
3. Please fill out your gender (M or F).

Part I - Demographics

Please answer the following questions by writing directly on this form. When several options are presented, please circle the one that **best** describes you.

1. How many full time (or equivalent) years have you studied at university?

   1 2 3 4 5 6 or more

2. Are you completing a B. Ed. After degree? yes no

   If yes, list previous degree(s) _____

3. Which population do you plan to teach? (circle all that apply)

   elementary secondary post-secondary/adults

4. What is your major subject area? _____Generalist None

5. What is your minor subject area (if applicable)? _____None

6. Have you completed student teaching? yes no

7. Have you taken any previous university computer courses? yes no

   If yes, please list the course number(s) _____

8. Do you own a computer? yes no

If yes, please circle which type of computer you own:

Macintosh/Apple DOS/Windows-based

Other (list type or manufacturer) _____

How often do you use it (per week)?

Never 1-2 times 3-5 times 6 or more times

9. How would you rate your current knowledge of computers?

very good quite good little very little none

10. Where did you obtain your computer experience? (if applicable)

at home at school/university at work at a friend's

APPENDIX D

Preservice Teacher Computer Experience and Attitude Scale - Previous Computer Experience

Part II - Previous experience using computers.

For each of the following statements, please select the letter that **best** describes the amount of your experience with computers. The following responses correspond to the ScanTron form you will use to record your answers.

A. Never **B**. 1- 2 times **C**. 3-5 times **D**. 6 - 10 times **E**. 11 or more times

1. Trained to use a computer in my job.
2. Used a computer to learn content material at school/college/university.
3. Word processing.
4. Desktop publishing.
5. Spreadsheet.
6. Computerized library search - DOBIS.
7. Computerized library search - CD-ROM (e.g. ERIC, PsycLit)
8. Databases.
9. Electronic Mail.
10. Computer-aided design.
11. Graphics software.
12. Authoring languages (HyperCard, LinkWay, etc.).
13. Programming (BASIC, Pascal, C, FORTRAN, etc.).
14. Computer games.
15. Computer simulations.

APPENDIX E

Preservice Teacher Computer Experience and Attitude Scale - Previous Computer Experience

Part III - Attitude Survey Questions

Survey Questions: For each of the following statements, please select the letter which **best** describes your belief about the statement. The following responses correspond to the ScanTron form you are using to answer this survey.

A. Strongly Disagree **B**. Disagree **C**. Neutral **D**. Agree **E**. Strongly Agree

16. Knowing how to use computers is a worthwhile and necessary skill.
17. I like using computers.
18. I feel confident with my ability to learn about computers.
19. Working with a computer makes me very nervous.
20. I use my knowledge of computers in many ways as a teacher.
21. Using a computer is more important for males than females.
22. I like using computers in my school work.
23. I wish I could use computers more frequently at the university.
24. I get a sinking feeling when I think of trying to use a computer.
25. Once I start to work with the computer, I find it hard to stop.
26. Computers make me feel inadequate.
27. More men than women have the ability to become computer scientists.
28. A job using computers would be very interesting.
29. I don't expect to use a computer when I have finished university.
30. I look forward to using the computers at the university.
31. I am not the type to do well with computers.
32. Working with computers is boring.
33. Using computers is more enjoyable for males than females.
34. Learning about computers is a worthwhile and necessary subject for all prospective teachers.
35. Computers make me feel uncomfortable.
36. It is important to know how to use computers in order to get a teaching position.
37. Integrating computers into my/a subject area would be difficult.
38. Females can do just as well as males in learning about computers.

A. Strongly Disagree **B**. Disagree **C**. Neutral **D**. Agree **E**. Strongly Agree

39. Computers make me feel uneasy and confused.
40. I think working with computers would be both enjoyable and stimulating.
41. Using a computer will be difficult for me.
42. Working with computers is more male-oriented than female-oriented.
43. I am able to do as well working with computers as most of my fellow students.
44. I will probably need to know how to use a computer if I leave university.
45. I feel comfortable in being able to integrate computers into my/a subject area.

Thank you very much for taking the time to answer all of these questions.
Please hand in your survey and computer answer sheet to the researcher.