THE RELATIONSHIPS AMONG COMPUTER SELF-EFFICACY, ATTITUDES TOWARD COMPUTERS, AND DESIRABILITY AND NEED FOR LEARNING COMPUTING SKILLS

by

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ABSTRACT

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Purpose of the Study: The purposes of this study were to investigate the relationships concerning computer efficacy, attitudes toward computers, and desirability and need for learning computing skills. Differences among computer science students, education students, general business students, and physical education students regarding the desirability of learning computing skills and their need for learning computing skills were analyzed.

Procedure: The sample was composed of 296 undergraduate students from a regional university in the Southwest in 1996. Seven hypotheses were formulated and they were tested using *Attitudes toward Computer Technologies* and *Confidence and Desired Knowledge with Computer Technologies*. Statistical analyses consisted of bivariate correlations, simultaneous multiple regression, one-way ANOVA, and Tukey's Honestly Significant Difference.

Findings: Multiple regression revealed that the computer attitude Comfort/Anxiety was a significant predictor of computer self-efficacy, but Usefulness was not. To predict the desirability of learning computing skills, the computer attitude Usefulness was a significant predictor, but Comfort/Anxiety was not. The subscale of computer self-efficacy of advanced computer skills was a significant predictor for desirability of learning computing skills. Furthermore, the multiple regression analysis revealed that there was a statistically significant combined predictive effect of computer self-efficacy subscales in beginning, advanced, and telecomputing skills on the need for learning computing skills. ANOVA revealed that students from computer classes had stronger desire and more need for learning computing skills than students from a non-computer class.

Conclusion: Comfort or anxiety about computers perceived by students was a predictor to their confidence levels about computers. Students' self-recognition of usefulness of computers and their perception of advanced levels of computer technologies were significant predictors in deciding their desirability of learning computing skills. The data revealed that attitudes toward computers, and computer self-efficacy, were significant predictors of the need for learning computing skills in both two groups of students, although students from computer classes demanded a higher level of learning computing skills and would possess more computer skills than those from a non-computer class. Recommendations for future research were also suggested.

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CHAPTER ONE

INTRODUCTION

Computer technology has developed rapidly so that millions of people are routinely using computers for jobs which, during the past three decades, had not required computers (Massoud, 1990). The important role computers play has been reflected in every realm of society (Amini, 1993). Moreover, the rapid growth of available computing applications has resulted in a high demand for people to obtain computing skills (Shaw, 1991).

Over a decade ago, Barger (1983) asserted that computer literacy had been recognized and practiced as essential knowledge equal in importance to reading and writing. Since then, computer literacy courses have sprung up across university disciplines (Tannenbaum & Rahn, 1985). Students in the humanities and social sciences, for example, felt a strong demand to become computer literate as a result of the significant computerization trend for their professions in the future (Tannenbaum & Rahn, 1985). Anderson (1987) suggested that "Today's educational curricula must be reassessed and restructured to take into account the skills and knowledge needed in an information-based society" (p. 15).

Anderson (1987) said that simply expanding computer literacy courses was not enough: "We must conduct the research and the planning to build a base of knowledge to plan and guide the educational system in this transition" (p. 19). Some researchers have further proposed that positive attitude and self-efficacy are important factors in helping people learn about computers (Delcourt & Kinzie, 1993). Geissler and Horridge (1993) have suggested, "It is imperative that university students' current knowledge of computers and their level of commitment about learning more about computer technology and computer applicability be assessed" (p. 347).

Sproull, Zubrow, and Kiesler (1986) discovered that some university students felt confused, as well as a loss of personal control, when they encountered technology. DeLoughry (1993) addressed this issue by citing an estimate from two researchers that "as many as one-third of the 14 million college students in the United States suffer from 'technophobia'" (p. A25), and by implying that the ideal goals for computer literacy in higher education might not be realized without research foundations and corresponding planning.

Kinzie, Delcourt, and Powers (1994) defined self-efficacy as an individual's confidence ability which may impact the performance of tasks:

> self-efficacy reflects an individual's confidence in his/her ability to perform the behavior required to produce specific outcomes and is thought to directly impact the choice to engage in a task, as well as the effort that will be expended and the persistence that will be exhibited. (p. 747)

Miura (1987) has suggested that self-efficacy may be an important factor related to the acquisition of computing skills. Self-efficacy as defined by Bandura (1982) "centers on people's sense of personal efficacy to produce and to regulate events in their lives" (p. 122). According to Bandura, the judgment of perceived self-efficacy in the course of action may produce and regulate a person's capability to deal with his or her environment. Distinct self-concepts toward efficacy may function differently; positive self-efficacy may encourage learning new skills, whereas negative self-efficacy may create resistance in operative capabilities.

The meaning of self-efficacy has been frequently cited from Bandura (1977), who indicated that efficacy expectancy, or self-efficacy, resided between the person and the behavior. If serious uncertainties regarding performance of necessary activities existed in efficacy expectations, then efficacy expectations would no longer impact behavior. The greater people perceive their self-efficacy, the more active and longer they persist in their efforts (Bandura, 1977; Bandura, 1981; Bandura, 1982; Bandura & Adams, 1977).

Woodrow (1991) specifically claimed that students' attitudes toward computers were a critical issue in computer courses and computer-based curricula. Monitoring the user's attitudes toward the computer should be a continuous process if the computer was to be used as a teaching and learning tool. Aiken (1980) described attitudes as "learned predispositions to respond positively or negatively to certain objects, situations, concepts, or persons" (p. 2). Attitudes toward computers were believed to be related to other attributes, such as the relationship with gender, household, age, and years of education (Morris, 1988-1989); the effects on training and learning (Ford & Noe, 1987); and positive and negative attitudes related to learning how to edit on the computer (Paxton & Turner 1984).

In the business world, microcomputing skills were listed as the first category which should be acquired by business students during their university studies. In a survey of 15 businesses in Michigan and two in Chicago, the 17 firms agreed that microcomputer skills were the basic requirement for future employees (Nellermore, 1992). The survey indicated that as a prerequisite, business employees must have the knowledge and skills to use microcomputers. Nellermore suggested that educators in higher education have the responsibility to restructure and design curricula to ensure these results.

Computer jobs require computer science graduates to have a broad range of knowledge to meet the needs of new technology and to have sufficient capabilities to solve a diversity of problems (Texas Higher Education Coordinating Board, 1993). Computer literacy courses for university students in computer science programs need to be evaluated continually due to the increasingly important role of computers in society and public recognition of related educational and socio-economic concerns (Quebec Commission on the Evaluation of Collegiate Teaching, 1994). Evaluation of the type of computer courses offered to students at universities is necessary to better prepare these students for the work force (Quebec Commission on the Evaluation of Collegiate Teaching, 1994).

Students in education are preparing for their future responsibility of educating and preparing the younger generation (Beaver, 1992). Brownell (1987) maintained that educators should be aware of the current and projected situation of computers in society, should be familiar with the components of computers, and should understand how computers work and interact in the teaching milieu. Other educational researchers have emphasized that education students must have educational computing skills at the time they graduate so that they might be successful in tomorrow's classrooms (Beaver, 1990; Uhlig, 1982).

With the growing availability of computers to teachers and students, the necessity of assessment of educators' and students' current knowledge and desired knowledge about computers has been advocated by Ronald (1983) and Mehlhoff & Sisler (1989). Geissler and Horridge (1993) suggested that assessing university students' current knowledge about computers and determining what they wanted to learn about computers was imperative so that the computer literacy courses offered would be appropriate for the students' needs.

Statement of the Problem

The problem under study was the relationships concerning computer self-efficacy, attitudes toward computers, and perceptions of both desirability and need for learning computing skills among undergraduate students. An additional concern was a comparison of desirability and need for learning computing skills between computer class group and non-computer class group.

Purpose of the Study

The purposes of this study were to measure computer self-efficacy, attitudes toward computers, and desirability and need for learning computing skills by undergraduate students. Specific purposes were the following:

1. to determine whether there is a statistically significant predictive effect of attitudes toward computers on computer self-efficacy.

2. to determine whether there is a statistically significant predictive effect of attitudes toward computers on the desirability of learning computer skills.

3. to determine whether there is a statistically significant predictive effect of computer self-efficacy on the desirability of learning computer skills.

4. to determine whether there is a statistically significant predictive effect of attitudes toward computers on the need for learning computing skills.

5. to determine whether there is a statistically significant predictive effect of computer self-efficacy on the need for learning computing skills.

6. to determine whether there are statistically significant differences between university students in computer and non-computer classes regarding the desirability of learning computing skills.

7. to determine whether there are statistically significant differences between university students in computer and non-computer classes regarding the need for learning computing skills.

Hypotheses

The following hypotheses were tested at the .05 level of significance.

Hypothesis 1: There is no statistically significant predictive effect of attitudes toward computers on computer self-efficacy.

Hypothesis 2: There is no statistically significant predictive effect of attitudes toward computers on the desirability of learning computing skills.

Hypothesis 3: There is no statistically significant predictive effect of computer self-efficacy on the desirability of learning computing skills.

Hypothesis 4: There is no statistically significant predictive effect of attitudes toward computers on the need for learning computing skills.

Hypothesis 5: There is no statistically significant predictive effect of computer self-efficacy on the need for learning computing skills.

Hypothesis 6: There are no statistically significant differences between students in computer and non-computer classes regarding the desirability of learning computing skills.

Hypothesis 7: There are no statistically significant differences between students in computer and non-computer classes regarding the need for learning computing skills.

Significance of the Study

According to Walla and Wendel (1984), 90% of the work force will be employed in an automated office by the end of this century. Robinson (1983-1984) further stated that these jobs will require computing technology; therefore, the integration of computing into higher education is essential. Ferren (1993) indicated that mandatory computer literacy was based not only on an intellectual concern, but also on social and economic concerns, and pointed out that "as more faculty members increase their use of computers, they would also focus on how computers can help students learn" (p. 175).

Several studies have recently examined the relationship between computer self-efficacy and other attributes. Self-efficacy was found to be associated with attitudes toward computer technologies by Delcourt and Kinzie (1993) and Zubrow (1987). Others (Hill, Smith, & Mann, 1987; Miura, 1987) found that self-efficacy was related to enrollment in computer courses. Kinzie, Delcourt, and Powers (1994) investigated attitudes and self-efficacy toward computer technology among business, education, and nursing undergraduate students and found computer attitudes were essential elements in examining the computer self-efficacy of these students. Schunk (1981) proposed that self-efficacy could be used as a predictor in academic performance. Based on this research, the question arose as to whether self-efficacy could predict students' learning and use of computers.

Previous studies on self-efficacy toward computer technology have determined that self-efficacy was essential in the learning and use of computers (Delcourt & Kinzie, 1993; Hill, Smith, & Mann, 1987; Jorde-Bloom, 1988; Kinzie, Delcourt, & Powers, 1994; Miura, 1987; Schunk, 1981; Schunk, 1985). Studies of self-efficacy in education have focused on children, undergraduate students, and administrators (Hill, Smith, & Mann, 1987; Jorde-Bloom, 1988; Miura, 1987; Schunk, 1981; Schunk, 1985). Delcourt and Kinzie (1993) investigated self-efficacy toward computer technology for both undergraduate and graduate education students, and Kinzie, Delcourt and Powers (1994) conducted studies on attitudes and self-efficacy among undergraduate students at all levels. None of these studies examined the connection of self-efficacy to the construct of desirability of learning. Furthermore, many of the previous studies in this area did not include the current expansion of computer technologies (Kinzie, Delcourt, & Powers, 1994).

Educators in higher education have recognized that computer literacy is essential for university students (Mehlhoff & Sisler, 1989; Tannenbaum & Rahn, 1985). In order to help university students better learn basic computer skills, much research has been conducted to test computer attitudes and their related attributes (Loyd & Loyd, 1988; Savenye, Davidson & Orr, 1992). However, Hignite and Echternacht (1992) noticed that previous studies of the significant intercorrelations between computer attitude variables and computer literacy levels have produced conflicting results.

Kay (1993b) surmised that researchers had assessed over 15 different constructs of attitudes toward computers in more than a decade, but, due to a lack of theoretical justification, clearer explanations remained to be resolved. He believed that further research was needed to identify specific contextual elements. Conclusions drawn from previous studies indicated that considerations of research in this area should include perceived self-efficacy, attitudes, and desirability for learning computing across undergraduate disciplines with updated expansion of computer technologies (Geissler & Horridge, 1993; Kinzie, Delcourt, & Powers, 1994).

Other researchers assessed faculty and students' desired needs for computer technologies (Geissler & Horridge, 1993; Ronald, 1983). However, the variables of both computer self-efficacy and attitudes have not been combined. Examining the computer levels together with other attributes is not a simple task. Hignite and Echternacht (1992) maintained that future study should include "individual values and opinions or other personality characteristics" (pp. 387-388). This current study explored relationships across computer self-efficacy, attitudes, and desirability and need for learning computing skills. Using a linear combination of two attitudinal variables (Comfort/Anxiety and Usefulness) and three self-efficacious variables (Beginning Computer Skills, Advanced Computer Skills, and Telecomputing) with a linear relation of three computer skills factors (Computer Self-Efficacy, Desirability of Learning Computing Skills, and Need for Learning Computing Skills), "some of the more complex relationships that exist between certain combinations of variables might be identified" (Hignite & Echternacht, 1992, p. 382) and the combination of the variables "could be better understood" (p. 382).

Understanding students' backgrounds, self-readiness, and the expectations for different groups of students in different departments is the first step for instructors (Fann, Lynch, and Murranka, 1989). They suggested that "instructors need to be aware of the wide variation of characteristics of students as computer users" (p. 316) and "to meet their varying needs" (p. 316).

McClintock (1986) expounded:

> Knowledge-based systems are generative, not determinative; they import tools, not finished structures, tools that people can use to form conviction, to empower action, to sustain reflection, to nurture hope. The purpose of culture is to empower human expression and a fully computer-based education will do that in effect, enabling people to use the tools of expression to pursue their aim in life. (p. 212)

The findings of the extent to which computer attitudes and self-efficacy contribute to the students' desirability and need for learning computing skills, as well as the comparisons of desirability and need for learning computing skills among students (computer science, educational technology, general business, and health and physical education) provide implications for curriculum planning of knowledge and skills to help students in their respective educational pursuits.

Methods of Procedure

The instrument used in this study was *Computer Technologies Survey*, adopted and modified from *Attitudes toward Computer Technologies* by Delcourt and Kinzie (1993) and *Confidence and Desired Knowledge with Computer Technologies* by Murphy, Coover, and Owen (1989). Subjects participating in this study were students from three introductory computer classes and a non-computer class. The three computer classes were entry-level computer classes, providing computer concepts and knowledge and skills in using computers. These three computer classes were from the departments of Computer Science and Information Systems, Secondary and Higher Education, and General Business and Systems Management. The non-computer class was from the Department of Health and Physical Education. The data were collected at a regional university in the southwest.

Treatment of Data

The raw data were scrutinized, and unusable data were discarded before analyzing the data. Cronbach's alpha was used to check the reliability coefficients of the internal consistency of the responses for all subscales as well as the whole instruments in general.

To test Hypothesis One through Hypothesis Five, the Pearson product-moment was used to determine the correlations of selected variables in this study. Simultaneous multiple regression as a general linear model was conducted to detect the significantly predictive effect of attitudes toward computers on computer self-efficacy, effect of attitudes toward computers and computer self-efficacy on desirability of learning computing skills, and effect of attitudes toward computers and computer self-efficacy on need for learning computing skills.

To test Hypothesis Six and Hypothesis Seven, descriptive statistics regarding the students' desirability of learning and the need for learning computing skills were presented. Strategies of analysis of variance included the one-way ANOVA and Tukey's Honestly Significant Difference. These statistical techniques were performed to test desirability of learning computing skills and the need for learning computing skills among the students from three computer classes and one non-computer class.

Definition of Terms

Definitions relative to this study are given in the following.

Self-efficacy referred to confidence levels a student felt concerning his/her basic computer skills, advanced skills, and telecomputing.

Attitudes were concerned with a student's personal standpoints relating to computer technologies.

Desirability of learning computer skills described what the students *would like* to learn in terms of computing skills.

Need for learning computing skills reflected the students' perceptions concerning the computing skills they felt they *needed* to have.

Telecomputing was student's use of the university computer system and the use of electronic mail.

Computer classes referred to those entry-level computer classes which introduce basic computer concepts and provide necessary knowledge and skills in using computers.

Delimitations of the Study

The delimitations of this study were as follows:

1. Only students enrolled in three computer classes and a non-computer class at a regional university in the Southwest in spring 1996 were included.

2. The *Attitudes toward Computer Technologies* (Part Two of the *Computer Technologies Survey)* was used to estimate respondents' computer comfort/anxiety and usefulness.

3. The *Confidence and Desired Knowledge with Computer Technologies* (Part Three of the *Computer Technologies Survey)* was used to measure the respondents' computer self-efficacy, and their desirability of learning and need for learning computing skills.

Limitations of the Study

The current study was limited by the following: the analysis was based on 220 returned usable questionnaires after screening the raw data.

Assumptions of the Study

This study was based on the following assumptions:

1. The instrument used in this study was valid and reliable; therefore, it provided accurate information.

2. All the students who participated in this study were competent for reading and comprehending the research instrument.

3. Participating students responded to the research instrument responsibly.

Organization of Remaining Chapters

The present study investigated correlations and variances of computer self-efficacy, attitudes, and desirability, and need for learning computing skills among students in three computer classes and a non-computer class. Chapter Two presents a detailed review of literature related to this topic, and Chapter Three describes the methodology used in this study. Chapter Four details the analysis of data for each of the hypotheses examined in this study. Finally, Chapter Five addresses summary, findings, conclusions, implications, and recommendations for further research.

CHAPTER TWO

LITERATURE REVIEW

This chapter presents a summary of the literature in the area of computer education among college students. The three sections discuss previous research in three areas: the role of computer self-efficacy expectations, attitudes toward computers, and college students' commitment to and need for learning computing skills in institutions of higher learning.

The first section outlines research on self-efficacy as a factor related to computer use, learning, and application, which includes underlying self-efficacy theory, predictive self-efficacy effects on computer technologies, gender issues and computer self-efficacy, and effects of instruction on computer self-efficacy. The second section reviews attitudes toward computers, which includes attitudinal constructs in computer technologies, gender role of attitudes toward computers, attitudinal changes through computer literacy courses, and computer anxiety. The last section describes research regarding perceived need and desirability of learning computing skills by college students and faculty, which includes usefulness of computer skills, desire to learn computing skills, and need for learning computing skills.

The Role of Computer Self-Efficacy Expectations

Self-efficacy is defined as a construct referring to self-perceived confidence in a person's ability to accomplish designated actions and attainments (Schunk, 1989a). "Self-percepts of efficacy influence thought patterns, actions, and emotional arousal" (Bandura, 1982, p. 122).

Underlying Self-Efficacy Theory

Self-efficacy theory indicates that those who have stronger self-efficacy are willing to persist in coping with difficult and threatening activities, while those who feel their capabilities inferior to the task they are confronting would avoid and cease their effort prematurely (Bandura & Adams, 1977). Self-efficacy, denoted as expectations of personal efficacy in social learning analysis, stems mainly from four sources: (a) successful performance, (b) experience of observing others' accomplishments, (c) verbal persuasion, and (d) physiological arousal. Bandura and Adams studied six severe snake phobics recruited through advertisements placed in a newspaper serving a metropolitan area and its suburban communities. The average age of the subjects was 31 years. By using microanalysis of the relationship between the level of self-efficacy and the corresponding behavioral changes, the results showed a positive relationship regardless of what resources of self-efficacy were used. Cognitive self-efficacy played an important role in reducing fear consciousness and action avoidance. The formulation of efficacy depended upon judgments of the appraisal of the difficulty level of tasks, the amount of time they had to spend, and number of trials required.

Self-efficacy was found positively correlated with behavioral changes vicariously and emotively (Bandura, 1977). Perceived efficacy expectations were initiated from psychological procedures. They served as convictions that made people feel they could successfully execute an action to produce outcomes. Once self-efficacy had been formulated, it influenced the behavioral settings to give vent to efforts. According to Bandura, efficacy expectations were determinants in choosing activities. Cognitive appraisals in contextual situations impacted the information of efficacy expectations. In social learning theory, self-efficacy rose from various experiences, which implied that studying self-efficacy would grant information of behavioral process and motivational sources. Because of self-referent thought, people sometimes did not perform optimally. Lack of self-efficacy could cause people to give up trying and to cease attempting to achieve their goal due to their belief in unresponsive results by their efforts. The higher personal efficacy expectation, the more likely tasks could be successfully accomplished. Analysis of subjects' judgments of past experiences in the enactive mode of treatment, the prediction of results of congruent tests between self-efficacy and performance, revealed that self-efficacy was an accurate predictor of subsequent performance of 85% of the total tasks. Self-efficacy assisted in the determination of behavioral efforts by increasing intensity and persistence.

Self-efficacy was explained as efficacy perceived by people toward judgments as to how well they performed the process of tasks in dealing with specific situations (Bandura, 1982). People executed or avoided activities based on their appraisals of their coping capabilities and the actions required for their capabilities to manage them.

Self-efficacy played an important role in mediating knowledge and action, and it influenced behavior and motivation. Pajares (1995) indicated that self-efficacy was a strong predictor of academic outcomes and mediation of other determinants when included in personal characteristics and other self-beliefs. Lewis (1985) found that computing experience facilitated the levels of self-efficacy in corrective learning experience. Oliver and Shapiro (1993) defined computer self-efficacy as "the understanding of an individual's beliefs of their capability of using the computer" (p. 81), which provided fundamental strategies in learning and using computer-related technologies.

Fann, Lynch, and Murranka (1989) explained that "computer efficacy is a belief in one's self to be able to use computers" (p. 310). In analyzing the role of personal efficacy in the use of advanced technologies, Hill, Smith, and Mann (1987) indicated that "technological phobia" could be a crucial factor in task performance. Consideration of attitudes, self-efficacy, and students' levels of computer knowledge was important, but the assumption that offering a computer literacy course would automatically result in positive attitudes was not appropriate (Hignite & Echternacht, 1992).

Predictive Self-Efficacy Effects on Computer Technologies

Owen (1986) summarized self-efficacy expectations as a noticeable construct of affect, cognition, and performance, and suggested that self-efficacy could be easily measured. Jorde-Bloom (1988) conducted research to test 80 early childhood administrators' (a) varying use of computers along with the difference of computer self-efficacy and attitudes, (b) self-efficacy expectations as predictive effects in the use of computers, (c) higher professional orientation with greater microcomputer self-efficacy expectations, and (d) being male and having better background of math and science with greater self-efficacy expectations. Two dependent variables were used respectively: level of computer use for administrative purposes and level of computer use for instructional purposes. Independent variables in the study included gender, self-efficacy expectations, and attitudes about computer technology. Testing instrumentation included *Self-*

Perception of Innovativeness, *Experience with and Knowledge about Computers*, *Outside Support and Encouragement*, *Professional Orientation*, and *Background in Math and Science*. Four variables--attitudes, experience/knowledge, self-perception of innovativeness, and support/encouragement--accounted for approximately 62% of the variance in self-efficacy. The results indicated that those administrators who possessed more knowledge and experience would be likely to make decisions in choosing the use of microcomputers. Self-efficacy, explained as the judgments about action capabilities, was a strong predictor of people's behavioral changes. Jorde-Bloom (1988) concluded that self-efficacy constituted a general framework about predicting choices of computer use for early childhood administrators.

Miura (1987) used computer self-efficacy as a factor to examine the gender difference in enrollment of computer science courses. The rate of computer self-efficacy perceived by men was higher than that by women among 368 students. The study suggested that those who were more self-confident in computer-related tasks would be more likely to enroll in computer science courses.

Delcourt and Kinzie (1993) believed that teachers must feel confident about their ability to use computer technologies in order to become appropriate models for students in an information age. They examined kinds of attitudes toward computers and self-efficacy expectations about computer competencies of computers of 328 graduate and undergraduate education students at six universities. Hierarchical regression was used to examine relationships between computer self-efficacy and certain demographic variables, attitudes, and experiences in using computer technologies. Computer attitudes were divided into comfort/anxiety and usefulness. Feelings of self-efficacy of computer technologies were investigated in three areas of computer applications--word processing, electronic mail, and CD-ROM databases. Self-efficacies of word processing, electronic mail, and CD-ROM were used as dependent variables respectively. Demographic variables were entered as the first block, course experience as the second, and the frequency of using each type of technology as block three. Attitudes were entered last after demographic variables, course experience, and frequency of using technologies were statistically eliminated to predict the self-efficacy by attitudes. Results revealed that all independent variables were statistically significant in predictive equations though their strengths were varied. Attitudes presented were significant predictors of self-efficacy in all three computer technologies.

Kinzie, Delcourt, and Powers (1994) expanded this research by adding three computer technologies (spreadsheets, database programs, and statistical packages) among different populations. The study included a total of 359 undergraduate students from three disciplines--business, nursing, and education--from the western, midwestern, and eastern sections of the United States. The testing of internal consistency of reliability coefficients yielded results that indicated the acceptable levels for *Attitudes toward Computer Technologies*, and *Self-Efficacy for Computer Technologies* research instruments. The same hierarchical regression procedures were conducted to investigate predictive effects of self-efficacy on six computer applications--word processing, electronic mail, spreadsheet, database, statistical package, and CD-ROM database. Learners' characteristics, course experience, frequency of the use of computer technologies, and attitudes toward computers served as independent variables and were entered hierarchically. Each computer application was accounted as an individual outcome. Results confirmed that computer attitudes of comfort/anxiety and usefulness contributed significantly predictive effects on self-efficacy of computer technologies after accounting for other variables.

Gender Issues and Computer Self-efficacy

Hackett (1985) conducted research among 117 undergraduate students to investigate the relationships of mathematics-related self-efficacy and effects of gender and mathematics relatedness for choice of a major. He stated that computer technology had been considered a mathematics-related subject, and male college students had higher self-efficacy than female students in math-related subjects. Female students were also found to have lower computer self-efficacy expectations than male students (Harrison & Rainer, Jr., 1992; Jorde-Bloom, 1988; Miura, 1987). Robbins (1986) claimed that self-judgment of programming ability among male students in a computer literacy class was higher than that among female students. In Lewis' (1985) study, however, computer knowledge self-efficacy was not significantly predicted by previous mathematics background and gender. Riggs and Enochs reported (1993) that the relationship between positive attitudes toward science and computer self-efficacy was weak.

Murphy, Coover, and Owen (1989) conducted a study of 414 graduate students, adult vocational students, and nurses. They examined self-perceived capabilities of computer knowledge and skills with the *Computer Self-Efficacy Scale*. Males and females in the study were reported differently with respect to their self-perceived capabilities of computer knowledge and skills, and males had higher efficacy expectations than females. Murphy, Coover, and Owen (1989) noticed that the significant difference of computer self-efficacy between male and female students was even higher when computers were used at an advanced level.

Busch (1995) gave a questionnaire to 147 Norwegian college students at the end of a computer course to measure computer self-efficacy, computer anxiety, computing liking, and computer confidence. Results revealed a significant difference between male and female students in terms of computer self-efficacy regarding the completion of both WordPerfect word processing and Lotus 1-2-3, but not in the completion of simple tasks in both attitudes toward computers and computer self-efficacy. Previous experience in word processing was found to be the most important predictor of students' self-perceived self-efficacy and computer confidence in WordPerfect, and ownership of personal computers contributed successful prediction to complex tasks of WordPerfect and Lotus 1-2-3.

Effects of Instruction on Computer Self-Efficacy

Smith (1994) conducted an experimental study of the effects of instruction on computer self-efficacy. Participants were voluntary college students who were not majoring in computer science (46 students in the standard instruction group, 46 with additional verbal persuasion lectures, and 56 as a comparison group). The measurements were *Task Self-Efficacy* (TSE) and *Generalized Self-Efficacy* (GSE) developed by the researcher. The pre- and posttests indicated that aggregated TSE scores in the standard group were increased. The verbal persuasion group ranked second. The same results were found in the GSE scores; the aggregated GSE scores were increased significantly both in the standard group and the verbal persuasion group. Generally, these findings supported the assumption that effective instruction could make changes in students' feelings about computers.

In Russon, Josefowitz, and Edmonds' (1994) study, 20 female undergraduate computer novices were evenly divided into an experimental group and a control group. Both groups were given an instructional package asking the students to reproduce a standardized letter, with an additional preface of instruction given to the experimental group. The result of the study implied that self-efficacy was affected by subjective judgments upon success.

Ertmer, Evenbeck, Cennamo, and Lehman (1994) examined computer self-efficacy and attitudes toward computers in terms of electronic mail and word processing among 32 students in a physical education computer applications course. Students were assigned to use one of three different methods of interaction between the instructor and students--electronic mail, word-processing note, or handwritten note. Researchers hypothesized that the students would learn the new computer technologies through their efforts by interacting with the instructor; thus, self-perceived computer competency would be enhanced. Students' confidence about computers was significantly increased across all treatments in a nonthreatening learning environment. The authors concluded that self-perceived computer capability tended to be a critical issue of quality rather than quantity.

The levels of computer self-efficacy were also related to the individual's points of view of computer control. Hattie (1990) determined that those who saw computers as controllable would increase their self-efficacy to manipulate computers, while those who felt computers were complex and difficult tools would tend to become discouraged. Hattie investigated 1,868 students and 1,000 schools in Australia and did a meta-analysis on 19 studies. He found that students with a lower level of self-efficacy tended to have higher levels of anxiety or arousal and that students with higher self-efficacy were capable of coping with the effects of difficult situations and had fewer reasons to be afraid of computers.

Relan (1992) examined whether motivational foundations of cognitive, affective, and social learning theories could be applied as strategies of motivation in computer-based instruction. He discovered that even though students with lower self-efficacy felt less vulnerable to social interactions, they were more vulnerable to computer based instruction because they viewed the computer as more fair than teachers and its feedback was immediate. Carlson and Grabowski (1992) conducted a study of 57 undergraduate students in military training and a large education course, investigating the effects of computer self-efficacy on direction-following behavior in computer assisted instruction. Female and male students demonstrated opposite directions in the relationship of computer self-efficacy and direction-following behavior. Male students showed higher perceived computer self-efficacy than female students. Male students with a high computer self-efficacy rating followed directions better than those male students who had a lower computer self-efficacy rating. However, female students with a high computer self-efficacy rating followed directions less than those female students who had lower computer self-efficacy.

Faseyitan and Hirschbuhl (1992) conducted research on how some selected variables affected faculty's adoption of computers in their instruction. "Adoption" was defined as either the faculty using computers in their instruction or requiring students to use computers in their coursework. The survey polled 600 faculty, and 43% of them returned the questionnaire (N = 257). A significant difference was found between adopters and non-adopters in terms of computer self-efficacy. Faculty in technology-oriented disciplines had a higher level of computer self-efficacy and a more positive attitude toward computers. They were more likely to adopt computers. Thus, self-efficacy could be used as a significant predictor of computer adoption. Faculty who were reluctant to adopt computers could attribute their feelings to criticism, change, and lack of understanding of computer utilities.

Gist, Schwoerer, and Rosen (1989) compared the interactive tutorial method and modeling method in computer software training. They found that trainees high in self-efficacy performed better in behavior modeling, but trainees low in self-efficacy had better outcomes in the interactive tutorial group. The authors explained that one possibility was due to raised self-efficacy when tasks were subdivided and reinforced. Hill, Smith, and Mann (1986) found that college students felt more self-efficacy toward computer-related technologies which were less complicated. The more complex the computer-related tasks, the more important the role of self-efficacy played in adaptation to the new technologies.

Attitudes toward Computers

Self-efficacy is an important attribute of computer education research. Another attribute, attitude, one of the unique characteristics of human beings, also deserves review in computer education.

Attitudinal Constructs in Computer Technologies

Social scientists have focused on computer attitudes in recent years because of the beliefs that attitudes toward computers affected the learning about and use of computers (Savenye, 1993). Kay (1992a) proposed a number of concepts in examining attitudes toward computers, including acceptance, affect, cognition, comfort, confidence, course, interest, liking, locus of control, motivation, programming, training, case scenarios, and stereotypes. Attitudes toward computer technology among college students have been changing (Price & Winiecki, 1995). As a result, researchers have used various computer attitude measures in the last decade. "It would be best to be as specific as possible about the content of the attitude object" (Kay, 1993b, p. 373).

In the assessment and development of computer-related curriculum, awareness of students' attitudes toward computers was an essential criterion (Woodrow, 1991). Continuous monitoring of students' attitudes toward computers could maximize the utilization of computers in education. Woodrow compared four computer attitude scales among age, gender, computer experience, computer literacy, and computer achievement. The total of sample size was 98 student teachers. A significant correlation between background variables and computers was found only in word processing experience. Age and gender were not significantly correlated with attitudes toward computers.

Additionally, student achievement was not necessarily correlated with positive attitudes in Woodrow's study.

Massoud (1991) conducted a study to examine the relationship between computer attitudes--anxiety, confidence, and liking--and some adult students' age, gender, and computer knowledge. A total of 252 adult basic education students participated in this survey. The research instruments consisted of *Participant Inventory, Computer Competence Instrument,* and *Computer Attitude Scale.* A significant relationship was found only between the computer liking subscale and age. As a whole, the adult basic education students demonstrated positive attitudes toward computers, and this attitude was significantly related to their computer knowledge. Male adult students had more positive attitudes than female students. Gender differences were found with respect to computer anxiety, confidence, and liking, but not age groups.

Leite (1994) conducted a study of 143 undergraduate students regarding their attitudes toward computers. He found that these students held positive attitudes toward computers regardless of years in school and gender. He also noticed that there was no significant attitude difference between male and female students. Metu (1994) investigated Nigerian teachers regarding their attitudes toward computers. The sample consisted of 85 teachers with ages ranging from 25 to 50. These teachers were from either elementary or secondary schools with teaching experiences from 3 to 25 years. The majority of those Nigerian teachers demonstrated positive attitudes toward computers.

Morahan-Martin, Olinsky, and Schumacher (1992) conducted a study in a small business college to investigate incoming students' computer experience and attitudes. This study involved two years--1989 and 1990. Although experience of using computers between female and male students was not easy to distinguish, interesting patterns of differences were found in multidimensional types of usage, such as games, programming, graphics, and applications in scientific applications. Male students showed more skills and had more experience in these delineated areas.

Landerholm (1995) found that 91% of kindergarten and preschool teachers (N = 250) held positive or very positive professional attitudes toward computers, and 92% held positive or very positive personal attitudes toward the computers. Hignite and Echternacht (1992) used the *Computer Attitude Scale* and the *Standardized Test of Computer Literacy* to test 83 (92% of the total population) prospective business education teachers in higher education in Missouri. The computer attitude variables were found significantly associated with computer systems. However, the selected attitude variables were not significantly correlated with computer applications.

Marcoulides (1988) claimed that a higher level of previous computer knowledge was found to be related to more positive attitudes toward computers, computer anxiety, and computer confidence. Mehlhoff and Sisler (1989) saw that positive attitudes toward computers were significantly related to the degrees of computer experience among home economics faculty. In Price and Winiecki's study (1995), positive attitudes were found among student teachers, although these were less positive than they had been a few years earlier, especially among female student teachers. Busch (1995) discovered that previous computer experience and encouragement from friends and parents were important factors in predicting computer attitudes.

Moon (1994) used the *Computer Attitude Scale* and *Computer Experience* questionnaires to test 303 Korean students about their attitudes toward computers, relating to gender and computer experience. Male students had significantly higher confidence about computers than female students. Students with more experience in word processing demonstrated more positive attitudes. Students with more experience in other software showed more computer confidence and liking. The author also found that those Korean students who had experience in data entry tended to have more positive attitudes toward computers.

Gender Role of Attitudes toward Computers

In a review of 98 instances of attitude measurements on attitudes toward computers, Kay (1992a, 1992b) summarized that females had more positive attitudes on 14 occasions, males had more positive attitudes on 48 occasions, and males and females had the same attitudes on 36 occasions. Arch and Cummins (1989) noticed that females retained lower confidence about their ability to use computers and more negative attitudes toward computers, and fewer tended to use computers than males. However, once female and male college students participated simultaneously in structured instruction on computers, there was little or no difference between females and males in terms of the use of computers, general attitudes toward computers, and confidence levels in one's skill.

Ogozalek (1989) surveyed 212 computer science students. He found that females seemed to have more confusion about and less control of computers than males. On the other hand, male students felt they had more control of computers and became more predictable as they learned more about computers. Based on surveys of 160 undergraduate students, Colley, Gale, and Harris (1994) found that male students were more likely to use computers at home, and their confidence about computer use may at least partially be attributed to their previous computer experience. The measurements of relationships between computer attitude components and home experience of female students revealed that having a brother using a computer at home increased students' confidence and lessened their computer anxiety. Results also demonstrated the same-sex modeling within families. A mother's use of a computer at home was correlated with female students' lower anxiety while a father's use of a computer at home was correlated with male students' lower anxiety. Colley, Gale, and Harris concluded that the influence of family members should be taken into account while examining the students' home experience with computers, which in turn affected students' attitudes toward computers.

Attitudinal Changes through Computer Literacy Courses

Savenye, Davidson, & Orr (1992) conducted a study to investigate whether attitudes and feelings of computer anxiety were influenced by a computer literacy class taken by a group of preserve teachers. Results of pre- and posttests of students in a computer literacy class concluded that a well designed computer literacy class could help students build up positive attitudes toward computers and reduce their degree of anxiety. Preservice teachers increased their positive attitudes toward computers through a semester long computer literacy applications class.

Savenye (1993) also conducted a study of a five-week computer applications course in a major university in the southwest to determine if the computer literacy course influenced his subjects' attitudes. A total of 75 preservice teachers participated in the study, and it appeared that they increased their positive attitudes. By the end of the course, they had experienced more confidence and less anxiety about using computers.

Okinaka (1992) investigated teacher candidates attending computer literacy classes, using five separate class sections to explore those factors which influenced students' attitudes toward computers. The selected variables included confidence about computers, interest in taking more computer courses, and intent to use computers in their classrooms. Forward multiple regression was used to analyze the data. The study found that the majority of the subjects retained their eagerness to learn computer applications, such as word processing, spreadsheets, and databases. Participants also showed interest in learning telecommunications and computer applications in the classrooms. Okinaka concluded that, according to the results, if prospective teachers knew how to use computers effectively, their positive attitudes toward computers would grow. The data supported the assumption that both comfort and interest could be enhanced during the computer literacy courses.

Hunt and Bohlin (1995) used qualitative research to investigate 88 students' attitudes toward computers and their emotions while taking computer courses. Data were collected from four sections of a three-unit course, *Educational Applications of Microcomputers*, by journal writing and interviewing. The journals were collected the fourth week of the semester and the interviews were conducted at the end of the semester. Overall, the computer course positively improved students' attitudes, and successful completion of any assignment in the classroom was the most influential factor in changing attitudes. Another factor which generated positive attitudes for students was the hands-on approach. Students felt that they needed hands-on time in addition to demonstrations. Providing students with opportunities to explore personal and professional applications was also very helpful.

Computer Anxiety

Kolehmainen (1992) defined computer anxiety as "a fear or a prejudice, which appears when one is using computer technology or when he is thinking [of] the consequences of the use" (p. 5), and he felt that it was a negative factor in learning and using computing skills. Cambre and Cook (1987) defined computer anxiety as the self experience of fear in using computers. Computer anxiety had also been described as "the fear or apprehension felt by individuals when they used computers, or when they considered the possibility of computer utilization" (Simonson, Maurer, Montag-Torardi, & Whitaker, 1987, p. 238).

When students were required to use or learn to use computers, many students demonstrated varying levels of computer anxiety (Bandalos & Benson, 1990). A computer anxiety index was developed by Simonson, Maurer, Montag-Torardi, and Whitaker (1987) and tested with normative data from 1,943 high school, college, and non-students in six states. The results from a three-part achievement test and completion of a computer anxiety index by a subset of 67 students showed significantly negative correlation. The higher scores were in the computer anxiety index, while the lower scores were in the achievement test. Thus, researchers suggested that non-anxiety attitudes toward computers were a prerequisite to acquiring computer literacy.

Marcoulides (1988) noticed that computer anxiety was a better predictor than previous experience in terms of computer achievement. Roszkowski, Devlin, Snelbecker, Aiken, and Jacobsohn (1988) found a significant relationship between computer course performance and computer anxiety. For those students who did not have a strong background of computer skills, nonprogramming computer performance seemed to be predictable by computer anxiety (Szajna, 1994). Kolehmainen (1992) conducted a study of 29 student teachers to examine changes about their computer anxiety during a computer science course. Responses to the questionnaire were gathered both at the beginning and at the end of the course. The reduction of computer anxiety was indeed found during the computer science course; the use of computers and experience with the computer equipment increased positive attitudes toward new technology.

Liu, Reed, and Phillips (1992) divided prior computer experience into four categories--none, using content-area software, using application software, and programming languages--among 914 teacher education students over four years. Results revealed a negative relationship; that is, those who had more previous computer experience felt less anxious about computers.

Concerns have been expressed regarding technophobics for females (Miller & Varma, 1994). Price and Winiechi (1995) discovered more anxieties about computers among female student teachers than among male student teachers. Results in Chen's (1986) study indicated that women had higher levels of anxiety than men. Shashaani (1993) found that female students had less self-confidence in using computers than male students. Busch (1995) claimed that female students had lower computer confidence and higher computer anxiety than male students. Colley, Gale, and Harris (1994) noticed that, in a study of 160 undergraduate students, female students had higher computer anxiety than male students.

A total of 219 young students (30 years and under) from universities or community colleges and 203 older students (55 years and over) from senior citizens centers and continuing education courses participated in Dyck and Smither's (1994) study comparing attitudes toward computers and computer anxiety between these two groups. The study showed that a high level of computer experience was correlated with a lower level of computer anxiety, but no significant difference was found between male and female students. The younger students manifested more computer confidence and more computer experience than older students. The older students demonstrated lower computer anxiety and more positive attitudes toward computers than younger students. Overall, the older students self-rated better attitudes, less anxiety, and more liking than the younger students except in computer confidence. When Dyck and Smither (1994) compared younger and older students' computer anxiety and computer experience, they found that higher levels of computer anxiety were associated with lower levels of computer experience for both younger and older students. When the computer experience was controlled, there was no significant difference between male and female students in terms of computer anxiety. Therefore, the authors assumed that some other mixed conditions might exist, and further research examining these areas was recommended.

Research findings on computer anxiety differences between females and males have been mixed. Several studies found that males had less computer anxiety, but some found that there was no difference between females and males regarding computer anxiety (e.g., Chen, 1986; Colley, Gale, & Harris, 1994; Price & Winiechi, 1995; Shashaani, 1993). Some other factors might confound the studies such as previous experience and age. In general, males had more previous computer experience than females, and younger persons had been reported to be less anxious (Maurer, 1994).

Cambre and Cook (1985) found that computer anxiety was reduced even through a short period of a computer course taken by community members. Honeyman and White (1987) found that taking a computer literacy class by teachers and school administrators did not help reduce computer anxiety for the first half of the semester but did by the end of the semester. Gristword (1985) found that students majoring in education had significantly higher computer anxiety than students majoring in business. Rosen, Sears, and Weid (1987) found that general students had significantly higher computer anxiety than computer students and business students.

Reed and Overbaugh's (1993) study included 40 psychology students in four-day module and 56 psychology students in one-day module computer technology courses. Subjects in both module instruction formats reduced their computer anxiety even though the instructional period of computer technology was short. Statistical difference was found between two categorized students, that was, those who had more experience alleviated less anxiety than those who had less experience.

Using pre- and posttests, Leso and Peck (1992) compared computer anxiety of students in two different computer courses--a tools software application (non-programming) course and a programming course--by 60 freshman and sophomore university students. The students were evenly divided, so 30 students took a tools software applications course, and 30 students took a programming course using the Pascal computer language. The pretest was completed on the first day of instruction in the microcomputer laboratory; the posttest was administered during the fourteenth week of the fifteen-week semester. Surprisingly, significant reduction of anxiety levels in pre- and posttests was not found for students in either the programming course or the tools software application course. However, students' reduction of computer anxiety in the tools software application course was significantly greater than in the programming course. This difference contradicted the common assumption that the programming course was more effective for reducing computer anxiety. The authors suggested paying more attention to tools software applications to reduce computer anxiety.

Feldman (1992) studied the computer technology perceptions and computer experience among 170 dental students (n = 68 in 1989; n = 66 in 1991; n = 36 in 1992). Over one quarter of his sample indicated that they felt anxious or afraid of using the computer. The majority of students benefited from their computer classes. The author suggested that introduction to computer courses should allow dental students to learn computer methods for dental practical management.

Moon (1994) conducted a study in Korea to investigate college students' relationships among attitudes toward computers, gender, and computer experience. The instruments contained a personal information form, *Computer Attitude Scale*, and *Computer Experience Questionnaire*. A total of 303 undergraduate students returned their questionnaires. Moon concluded that "Although the results have been conflicting and confusing, such computer-related behaviors have been considered important factors influencing successful usage of computers in the classroom" (p. 3). Pina and Harris (1994) reviewed those strategies for reducing computer anxiety and increasing confidence. They claimed that any programs including computer components should seriously consider computer anxiety and that increasing computer confidence and lessening computer anxiety should be considered as an important component in the use of computer technologies in education.

Commitment to and Need for Learning Computing Skills

Improving students' mastery of computer technologies may involve understanding what students would prefer to learn and what kinds of computer knowledge they need. Studies dealt with usefulness of computing skills, desirability of learning computing skills, and the need for learning computing skills were reviewed.

Usefulness of Computing Skills

Due to the increasingly important role of computer literacy courses in the information age, the questions of what constitutes these courses and how to reorganize them have become crucial (Amini, 1993). The rapid development in computer technology has forced business educators to reformulate curricula and to prepare students to enter the computer-literate workforce (Porter & Miller, 1985). Feldman (1992) studied computer technologies among dental students and claimed that the purpose of assessing dental students' experiences and their perceptions of computer technology was twofold: courses could be appropriately implemented and course objectives could be achieved. A longitudinal trend of computer technologies might be identified so that computer technology could be integrated into course planning. Feldman's study used two kinds of scales--the dental students' current knowledge of computers and the dental students' self-reported attitudes about computer usefulness. Students felt that computers were useful in practical management such as word processing, billing, financing, and marketing, but not very useful in managing their patients.

Based on Volet and Styles'(1992) study to examine the relationship of goals of students' stable characteristics, students' management, and performance in the first-year computer class, Volet and Styles claimed that personal goals were positively and dynamically associated with their achievements and interactions. They indicated that the goal, when taking a course, could be for either the intention of endorsement of instructional objectives or for personal interests or needs The students' goals for the course reflected subjective perceptions of study, their course requirements for a legitimate degree, and the situation in which they were studying.

Desire to Learn Computing Skills

Geissler and Horridge (1993) suggested that commitment to computer technologies must occur before actual use of computers can occur. Further, "though adoption rates vary, the reinforcement stage of acceptance indicates a commitment to gaining additional knowledge and skill in the use of innovation" (p. 349).

Corcoran and Clark (1984) conducted two phases of interviews among college faculty. A sample of 63 tenured faculty members were interviewed in the 1980-1981 phase and 66 faculty members were interviewed in phase II during 1981-1982. Based on these interviews, the researchers suggested that career commitment may be represented by the intention of investing time and efforts. Desire to learn, or willingness to make commitment to computer technologies, would be a prerequisite to help gain necessary computing skills in the information age (Mehlhoff & Sisler, 1989). Mehlhoff and Sisler examined home economics faculty's attitudes toward, current knowledge of, and commitment to computers. The population was faculty from member institutions of the Association of Administrators of Home Economics in State Universities, Land Grant Colleges and the National Council of Administrators of Home Economics. A total of 719 questionnaires were distributed and 474 (66%) questionnaires were returned. Other variables included age, gender, years of teaching experience, number of computer classes taken, computer programming experience, and home computer ownership. Higher mean scores in desired knowledge than in current knowledge among Mehlhoff and Sisler's subjects indicated that these home economics faculty members desired to learn more computer technology. The number of computer courses taken significantly influenced current computer knowledge and desirability of learning computers.

Geissler and Horridge (1993) surveyed 790 university students, assessing their current computer knowledge and their commitment to learn more about computer technologies in terms of selected demographic variables--college, year in college, age, gender, cumulative grade point average, computer courses taken, and home computer ownership. ANOVA procedures were used in data analysis, and Tukey's HSD procedure was used to identify mean differences. Results reaffirmed that computer familiarity and use were related to current level of computer knowledge and desire to learn more about computers. Those who had taken computer courses either in high school or college had higher computer knowledge and had more desire to learn about computers in most computer competency parameters. The demographic variable of computer ownership was also significant--those who owned computers at home had higher levels of computer knowledge and were more willing to learn about computers than those who did not own computers. A difference was also found among age groups. Younger students had a higher level of current computer knowledge than older students. Current computer knowledge was found to be significantly different among different colleges in the tested computer competency parameters, but commitment to learn more about computers remained the same. Those students with a GPA between 1.1 and 2.0 reported a lower level of computer knowledge than those who had a GPA between 2.1 and 3.0.

Based on the analysis of 383 returned questionnaires from a total of 465 student teachers, Kay (1990) noticed that cognitive attitude, awareness, and knowledge of application software were found to be the best predictors of commitment to the use of computers. Factors influencing the regular use of computers could be availability of hardware, software, and training; however, personal willingness was a priority factor which related to a person using the computer effectively. Other factors, though less effective, were affective attitude, locus of control, and gender. Male student teachers showed a significantly higher level of commitment to computers than female student teachers.

Volet and Styles (1992) used quantitative and qualitative methods to study students in a first-year computer class. All of the students' perceptions of their learning environments were significantly related to their commitment to what they would like to learn during the semester. However, their perceived goals were affected by different factors. A repeated factor of ANOVA revealed that the students' goals in the first-year class were significantly related to gender, program of study, and background in computing, but not to age. The relationship of age to goals was not found supportive of the previous research that mature students made stronger commitments. Male students' content-related goals were higher than female students. The group of math/computing students showed a higher level of content-related goals than those non-math/computing students.

Metu (1994) investigated the desirability of learning computer technologies among Nigerian teachers. Although those Nigerian teachers had little or no computer experience, they responded that they would like to learn necessary computer skills. Students persisted in computer-related courses because they felt computer-related courses were enjoyable and interesting and they could get help from teaching assistants (Jagacinski, Lebold & Salvendy, 1988).

Need for Learning Computing Skills

Price & Winiecki (1995) found that many students came to introductory computer classes in college with different backgrounds and attitudes from their predecessors because they might have taken computer courses in high school, or might have computer experience from job settings or at home. "Courses therefore need to be continually updated to meet the changing needs for students" (p. 21).

In 1993, Geissler and Horridge (1993) examined what current computer knowledge students at Texas Tech University had and what commitment they had toward computer knowledge. They believed that "to make computer courses relevant at the university level, it is imperative to assess the students' needs" (p. 349). Hignite and Echternacht (1992) stated assessment of business educators' computer literacy level was necessary in order to provide an appropriate educational program. They found that the mean scores of their subjects' computer literacy measured by *Standardized Test of Computer Literacy* were basically low.

In the 1980s, Ronald (1983) conducted an investigation among nursing educators to determine their current knowledge of computers and what commitment they had to learn more about computers. Results revealed that nursing educators felt they had a low level of computer knowledge, and they felt a great need to learn more about computing skills. However, they did not feel they needed to learn more about how computers function.

Shifflett et al. (1993) argued that college educators had to master basic computer knowledge and skills in order to take full advantage of the benefits of computing resources in their disciplines. Need for learning computer skills and knowledge had to be identified. They first stratified six universities from 19 campuses of the California State system from which 600 faculty members were selected to participate in the survey to determine their computing needs. The responses to questions about telecomputing were not optimistic. A total of 14% of the faculty members sampled accessed the campus mainframe only once a month and 62% of this sample had never used the campus mainframe. Only 15% had accessed computer networks such as Bitnet or Internet, 14% had used computer networks to interact with colleagues in other institutions, and 15% had used bulletin boards. This situation was pessimistic since a large amount of useful information existed on the computer network, according to Shifflett et al. The survey summarized that the college educators needed: (a) to have more release time to learn computer skills, (b) to attend computer workshops, (c) to have a computer available in each office, and (d) to have individual tutoring. The college educators needed more help to integrate the potential benefits of computers into their disciplines and to upgrade their computing skills.

Karasz (1991) suggested that there should be a necessity to measure students' computer knowledge in computer literacy classes. If students were computer literate, the decision had to be made either to upgrade the level of the computer literacy courses or to supplement them. Karasz conducted a study in a midwest university to examine the relationships between the students' previous computer experience and/or computer courses taken and achievement in pre- and posttests. Results revealed that information from previous computer courses in high school was irrelevant to the subjects' achievement. Computer experience either from work or at home seemed to strengthen the subjects' recall of information from their experience, and thus their pre- and posttest scores were higher. However, the gain scores from ANOVA did not demonstrate statistically significant differences among students with different computer backgrounds.

Amini (1993) studied 123 undergraduate non-MIS (Management Information System) business students to determine how these students perceived their computer literacy and what factors influenced their perceptions. Analysis of data showed that gender, prior computer knowledge, and familiarity with spreadsheets were factors which were significantly associated with self-perceived computer literacy. Logistic regression results also revealed that the variables of ownership of computers at home and frequent use of word processing were contributing factors to acquisition of computer literacy. Finally, students learned computer applications of spreadsheets and database faster after entering school than those applications at advanced levels such as programming, communication, and graphics.

Price and Winiecki (1995) stated that although there were some changes in college introductory computer courses, students still lacked the necessary knowledge to use computers efficiently as prospective teachers. They surveyed 576 students taking an introductory computer course in the Fall, 1994 at Texas Tech University. The information provided by the survey indicated that the majority (91%) of these students believed that they would need or wished to use a computer. Most students looked at computers as friends (74%), as a savior (70%), or for pleasure (60%). Price and Winiechi pointed out that students who had taken computer courses would tend to use computers more frequently and would be more likely to look at computers as a hobby rather than as work. Students who had taken computer courses were more likely to use computers regularly in the future. Male students were more likely to believe in computer usefulness than female students. Younger students were more likely to perceive the computer as a "threatening" device than older students.

Tannenbaum and Rahn (1985) found that since undergraduates majoring in the humanities and social sciences had recognized computer applications as the trend of future job markets, they wanted to be computer literate and well prepared for prospective professions. The needs for computer literacy among students in the humanities and social sciences were based on three reasons: (a) awareness of increasing demands of computing skills in our society, (b) recognition of current inadequate computer skills, and (c) understanding computer skills as major factors for the basic knowledge in these disciplines. Tannenbaum and Rahn further suggested that students in humanities and social sciences need to acquire the following computer knowledge at entry levels: (a) history of computers, (b) computer hardware and software, (c) applications for the areas in humanities and social sciences, (d) understanding of positive and negative social impact of computers, (e) ability to program in the student's field, and (f) ability to use ready-to-run software in the student's field.

Kay (1993a) surveyed 647 preservice teachers to assess their computer abilities in terms of software, awareness, programming skills, and perceived control. Each of these four subclasses contained 7-point Likert items, ranging from extremely low to extremely high, or ranging strongly disagree to strongly agree. Four principal components--cognitive attitudes, affective attitudes, programming skills and applied software ability--were all demonstrated as class use of computers. Results revealed that the four subclasses, though independent, could be used together for a total computer ability score. The high ability score was found to be significantly related to mathematical ability and computer attitudes. Programming skills were barely related to attitudes scores, and software was moderately related to awareness of computers in society. Thus, awareness and applied skills rather than programming skills were emphasized to improve attitudes toward computers. In other words, preservice teachers who had positive attitudes toward computers would be more likely to teach computer awareness and applied skills rather than programming skills.

Erion and Moeller (1991) surveyed 159 education students to examine what topics they would like to cover in college computer literacy classes as well as 47 superintendents and 43 high school and junior high school principals to discover how much importance was placed on computer skills when making hiring decisions and how much emphasis college computer literacy courses should have. The same questionnaires were also sent to experienced teachers who had once worked with student teachers. Responses varied from education students, school administrators, and teachers who had worked with student teachers. Some indicated that education students should not be exposed to certain knowledge, and others specified some of the software programs the education students should learn. Some teachers placed emphasis on the needs for a knowledge of different two computer systems, even in a small district. Education students reported that they hoped the computer literacy course would reduce computer-related anxiety. In sum, education students did not perceive programming skills as important, but they felt computer literacy courses would meet their needs in the use of computers as instructional and management tools.

Brown and Kester (1993) surveyed 193 college students to determine their computer competencies. Nearly half of the students had taken computer courses in high school or in college, or had worked with a computer at home or on the job. They found that students forgot what they had learned previously, such as DOS or BASIC. Few students still remembered multimedia applications. What they had not forgotten were the computing skills they were continuing to use, such as WordPerfect and Word. They concluded that students should start working with computers earlier, as soon as computers were available to them. Pull-down menu or icon-driven programs such as those in the Windows programs were recommended for students to use. The authors did not recommend that students learn programs such as DOS or LOGO and encouraged students to practice their computer skills across the campus or they would forget what they had learned. Researchers also recommended that further studies of carryover value from high school to college were needed.

Ransom and Swearingen (1990) investigated elementary education students in terms of need for learning computing skills in their computer literacy classes. The results showed that all students demonstrated their needs for computer knowledge for their future career. They indicated that hands-on materials and applications for classroom use were most beneficial in their college computer literacy courses.

In debating the conflict of computer applications and programming, Yoder and Moursund (1993) argued that programming and computer science should be included in a teacher education program. They suggested that computer programming and applications should emphasize an understanding of the fundamental basics so students could develop problem solving skills in a computing environment. Furthermore, procedures and procedural thinking were essential in meeting teachers' needs. Leso and Peck (1992) advocated that tool software applications should be considered before introducing programming courses to students who were attending entry level computer science courses. McKeown (1988) agreed that programming was not necessary and that the ability to work with various hardware, to be familiar with educational software, and to manipulate needed data would be more productive for education students.

Morahan-Martin, Olinsky, and Schumacher (1992) studied incoming undergraduate students' gender difference in computer experience and their attitudes toward computers in 1989 and 1990. In 1989, 161 male students and 157 female students participated in the study. In 1990, 165 male students and 136 female students completed the survey. The conclusion of their study indicated that female students felt that computing skills would be useful in their future careers, but male students felt that the computer skills they learned at school would be useful only for those jobs directly related to computers. These authors further found that male students were more willing to purchase computers than female students.

In dealing with the issues of what chemistry students should learn about computing, Swift and Zielinski (1995) suggested that educators should provide environments in which students could use hardware and software to learn problem-solving and to study chemical problems. Simply teaching students how to follow steps and press buttons would not be sufficient. Educators must convert learning and practice through computing skills into concepts and ideas which the students would link to their real lives in the future.

Computer literacy courses were commonly required in all college curricula. However, Lee, Pliskin, and Kahn (1994) indicated that diversity of students' background was sometimes a reason why some instructors of computer literacy courses were unsuccessful. Lee, Pliskin, and Kahn studied a sample of 140 undergraduate students. Results revealed that many students had actually never had a computer course in high school. Further, the contents and levels of computer courses were different from those taken in high school. These findings reaffirmed a previous study that computer courses from high school had no effect on college computer literacy courses (e.g., Karasz, 1991). The "middle-of-the-road" computer literacy course could not meet the needs of students with different backgrounds. "Educational institutions should thus give serious thought to groupings in computer literacy courses in accordance with the student's abilities and expectations" (Lee, Pliskin, & Kahn, 1994, p. 73). In the same study, Lee, Pliskin, and Kahn also found that students' SAT scores, high school rank, computer use at work, and prior knowledge of programming might be considered in customizing the content and pace of computer literacy courses to the diverse students' needs.

Summary

The expanding body of literature on computer self-efficacy has demonstrated its influential effects in improving students' and faculty's learning computer technologies and use of computers effectively. Supporting evidence showed that computer self-efficacy could be used as a significant predictor of computer adoption.

Another aspect of crucial constructs, attitudes toward computers, has also been discovered to be of equal importance. Social scientists believed that attitudes toward computers affected the learning about and use of computers. The research findings confirmed this assumption. Attitudes toward computers was a significant predictor of self-efficacy in learning computer technologies. Research evidence also showed that attitudes toward computers could be affected by other attributes such as gender, anxiety, computer experience, and instruction on computer technologies.

Review of the literature showed that desirability and need for learning computing skills were a motivation for a person to learn computer skills. However, the research findings about university students' perceived needs and desire to learn computer technologies varied and commitment to computer technologies was based on the levels of their desire and need for learning computer skills. Desire to learn, or willingness to make commitment to computer technologies, would be a prerequisite to help obtain necessary computer skills in the information age.

This current study explored the relationships of computer self-efficacy, attitudes toward computers, and students' desire and need for learning computer skills. Chapter Three describes methodology with specific discussion of description of the study design, participants, instrument, data collection, and statistical procedures.

CHAPTER THREE

METHODOLOGY

This study examined relationships among computer efficacy, attitudes toward computers, and the desirability and need for learning computing skills in groups of undergraduate students in business, computer science, education (computer classes), and health and physical education (non-computer class) at a regional university in the Southwest in 1996. Description of the study design, participants, instrument, data collection, and statistical procedures used in data analysis are described in this chapter.

Description of the Study Design

This study utilized a cross-sectional survey with two different groups of university students. Data collection in a cross-sectional survey is, as described by McMillan (1992), that "information is collected from one or more samples or populations at one time" (p. 157). In educational research, surveys have been utilized in research design to compare groups (Tuckman, 1994). Borg and Gall (1989) proposed that "survey research utilize a variety of instruments and methods to study relationships, . . . and comparison of groups" (p. 417). The current study was to investigate the relationships among computer self-efficacy, attitudes toward computers, and desirability and need for learning computing skills between students from three computer classes and students from a non-computer class. The instrument used in this study was *Computer Technologies Survey*, which consisted of three parts--*Background Information, Attitudes toward Computer Technologies* and *Confidence and Desired Knowledge with Computer Technologies.*

This study examined five factors from the subjects: (a) computer attitudes (comfort/anxiety and usefulness), (b) computer self-efficacy (beginning computer skills, advanced computer skills, and telecomputing), (c) desirability of learning computer technologies, (d) need for learning computer skills, and (e) demographic characteristics (computer and non-computer classes).

Participants

Students participating in this study were from three computer classes and one non-computer class in the spring of 1996. Computer classes were from the departments of Computer Science and Information Systems, Secondary and Higher Education, and General Business and Systems Management. The non-computer class was from the department of Health and Physical Education. All students enrolled in these four classes were initially included in the study.

A total of 296 subjects completed the questionnaires in their classrooms on a voluntary basis. Questionnaires with any missing responses, or questionnaires from students who were taking two or more of these four classes at the same time, were eliminated to avoid confounding variables. The resulting sample size was 220 students. Table 3-1 provides a description of the students' ages, gender, ethnic status, and current status.

Table 3-1

Physical Characteristics of Students

Age Group	Number	%
19 or less	74	33.64
20-24	95	41.18
25 or above	51	23.18
Total	220	100.

Gender	Number	%
Male	95	43.18
Female	125	56.82
Total	220	100.

Ethnic Status	Number	%
African-American	36	16.36
Caucasian	164	74.55
Hispanic	8	3.64
Native American	5	2.27
Asian/Pacific Island	2	.91
Other	5	2.27
Total	220	100.

Current Status	Number	%
Freshman	80	36.36
Sophomore	71	32.27
Junior	44	20.00
Senior	19	8.64
Other	6	2.73
Total	220	100.

Age distribution was divided among the three categories, with no one majority group. Although there were more students in the 20 to 24 age range, one-third were below that, and almost one-fourth were older.

Female students were in the majority. However, there were only 30 (13.64%) more female students than male students.

Students were from varied ethnic backgrounds. Students with Caucasian background were dominant at almost 75% of the student sample size. African-American students ranked second. The remaining ethnic groups made up less than 10% of the student sample.

Students represented all undergraduate classifications. The majority of the students were freshmen. Sophomores ranked second, and juniors ranked third. Other student category was made up of non-degree students.

Students were asked how many computer courses, including any current ones, they had taken from high school, the university, or other places. Table 3-2 presents the information about students' computer ownership, use frequency, and computer preference.

Table 3-2

Computer Characteristics of Students

Computer Courses Taken	Number	%
0	2	0.01
1	28	12.73
2	91	41.36
3	68	30.91
4 or above	31	14.09
Total	220	100.

Computer Ownership	Number	%
Students who owned a computer	116	52.73
Students who did not own a computer	104	47.27
Total	220	100.

Computer Use Frequency	Number	%
Never	5	2.27
At least once a year	14	6.36
At least once a month	49	22.27
At least once a week	96	43.64
Daily	56	25.45
Total	220	100.

Computer Preference	Number	%
Macintosh	23	10.45
IBM or Compatibles	113	51.36
Mainframe	13	5.91
No Preference	71	32.27
Total	220	100.

Only two of 220 subjects had never taken, and were not now taking, any computer courses. The majority (86.36%) had taken more than one computer course, including any in which they were currently enrolled.

Many students owned computers. The distribution of students' ownership of computers was almost even. Slightly more than half the students had computers, and slightly under half did not have computers.

Students were asked how often they used computers. The majority of students used computers at least once a week. This number was the largest among the five groups presented in Table 3-2.

Multiple computing platforms were used by students. The majority of students preferred to use IBM computers or IBM compatibles. However, the second highest choice indicated that many students had no preference for specific types of computers, with only 10% preferring Macintosh..

Students were also asked where they used computers. Their responses are indicated in Table 3-3.

Table 3-3

Students' Use Settings

Use Settings	Number	%
University Computer Lab	67	30.45
Dormitory or Resident Hall	20	9.09
Job Settings	44	20.00
Home	79	35.91
Other	10	4.55
Total	220	100.

No one location was used by a majority of students. Although the largest group used computers at home, many used them in job settings and less 10% used computers in their dormitory or resident hall.

Instrument

The current study used *Computer Technologies Survey* as an instrument. *Computer Technologies Survey* was a product, combined from two instruments: *Attitudes toward Computer Technologies* (ACT) (Delcourt & Kinzie, 1993) and *Confidence and Desired Knowledge with Computer Technologies* (CDK) (Murphy, Coover, & Owen, 1989), by the researcher of the current study. *Computer Technologies Survey* consisted of three parts. Part one contained the modified demographic items from *ACT*; part two included attitude items from *ACT*; and part three asked for responses to the items of computer self-efficacy, desirability, and need for learning computing skills from *CDK*.

Developed by Delcourt and Kinzie (1993), *Attitudes toward Computer Technologies* (*ACT*) contains three factors consisting of 19 items--computer/anxiety, positive usefulness, and negative usefulness. In the process of developing the *ACT*, Delcourt and Kinzie invited 17 experts to examine the initial instrument. Based on the information provided by these experts, revisions were made. Delcourt and Kinzie (1993), in a study of 328 undergraduate and graduate students enrolled in education courses at six universities, reported that the ranges from varimax rotation for construct validity in the factors were .50 to .85 (Comfort/Anxiety); .61 to .74 (Usefulness: positively phrased, specific content); and .50 to .76 (Usefulness: negatively phrased, general content). The reliability coefficients for individual scales were .90 (Comfort/Anxiety) and .83 (Usefulness). Results from another study of 359 undergraduate students (Kinzie, Delcourt, & Powers, 1994) showed similar construct validity and reliability. Items reflected "Comfort/Anxiety" as Factor 1 loaded between .66 and .82. Loadings for items related to "Usefulness" for Factor 2 ranged from .42 to .74; and for Factor 3, ranged from .40 to .75. The reliability coefficients were .91 for "Comfort/Anxiety; and .85 for "Usefulness". The alpha estimate of .91 was obtained for the total 19-item scale.

Based on a review of the literature and an in-depth analysis of graduate students and practicing teaching professionals, Murphy, Coover, & Owen (1989) developed the *Confidence and Desired Knowledge with Computer Technologies* (*CDK*), which was evaluated by a panel of five experts. The experts reviewed the difficulty levels, contents of the items, and comprehensiveness of the initial instrument, which finally employed 32 items, representing three principal components--"Beginning Level Computer Skills," "Advanced Level Computer Skills", and "Mainframe Computer Skills". Principal factor analysis with oblique rotation in the CDK produced the following results: first factor with loading ranging from .52 to .91; second factor with loading ranging from .35 to .99; and third factor with loading ranging from .83 to .88. The internal consistency reliability coefficients for individual factors were .97, .96, and .92, respectively. In 1992, Harrison and Rainer argued that, "While . . . organizations can use such survey instruments to identify these phenomena to target training needs, the psychometric properties of any instrument should be thoroughly examined prior to use" (p. 735). They re-examined the factor structures and concurrent validities for the *CDK* by sampling 693 university personnel. The outcome replicated the factor structure found by Murphy et al. (1989).

In consultation with the original author (S.V. Owen, personal communication, October 30, 1995), three items related to telecomputing in *Self-Efficacy for Computer Technologies* (Kinzie, Delcourt, & Powers, 1994) were selected and added to the *Computer Technologies Survey.* One item in the subscale of "Beginning Computer Skills" was changed and moved to the subscale of "telecomputing" for a more appropriate title. One of the factor names--"Mainframe Computer Skills" was changed to "Telecomputing." The original author (S.V. Owen, personal communication, October 21, 1995) also agreed with the researcher of the current study that the *CDK* could be used to gauge the levels of desirability and need for learning computing skills.

Ronald (1983) designed an instrument to determine current computer knowledge and desired computer knowledge, in which each item contained two scales, from zero to four respectively. The scale on the left side of the item measured the respondent's current perceived computer knowledge, and the one on the right side of the item measured the desired knowledge--the knowledge the respondent would like to have. The same structure with two sets of scales in one instrument to test present computer knowledge and desirability of learning computer technologies was successively used in studies by Mehlhoff and Sisler (1989) and Geissler and Horridge (1993). This method also had been used in the *CDK* by the original author (S.V. Owen, personal communication, October 21, 1995). In the current study, *Computer Technologies Survey* adopted this structure to measure desirability and need for learning computing skills by the *CDK*. For the purpose of this study, *need for learning computing skills* followed Geissler and Horridge's (1993) method of subtracting the respondents' confidence level from the right side of the items, *desirability of learning computing skills*.

A review panel, consisting of seven computer-using educators, examined *Computer Technologies Survey* to be used in this study. When more than 50% of the panel indicated that an item or description was not clear or appropriate, adjustments were made.

Cronbach alpha (Cronbach, 1951) was used to evaluate the internal consistency reliability for *Confidence and Desired Knowledge with Computer Technology* (*CDK*), and *Attitudes toward Computer Technology* (*ACT*), as well as for newly created variables for this study--desirability of learning computing skills and need for learning computing skills. An internal consistency reliability (alpha) estimate of .96 was obtained for the entire 35-item *CDK*. The reliability estimates for the subscales were .93 (Self-Efficacy of Beginning Computer Skills), .91 (Self-Efficacy of Advanced Computer Skills), and .91 (Self-Efficacy of Telecomputing). An internal consistency reliability estimate of .86 was obtained for the entire 19-item *ACT*. The alpha reliabilities derived for subscales Comfort/Anxiety and Usefulness were .86 and .82 respectively.

A reliability alpha estimate of .98 was obtained for the entire 35 items of desirability of learning computing skills. The reliability estimates for subscales were .97 (Beginning Computing Skills), .96 (Advanced Computing Skills), and .93 (Telecomputing). The alpha reliabilities for the three subscales of need for learning computing skills were .95 (Beginning Computing Skills), .94 (Advanced Computing Skills), and .91 (Telecomputing) respectively. An internal consistency alpha estimate of .97 was obtained for the entire 35 items of need for learning computing skills.

The internal reliability coefficients represented compatible results with those in Murphy, Coover, and Owen's (1989) and Delcourt and Kinzie's (1993) tests. Therefore, the reliability of measurements are appropriate for the matter of validity in this study.

Data Collection

The focus of this study was an examination of the relationships among computer self-efficacy, attitudes toward computers, and desirability and need for learning computing skills among undergraduate students from three computer classes and one none-computer class. Computer classes were from the departments of Computer Science and Information Systems, Secondary and Higher Education, and General Business and Systems Management. The non-computer class was from the department of Health and Physical Education. Attention was also given to the comparisons of desirability and need for learning computing skills between computer class group and a non-computer group.

Balian (1988) compared five data collection methods--captive group, in-person, phone, mail, and computer voice. He noted that captive group data collection was excellent in terms of accuracy of data. The "Captive Group" is a method of collecting data, in which a researcher collected data among a group of people. This method was used for the current study to gather data in January, 1996, in all four classes, so that the commonalties of exposure to individual courses among the different samples were kept at maximum. The same person--the researcher of this study--contacted each involved instructor through the department heads to obtain permissions and to schedule the time to go to each classroom to collect data. To insure consistency, the researcher went to each class to administer the instrument. The nature of the survey was explained, emphasizing the confidentiality of data, and students was told that participation was voluntary but was greatly appreciated. Each student was given one copy of the instrument--*Computer Technologies Survey*--in the classroom. The total time for the completion of the questionnaire was approximately 12 minutes. The researcher collected the completed questionnaires in the classrooms.

Statistical Procedures

Questionnaires were collected from all students in three computer classes and a non-computer class; however, questionnaires from those students who were currently enrolled in more than one of these four classes were eliminated. Instruments with any blanks were also discarded.

The Pearson product-moment correlation technique was used to identify significant correlations among all variables. If significant correlations were noted, multiple regressions were employed to analyze data for the first five hypotheses, examining those predictive effects. Criterion and predictor variables depended on specific questions described in the Hypotheses. Table 3-4 shows the multiple regression equations which were applied to Hypothesis One through Hypothesis Five:

Table 3-4

Multiple Equations Applied to Each Hypothesis One through Five

	Y=	a +	b_1x_1+	b_2x_2+	b_3x_3
Hypothesis 1	sum score of self-efficacy	a+	comfort/anxiety	usefulness	
Hypothesis 2	sum score of desirability of learning	a+	comfort/anxiety	usefulness	
Hypothesis 3	sum score of desirability of learning	a+	beginning computer skills	advanced computer skills	tele-computing
Hypothesis 4	sum score of need	a+	comfort/anxiety	usefulness	
Hypothesis 5	sum score of need	a+	beginning computer skills	advanced computer skills	tele-computing

Note. Y denotes a criterion variable, and a an intercept constant.

One-way analysis of variance (ANOVA) was utilized to test Hypothesis Six and Hypothesis Seven to determine if there were significant differences between students in computer classes and a non-computer class regarding perception of desirability of learning and need for learning computing skills. When significant differences were found, Tukey post hoc analysis was utilized to determine which groups were different.

Summary

This chapter has described the methods of procedure in detail, including description of the study design, participants, instrument, data collection, and statistical procedures used in data analysis. Chapter Four presents the analysis of data.

CHAPTER FOUR

ANALYSIS OF DATA

This study investigated the relationships among computer self-efficacy, attitudes toward computers, and desirability and need for learning computing skills at three levels--beginning computing skills, advanced computing skills, and telecomputing--among two groups of college students in four classes. To avoid confounding variables, any students who were members of more than one of these four classes were excluded from the analysis. Questionnaires with any blanks were also discarded. Evaluation of statistical assumptions was carried out prior to running the data.

A total of 296 subjects participated in this study. These students were enrolled in the three computer classes from the departments of Computer Science and Information Systems, Secondary and Higher Education, and General Business and Systems Management, and in one non-computer class from the department of Health and Physical Education. Three computer classes were basic computer literacy classes, introducing computer knowledge for their respective departments. The non-computer class, a fundamental course of kinesiology, did not involve any computer activities unless students engaged in computer activities themselves beyond class time. This class was used as a control group.

Screening Data

Initial sorting data eliminated 76 (26%) unusable questionnaires with 220 (74%) usable cases for the final data analysis. The questionnaires eliminated included: (a) students who were enrolled in more than one of these four classes, (b) multiple selections in the place where only one choice was expected, and (c) missing data. The usable data were from 47 computer science students, 50 education students and 90 general business students in three computer classes, and from 33 physical education students in the non-computer class.

Frequency distributions were developed to check the distributions of variables. The ratio of cases to independent variables was well above the minimum requirement for regression analyses (Tabachnick & Fidell, 1996). No multivariate outliers and missing cases existed in the data set.

All scores obtained from negatively phrased items were reversed for ease in reporting of data. All scores contained positive connotations with higher scores denoting "more," "higher," or " stronger," and lower scores denoting "less," "lower," or "weaker." Table 4-1 describes the abbreviations and meanings of eight variables used in the analysis.

Table 4-1

Eight Variables Used in Analysis

Variable	Meaning
CONFISUM	sum scores of computer self-efficacy
COMFANXI	attitude toward computers--comfort/anxiety
USEFULNE	attitude toward computers--usefulness
DESIRSUM	sum scores of desirability of learning computing skills
CONFIDE1	confidence level of beginning computing skills
CONFIDE2	confidence level of advanced level of computing skills
CONFIDE3	confidence level of telecomputing
NEEDSUM	sum scores of need for learning computing skills

Hypothesis One

Hypothesis One stated that there would be no statistically significant predictive effect of attitudes toward computers on computer self-efficacy. Bivariate correlations among eight selected variables were calculated. Table 4-2 shows that eight variables were significantly correlated.

Table 4-2

Intercorrelations between Subscales for All Students

	1	2	3	4	5	6	7	8
			Students	(n = 220)				
1 CONFISUM	–	.65*	.18*	-.10	.90*	.92*	.78*	-.73*
2 COMFANXI		–	.38*	.04	.65*	.58*	.41*	-.40*
3 USEFULNE			–	.37*	.24*	.10	.12*	.14*
4 DESIRSUM				–	-.03	-.16*	-.09	.75*
5 CONFIDE1					–	.72*	.52*	-.61*
6 CONFIDE2						–	.66*	-.72*
7 CONFIDE3							–	-.58*
8 NEEDSUM								–

*$p < .05$.

The correlation coefficients presented in Table 4-2 provide information for performing multiple regression analyses. Multiple regression was performed for Hypothesis One through Hypothesis Five.

Analysis of the subscales of attitudes toward computers in the multiple regression (Table 4-3) revealed that the independent variable Comfort/Anxiety contributed significantly to the prediction of computer self-efficacy (CONFISUM = 31.36 + 3.14 COMFANXI). The correlation coefficient between CONFISUM and USEFULNE was +.18, ($p < .05$). Although the bivariate correlation between CONFISUM and USEFULNE was significant, the correlation coefficient was low Table 4-2). Table 4-3 shows details.

Table 4-3

Summary of Simultaneous Regression Analysis for Variables Predicting Computer Self-Efficacy (N = 220)

Variable	B	SE B	β
Comfort/Anxiety	3.14	.26	.68*
Usefulness	-.29	.23	-.07

Note. $R = .65$; $R^2 = .43$.
*$p < .05$.

Multiple regression was used to test predictive effects of two variables of computer attitudes—Comfort/Anxiety and Usefulness--toward computer on computer self-efficacy. This analysis revealed that R for regression was significantly different from zero, $F(2, 217) = 80.56$, $p < .05$, with a determinant of coefficient of .43. Analysis of data showed that there was a significantly combined predictive effect of attitudes toward computers on computer self-efficacy. Therefore, Hypothesis One was rejected.

Hypothesis Two

Hypothesis Two stated that there would be no statistically significant predictive effect of attitudes toward computers on the desirability of learning computing skills. Analysis of the subscales of attitudes toward computers in the multiple regression (Table 4-4) revealed that the independent variable Usefulness contributed significantly to the prediction of computer desirability of learning computing skills (DESIRSUM = 70.07 + 1.80USEFULNE). The correlation coefficient between variable desirability of learning computing skills and variable Comfort/Anxiety was medial (Table 4-2). Table 4-4 shows details of multiple regression analysis.

Table 4-4

Summary of Simultaneous Regression Analysis for Variables Predicting Desirability of Learning Computer Skills (N = 220)

Variable	B	SE B	β
Usefulness	1.80	.29	.42*

Note. $R = .39$; $R^2 = .15$.
*$p < .05$.

The result of multiple regression revealed that R for regression was significantly different from zero, $F(2, 217) = 19.41$ ($p < .05$). Analysis of data showed that there was a significantly combined predictive effect of computer attitudes toward computers on desirability of learning computing skills. Therefore, Hypothesis Two was rejected.

Hypothesis Three

Hypothesis Three stated that there would be no statistically significant predictive effect of computer self-efficacy on the desirability of learning computing skills. Analysis of the subscales of attitudes toward computers in the multiple regression (Table 4-5) revealed that the independent variable Advanced Computer Skills contributed significantly to the prediction of desirability of learning computing skills (DESIRSUM = 126.99 -.77 CONFIDE2). This finding was consistent with the bivariate correlations shown in Table 4-2. Table 4-5 shows details of multiple regression analysis.

Table 4-5

Summary of Simultaneous Regression Analysis for Variables Predicting Desirability of Learning Computer Skills (N = 220)

Variable	B	SE B	β
Advanced Computer Skills	-.77	.28	-.30**

Note. $R = .20$; $R^2 = .04$.
*$p < .05$.

The result of multiple regression revealed that R for regression was significantly different from zero, $F(2, 216) = 3.15$, $p < .05$. Analysis of data showed that there was a significantly combined predictive effect of computer self-efficacy on desirability of learning computing skills. Therefore, Hypothesis Three was rejected.

Hypothesis Four

Hypothesis Four stated that there would be no statistically significant predictive effect of attitudes toward computers on the need for learning computing skills. The linear regression analysis (Table 4-6) demonstrated a statistically significant predictive effect of attitudes toward computers on the students' need for learning computing skills. The regression model indicated that if a student had a lower score of COMFANXI and a higher score of USEFULNE, the student would have a higher score of need for learning computing skills. Table 4-6 shows details of multiple regression analysis.

Table 4-6

Summary of Simultaneous Regression Analysis for Variables Predicting Need for Learning Computing Skills (N = 220)

Variable	B	SE B	β
Comfort/Anxiety	-3.70	.44	-.53*
Usefulness	2.09	.40	.33*

Note. $R = .51$; $R^2 = .26$.
*$p < .05$.

The predictive model in this multiple regression was NEEDSUM = 38.71 -3.70(COMFANXI) + 2.09(USEFULNE). Both subscales of attitudes toward computers, Comfort/anxiety and Usefulness, contributed significantly to the prediction of the need for learning computing skills. R for regression was significantly different from zero, $F(2, 217) = 37.20$, $p < .05$. Therefore, Hypothesis Four was rejected.

Hypothesis Five

Hypothesis Five stated that there would be no statistically significant predictive effect of computer self-efficacy on the need for learning computing skills. The multiple regression analysis (Table 4-7) showed that computer self-efficacy of beginning computer skills, advanced computer skills and telecomputing contributed significantly to the prediction of the need for learning computing skills (NEEDSUM = 126.99 - .58CONFIDE1 -1.77CONFIDE2 -.94CONFIDE3). Table 4-7 shows details of multiple regression analysis.

Table 4-7

Summary of Simultaneous Regression Analysis for Variables Predicting Need for Learning Computing Skills (N = 220)

Variable	B	SE B	β
Beginning Computer Skills	-.58	.22	-.18*
Advanced Computer Skills	-1.77	.28	-.48*
Telecomputing	-.94	.34	-.17*

Note. R = .74; R^2 = .55.
*$p < .05$

Analysis of the independent variables in multiple regression revealed that computer self-efficacy of Beginning Computer Skills, Advanced Computer Skills, and Telecomputing had significant effects on the students' need for learning computing skills. Comparing the regression coefficients, computer self-efficacy of Advanced Computer Skills contributed the strongest prediction in the equation. The result of multiple regression revealed that R for regression was significantly different from zero, $F(3, 216) = 87.15$, $p < .05$. Therefore, Hypothesis Five was rejected.

Hypothesis Six

Hypothesis Six stated that there would be no statistically significant differences between students in computer and non-computer classes regarding the desirability of learning computing skills. Table 4-8 shows details of multiple regression analysis.

Table 4-8

Means and Standard Deviations of Desirability of Learning Computing Skills by All Students

	Means	Standard Deviations	Minimum	Maximum
Computer Science	123.06	16.15	87.00	140.00
Education	123.58	17.74	62.00	140.00
General Business	125.24	15.66	86.00	140.00
Physical Education	107.06	22.37	58.00	140.00

$F(3, 216) = 9.34, p < .05$.*

* A significant difference was found

This indicated that computer science, education, and general business students (computer classes group) were significantly different from physical education students (non-computer class group).

Multiple comparison illustrated that the computer classes group indicated stronger desirability of learning computer skills (means = 123.06, 123.58, and 125.24) than the non-computer class group (mean = 107.06). Results of Tukey post hoc showed a significant difference between the two groups of students, $F(3, 216) = 9.34$, $p < .05$. Therefore, Hypothesis Six was rejected.

Hypothesis Seven

Hypothesis Seven stated that there would be no statistically significant differences between students in computer and non-computer classes regarding the need for learning computing skills. To evaluate this hypothesis, one-way ANOVA (Table 4-9) was used to analyze the variances of the sum scores of need for learning computing skills among four classes of students.

Table 4-9

Means and Standard Deviations of Need for Learning Computing Skills by All Students

	Means	Standard Deviations	Minimum	Maximum
Computer Science	30.72	26.96	-49.00	102.00
Education	35.96	24.21	-61.00	71.00
General Business	31.49	26.48	-25.00	100.00
Physical Education	11.61	24.02	-46.00	46.00
				$F(3, 216) = 6.58, p < .05$.*

* A significant difference was found.

This indicated that computer science, education, and general business students (computer classes group) were significantly different from physical education students (non-computer class group).

Results of Tukey post hoc showed a significant difference between the two groups of students (computer classes and a non-computer class), $F(3, 216) = 6.58$, $p < .05$. Therefore, Hypothesis Seven was rejected.

The result of Tukey post hoc analysis further illustrated that education and general business students in computer classes expressed more need of beginning computer skills than the physical education students from the non-computer class. The post hoc analysis also revealed that computer science students expressed more need for learning advanced computing skills and telecomputing than the physical education students.

Summary

Chapter Four has presented data regarding: (a) predictive effect of attitudes toward computers on computer self-efficacy, (b) predictive effect of attitudes toward computers on desirability of learning computing skills, (c) predictive effect of computer self-efficacy on desirability of learning computing skills, (d) predictive effect of attitudes toward computers on need for learning computing skills, and (e) predictive effect of computer self-efficacy on need for learning computing skills. Data also illustrated comparisons of desirability of learning computing skills and need for learning computing skills between computer and non-computer classes.

Predictive effects have been identified by multiple regression analyses. Significant differences between the students in computer classes and the non-computer class in terms of desirability of learning computing skills and need for learning computing skills have been identified by analysis of variance. Chapter Five presents summary, findings, conclusions, implications, and recommendations for further research.

CHAPTER FIVE

SUMMARY, FINDINGS, CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS FOR FURTHER RESEARCH

Chapter Five consists of five sections. This chapter commences with a summary of the study followed by the findings and conclusions. Based on those findings and conclusions, implications for practice in the area of computer education for university instructors and students, and recommendations for additional study are offered.

Summary

This study investigated the predictive effects of university undergraduate students' attitudes toward computers on their computer self-efficacy, which has been considered a crucial factor in computer education for university students (e.g., Delcourt & Kinzie, 1993). Further considerations included two aspects of computer education--desirability of learning computing skills and the need for learning computer skills--by two predictive attributes--attitudes toward computers and computer self-efficacy. The study also examined differences regarding the desirability of and need for learning computing skills between university students in computer and non-computer classes.

The subjects for the study were undergraduate students from four different undergraduate classes. Three were computer classes from the departments of Computer Science and Information Systems, Secondary and Higher Education, General Business and Systems Management, and one was a non-computer class from the Department of Health and Physical Education. The questionnaires of *Computer Technologies Survey*, the instrument of this study, which consisted of *Attitudes toward Computer Technologies*, *Confidence and Desired Knowledge with Computer Technologies* and demographic information were distributed to students for data collection. The questionnaires were collected on site by the researcher. Any incomplete questionnaires or questionnaires filled out by students who were enrolled in more than one of these four classes were discarded. A total of 220 questionnaires were analyzed. Statistical techniques included three domains: (a) screening data, (b) bivariate correlation and simultaneous multiple regression, and (c) one-way ANOVA and Tukey's Honestly Significant Difference. Analysis of data led to the following: (a) findings, (b) conclusions, (c) implications, and (d) recommendations for further research.

Findings

Hypothesis One stated that there would be no statistically significant predictive effect of attitudes toward computers on computer self-efficacy. By using the Pearson product-moment, bivariate relationships among eight variables which were used in this study were identified.

Computer Self-Efficacy was significantly correlated with: (a) computer attitude - Comfort/Anxiety, (b) computer attitude - Usefulness, (c) self-efficacy - Beginning Computer Skills, (d) self-efficacy - Advanced Computer Skills, (e) self-efficacy - Telecomputing, and (f) Need for Learning Computing Skills. Computer attitude - Comfort/Anxiety was significantly correlated with: (a) computer attitude - Usefulness, (b) self-efficacy - Beginning Computer Skills, (c) self-efficacy - Advanced Computer Skills, (d) self-efficacy - Telecomputing, and (e) Need for Learning Computing Skills. Computer attitude - Usefulness was significantly correlated with (a) Desirability of Learning

Computer Skills, (b) self-efficacy - Beginning Computer Skills, (c) self-efficacy - Telecomputing, and (d) Need for Learning Computing Skills. Desirability of Computer Skills was significantly correlated with: (a) self-efficacy - Advanced Computer Skills, and (b) Need for Learning Computing Skills. These facts provided groundwork for further multiple regression analyses.

Multiple regression analysis revealed Computer Comfort/Anxiety was a significant predictor of computer self-efficacy in general. The analysis also showed a significant combined predictive effect of scores in Comfort/Anxiety and Usefulness on computer self-efficacy. Therefore, Hypothesis One was rejected.

Hypothesis Two stated that there would be no statistically significant predictive effect of attitudes toward computers on the desirability of learning computing skills. The result of simultaneous multiple regression revealed that one of the computer attitudes--Usefulness--exerted significantly predictive effects on desirability of learning computing skills. Another computer attitude subscale--Comfort/Anxiety--failed to provide enough evidence to contribute successful prediction for desirability of learning computing skills. Therefore, Hypothesis Two was rejected.

Hypothesis Three stated that there would be no statistically significant predictive effect of computer self-efficacy on the desirability of learning computing skills. A significant predictor was found only for advanced computer skills. The combined multiple regression revealed that computer self-efficacy was a significant predictor of desirability of learning computing skills. Therefore, Hypothesis Three was rejected.

Hypothesis Four stated that there would be no statistically significant predictive effect of attitudes toward computers on the need for learning computing skills. Both computer attitude subscales--Comfort/Anxiety and Usefulness--were found as significant predictors of students' perceived need in beginning computer skills, advanced computer skills, and Telecomputing. The F-test statistic for the overall multiple linear regression showed a significant combined predictive effect of all independent variables on the need for learning computing skills. Therefore, the null hypothesis was rejected.

Hypothesis Five stated that there would be no statistically significant predictive effect of computer self-efficacy on the need for learning computing skills. The results revealed that all subscales of computer self-efficacy--beginning computer skills, advanced computer skills, and Telecomputing--shared significant contributions to the predictive effects on all groups of students' need for learning computing skills. Analysis of individual independent variables from Hypothesis Five indicated that all the subscores of computer self-efficacy had significant predictive effects on the need for learning computing skills. Therefore, the null hypothesis was rejected.

Hypothesis Six stated that there would be no statistically significant differences between students in computer and non-computer classes regarding the desirability of learning computing skills. The results of a one-way ANOVA indicated that the students in the non-computer class were significantly different from students in the computer classes in terms of desirability of learning computer skills. The students in the non-computer class showed less interest in learning beginning computer skills, advanced computer skills, and telecomputing, while students in the computer classes indicated a stronger desirability to learn beginning computer skills, advanced computer skills, and telecomputing skills. Therefore, Hypothesis Six was rejected.

Hypothesis Seven stated that there would be no statistically significant differences between students in computer and non-computer classes regarding the need for learning computing skills. When comparing which students had need for learning more computer skills, a significant difference was found between students in computer classes and students in a non-computer class. A further analysis of Tukey's HSD revealed that education and general business students in computer classes had more need for learning beginning computer skills than physical education students in the non-computer class. It also showed that computer science students would like to have more computer skills at advanced levels and more computer skills of telecomputing than physical education students. Therefore, Hypothesis Seven was rejected.

Conclusions

The analysis of the data revealed findings which served as the basis of the following conclusions. The hypotheses were tested at the .05 alpha level for statistical significance. Conclusions are limited to subjects similar to the ones in the sample.

1. Attitude toward computers, specifically, the students' self-perceived feelings of comfort or anxiety about computers, was correlated with computer self-efficacy as measured by both intercorrelations and multiple regression. Computer self-efficacy tended to increase as the score of comfort about computers increased. The relationship was significant to indicate attitude toward computers was a predictor of students' confidence levels about computers.

2. Computer attitude about the usefulness of computers was a predictor of the desirability of learning computing skills. However, the combined predictive effect was not very strong. Students may be self-motivated to learn more about computers when they have personal goals and recognize that acquiring computer knowledge will be useful in their future career. Volet and Styles' (1992) study of the relationships of goals of students' stable characteristics, students' management, and performance in the first-year computer class indicated that personal goals were positively and dynamically associated with their achievements and interactions. Their study was similar to the current study.

3. Computer self-efficacy may be a predictor of desirability of learning computer knowledge. However, the combined predictive effect was not very strong. A student's confidence about telecomputing may affect the willingness to learn about computer skills. Also, the less confident a student feels about advanced computer skills, the more he or she desires to learn about computer technology.

4. The combined subscales of attitudes toward computers are predictors of the need for learning computing skills. However, the combined predictive effect was not very strong.

5. The combined score as well as the subscale of computer self-efficacy may be predictors of students' perception of need for learning beginning and advanced computing skills as well as telecomputing skills. When students feel less comfortable at all levels of computer technologies, they may want to acquire more computer skills.

6. Students from computer classes are willing to learn more computer skills than students from non-computer classes. In the sample of this study, most of the students in

computer classes had previous computer experience and felt a stronger desire to learn about computers than the students in the non-computer class.

7. Students in the computer classes have more need for learning computing skills than students in the non-computer class. Computer science students want to learn more advanced computer skills and telecomputing skills, while education and general business students express a need for more beginning computer skills.

Implications

Recent educational computing research has indicated that computer self-efficacy is a crucial factor in learning and using computers (e.g., Delcourt & Kinzie, 1993; Hill, Smith, & Mann 1987). The current study confirms and supports the finding from the study by Ertmer, Evenbeck, Cennamo, and Lehman (1994) that students' self-perceived confidence levels may be related to their computer self-efficacy. Based on this finding, an instructor may enhance students' computer self-efficacy by creating a non-threatening environment for students to reduce their anxiety about computers and to help them feel comfortable about using computers.

Usefulness of computers was a predictor of the desirability of learning computer skills. Computer education instructors should help students be aware of the functions of computer technologies in the information age. Students may not feel a need to learn computing skills until they recognize that computer technologies are necessary in their future career. Thus, emphasis on the usefulness of computer technologies should be one of the pedagogical strategies during the teaching process.

Students may be self-motivated to learn more computer technologies if they feel confident about computer self-efficacy of beginning computer skills and telecomputing. However, students may not be self-motivated to learn more computer technologies if they feel too comfortable about advanced computer skills. Computer education instructors should be aware of differences between current students and previous students who had to learn computer literacy from the very beginning. For example, subjects in this study appear to have already obtained a certain level of computer skills before entering the university. Therefore, computer technologies at different levels and various teaching strategies should be applied in the teaching process.

Results of computer attitudes of both Comfort/Anxiety and Usefulness from this study have reinforced and supported the use of hands-on activities in teaching computer technologies. This confirmed Hunt and Bohlin's (1995) study of educational applications of microcomputers which also indicated that a hands-on approach in teaching computer technology could generate students' positive attitude toward computers. Computer education instructors should be aware of the significant role of hands-on activities in learning computer technologies. Students will further reduce anxiety and increase comfort about using computers by completing hands-on activities at their own pace.

Students with previous computer experience may already be motivated and ready to learn more advanced computing skills when they are enrolled in computer classes. This study suggests that students with different departments have different needs for learning computing skills. Awareness of students' background may be helpful in adjusting the curriculum of computer education and in planning course activities and teaching strategies.

Recommendations for Further Research

Based on the findings and conclusions of this investigation, recommendations for further research are listed as follows.

1. In examining the correlations of eight selected variables concerning the important factors in the area of computer education, a few bivariate correlations have not shown significance. Further, there are some positive correlations and some negative correlations. Although this is not the focus of this study, a correlational study seeking the reasons is suggested.

2. A pre-and posttest comparative study should be conducted to determine whether there are any changes of computer attitudes, and desirability and need for learning computing skills, and how much, if any, between students from computer and non computer classes. Such studies would provide more comprehensive data and, thus, a more valid basis of comparison.

3. The present study tested a sample of undergraduate students. It is, therefore, recommended that a similar study be conducted at the graduate level. Such a study may be used to compare the relationships of computer self-efficacy, attitudes toward computers, and desirability and need for learning computing skills between undergraduate and graduate students.

4. The data used in this study were collected from one university. It is recommended that similar studies be conducted to test undergraduate students from several institutions of higher learning so that results of similarity and disparity could be sought.

5. This quantitative study investigated a comparatively large number of undergraduate students by a cross-section survey. The data were solely dependent upon the subjects' self-rating. It is recommended that further investigations be conducted using qualitative research techniques such as participation observation and personal interviews. These studies would provide additional and consolidatory information.

References

Aiken, L. R. (1980). Attitude measurement and research. In D. A. Payne (ed.), *Recent Developments in Affective Measurement* (pp. 1-24). San Francisco: Jossey-Bass.

Amini, M. S. (1993). Factors affecting the perception of computing literacy among business majors. *Journal Education for business, 69,* 79-82.

Anderson, R. E. (1987). The unresolved need for research on computers and education. *Education and Computing, 3*(1-2), 15-20.

Arch, E. C., & Cummins, D. E. (1989). Structured and unstructured exposure to computers: Sex differences in attitudes and use among college students. *Sex Roles, 20,* 245-254.

Balian, E. (1988). *How to design, analyze, and write doctoral or masters research* (2nd ed.). New York: University Press of America.

Bandalos, D., & Benson, J. (1990). Testing the factor structure invariance of a computer attitude scale over two grouping conditions. *Educational and Psychological Measurement, 50,* 49-60.

Bandura, A. (1977). Self-efficacy: toward a unifying theory of behavioral change. *Psychological Review, 84,* 191-215.

Bandura, A. (1981). Self-referent thought: A developmental analysis of self-efficacy. In J. H. Flavell & L. Ross (Eds.), *Social cognitive development: Frontiers and possible futures* (pp. 200-239). Cambridge: Cambridge University Press.

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist, 37,* 122-147.

Bandura, A., & Adams, N. E. (1977). Analysis of self-efficacy theory of behavioral change. *Cognitive Therapy and Research, 1,* 287-310.

Barger, R. N. (1983). The computer as a humanizing influence in education. *T. H. E. Journal, 10,* 109-111.

Beaver, J. F. (1990). *A profile of undergraduate educational technology (in)competence: Are we preparing today's education graduates for teaching in the 1990's?* Buffalo, NY: State University of New York College at Buffalo. (ERIC Document Reproduction Service No. ED 332 985)

Beaver, J. F. (1992). Microsoft Works for educators on the IBM PC and compatibles. Pacific Grove, CA: Brook/Cole.

Borg, W. R., & Gall, M. D. (1989). *Educational research* (5th ed.). New York: Longman.

Brown, B., & Kester, D. (1993). *College students and computers.* (ERIC Document Reproduction Service No. ED 366 291)

Brownell, G. (1987). *Computers and teaching.* St. Paul: West.

Busch, T. (1995). Gender differences in self-efficacy and attitudes toward computers. *Journal of Educational Computing Research, 12,* 147-158.

Cambre, M. A., & Cook, D. L. (1985). Computer anxiety: Definition, measurement, and correlates. *Journal of Educational Computing Research, 1*(1), 37-54.

Cambre, M. A., & Cook, D. L. (1987). Measurement and remediation of computer anxiety. *Educational Technology, 27*(12), 15-20.

Carlson, R. D., & Grabowski, B. L. (1992). The effects of computer self-efficacy on directive-following behavior in computer assisted instruction. *Journal of Computer-Based Instruction, 19,* 6-11.

Chen, M. (1986). Gender and computers: The beneficial effects of experience on attitudes. *Journal of Educational Computing Research, 2,* 265-282.

Colley, A. M., Gale, M. T., & Harris, T. A. (1994). Effects of gender role identity and experience on computer attitude components. *Journal of Educational Computing Research, 10,* 129-137.

Corcoran, M., & Clark, S. (1984). Professional socialization and contemporary career attitudes of three faculty generations. *Research in Higher, 20,* 131-153.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16,* 297-334.

Delcourt, M. A., & Kinzie, M. B. (1993). Computer technologies in teacher education: The measurement of attitudes and self-efficacy. *Journal of Research and Development in Education, 27,* 35-41.

DeLoughry, T. J. (1993, April 28). Two researchers say "technophobia" may afflict millions of students. *Chronicle of Higher Education,* A25-26.

Dyck, J. L., & Smither, J. A. (1994). Age differences in computer anxiety: The role of computer experience, gender and education. *Journal of Educational Computing Research, 10,* 239-248.

Erion, R. L., & Moeller, L. (1991). A computer literacy course: A needs assessment. *The Rural Educator, 12*(3), 4-8.

Ertmer, P. A., Evenbeck, E., Cennamo, K. S., & Lehman, J. D. (1994). Enhancing self-efficacy for computer technologies through the use of positive classroom experience. *Educational Technology Research and Development, 42*(3), 45-62.

Fann, G. L., Lynch, D. H., & Murranka, P. (1989). Integrating technology: Attitudes as a determinant of the use microcomputers. *Journal of Educational Technology Systems, 17,* 307-317.

Faseyitan, S. O., & Hirschbuhl, J. (1992). Computers in university instruction: What are the significant variables that influence adoption? *Interactive Learning International, 8,* 185-194.

Feldman, C. A. (1992). Dental student experience and perceptions of computer technology. *Journal of Dental Education, 56,* 200-205.

Ferren, A. S. (1993). General education reform and the computer revolution. *Journal of General Education, 42,* 164-177.

Ford, K. J., & Noe, R. A. (1987). Self-assessed training needs: The effects of attributes toward training, managerial level, and function. *Personnel Psychology, 40,* 39-53.

Geissler, J. E., & Horridge, P. (1993). University students' computer knowledge and commitment to learning. *Journal of Research on Computing in Education, 25,* 347-365.

Gist, M. E., Schwoerer, C. E., & Rosen, B. (1989). Effects of alternative training methods on self-efficacy and performance in computer software training. *Journal of Applied Psychology, 74,* 884-891.

Gristword, P. A. (1985). Differences between education and business majors in their attitudes about computers. *AEDS Journal,* 131-138.

Hackett, G. (1985). The role of mathematics self-efficacy in the choice of math-related majors of college women and men: A path analysis. *Journal of Counseling Psychology, 32,* 47-56.

Harrison, A. W., & Rainer, R. K., Jr. (1992). The influence of individual differences on skill in end-user computing. *Journal of Management Information Systems, 9(1),* 93-111.

Hattie, J. (1990). The computer and control over learning. *Education, 110,* 414-417.

Hignite, M. A., & Echternacht, L. J. (1992). Assessment of the relationships between the computer attitudes and computer literacy levels of prospective educators. *Journal of Research on Computing in Education, 24,* 381-391.

Hill, T., Smith, N. D., & Mann, M. F. (1986). Communicating innovations: Convincing computer phobics to adopt innovative technologies. *Advances in Consumer Research, 13,* 419-422.

Hill, T., Smith, N. D., & Mann, M. F. (1987). Role of efficacy expectations in predicting the decision to use advanced technologies: The case of computers. *Journal of Applied Psychology, 72,* 307-313.

Honeyman, D. S., & White, W. J. (1987). Computer anxiety in educators learning to use the computer: A preliminary report. *Journal of Research on Computing in Education, 20,* 129-138.

Hunt, N., & Bohlin, R. M. (1995). Events and practices that promote positive attitudes and emotions in computing courses. *Journal of Computing in Teacher Education, 11,*(3), 21-23.

Jagacinski, C., Lebold, W. K., & Salvendy, G. (1988). Gender differences in persistence in computer-related fields. *Journal of Educational Computing Research, 4,* 185-202.

Jorde-Bloom, P. (1988). Self-efficacy expectations as a predictor of computer use: A look at early childhood administrators. *Computers in the Schools, 5,* 45-63.

Karasz, J. (1991). Computer literacy achievement based on prior education and training. *Computers and Industrial engineering, 21,* 583-587.

Kay, R. H. (1990). Predicting student teacher commitment to the use of computers. *Journal of Educational Computing Research, 6,* 299-309.

Kay, R. H. (1992a). An analysis of methods used to examine gender differences in computer-related behavior. *Journal of Educational Computing Research, 8,* 277-290.

Kay, R. H. (1992b). Understanding gender differences in computer attitudes, aptitude, and use: An invitation on build theory. *Journal of Research on Computing in Education, 25,* 159-171.

Kay, R. H. (1993a). A practical research tool for assessing ability to use computers: The computer ability survey (CAS). *Journal of Research on Computing in Education, 26,* 16-27.

Kay, R. H. (1993b). An exploration of theoretical and practical foundations for assessing attitudes toward computers: The computer attitude measure (CAM). *Computers in Human Behavior, 9,* 371-386.

Kinzie, M. B., Delcourt, M. A. B., & Powers, S. M. (1994). Computer technologies: attitudes and self-efficacy across undergraduate disciplines. *Research in Higher Education, 35,* 745-768.

Kolehmainen, P. (1992). *The changes in computer anxiety in a required computer course.* Paper presented at the European Conference on Educational Research. Enschede, the Netherlands. (ERIC Document Reproduction Service No. ED 350 975)

Landerholm, E. (1995). Early childhood teachers' computer attitudes, knowledge, and practices. *Early Child Development and Care, 109,* 43-60.

Lee, D. M., Pliskin, N, & Kahn, B. (1994). The relationship between performance in a computer literacy course and students' prior achievement and knowledge. *Journal of Educational Computing Research, 10,* 63-77.

Leite, P. T. (1994). *College students' attitudes toward computers.* (ERIC Document Reproduction Service No. ED 371 684)

Leso, T., & Peck, K. (1992). Computer anxiety and difference types of computer courses. *Journal of Educational Computing Research, 8,* 469-478.

Lewis, C. M. (1985). An exploratory study of the influence of self-efficacy on the personal computer learner. *Dissertation Abstract International, 46.* (University Microfilms No. 85-21, 103)

Liu, M., Reed, W. M., & Phillips, P. D. (1992). Teacher education students and computers: gender, major, prior computer experience, occurrence, and anxiety. *Journal of Research on Computing in Education, 24,* 457-467.

Loyd, B. H. & Loyd, D. E. (1988). *Computer Attitudes: Differences by Gender and among of computer Experience.* Paper presented at the annual meeting of the American Educational Research Association, New Orleans.

Marcoulides, G. A. (1988). The relationship between computer anxiety and computer achievement. *Journal of Educational Computing Research, 4,* 151-158.

Massoud, S. L. (1990). Factorial validity of a computer attitude scale. *Journal of Research on Computing in Education, 22,* 290-299.

Massoud, S. L. (1991). Computer attitudes and computer knowledge of adult students. *Journal of Educational Computing Research, 7,* 269-291.

Maurer, M. M. (1994). Computer anxiety correlates and what they tell us: A literature review. *Computers in Human Behavior, 10,* 369-376.

McClintock, R. (1986). Into the starting Gate: On computing and the curriculum. *Teachers College Record, 88,* 191-215.

McKeown, P. (1988). *Living with Computers.* New York: Harcourt Brace Jovanovich.

McMillan, J. H. (1992). *Educational research: Fundamental for the consumer.* New York: HarperCollins.

Mehlhoff, C. E., & Sisler, G. (1989). Knowledge, commitment, and attitudes of home economics faculty toward computers. *Home Economics Research Journal, 17,* 300-308.

Metu, R. (1994). *A study of computer attitudes of Nigerian teachers.* California State Polytechnic University. (ERIC Document Reproduction Service No. ED 370 528)

Miller, F., & Varma, N. (1994). The effects of psychological factors on India children's attitudes toward computers. *Journal of Educational Computing Research, 10,* 223-238.

Miura, I. T. (1987). The relationship of computer self-efficacy expectations to computer interest and course enrollment in college. *Sex Roles, 16,* 303-311.

Moon, S. B. (1994). *The relationships among gender, computer experience, and attitudes toward computers.* Paper presented at the Annual Meeting of the Mid-South Educational Research Association. Nashville, TN. (ERIC Document Reproduction Service No. ED 381 142)

Morahan-Martin, J., Olinsky, A., & Schumacher, P. (1992). Gender differences in computer experience, skills, and attitudes among incoming college students. *Collegiate Microcomputer, 10,* 1-8.

Morris, D. C. (1988-1989). A survey of age and attitudes toward computers. *Journal of Educational Technology Systems, 17,* 73-78.

Murphy, C. A., Coover, D., & Owen, S. V. (1989). Development and validation of the computer self-efficacy scale. *Educational and Psychological measurement, 49,* 893-899.

Nellermore, D. A. (1992). Preparing students for employment--Or, what managers really want. *Business Education Forum, 46*(3), 11-13.

Ogozalek, V. Z. (1989). A comparison of male and female computer science students' attitudes toward computers. *Sigcse Bulletin, 21*(2), 8-14.

Okinaka, R. (1992). *The factors that affect teacher attitude toward computer use.* (ERIC Document Reproduction Service No. ED 346 039).

Oliver, T. A., & Shapiro, F. (1993). Self-efficacy and computers. *Journal of Computer-Based Instruction, 20,* 81-85.

Owen, S. V. (1986). *Using self-efficacy in program evaluation.* Paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, CA.

Pajares, F. (1995). *Self-efficacy in academic settings.* San Francisco: Emory University. Paper presented as a symposium held during the meeting at the American Educational Research Association. (ERIC Document Reproduction Service No. ED 384 608)

Paxton, A. L., & Turner, E. J. (1984). The application of human factors to the needs of novice computer users. *International Journal of Man-Machine Studies, 20,* 137-156.

Pina, A. A., & Harris, R. (1994). *Preservice teachers and computers: Strategies for reducing anxiety and increasing confidence.* Paper presented at the Annual Conference of the Association for Educational Communication and Technology. (ERIC Document Reproduction Service No. ED 368 344)

Porter, M. E., & Miller, V. E. (1985). How information gives you competitive advantage. *Harvard Business Review, 63*(4), 149-160.

Price, R., & Winiecki, D. (1995). Attitudes and skill levels of college students entering a typical introductory college computing course. *Journal of Computing in Teacher Education, 12,* 20-25.

Quebec Commission on the Education of Collegiate Teaching (1994). *The computer science program programmer/analyst and micro-computer technology.* (ERIC Document Reproduction Service No. 373 852)

Ransom, P. E., & Swearingen, R. (1990). *Literacy: The aspect of computers at the university level.* (ERIC Documents Reproduction Service No. Ed 335 651)

Reed, W. M., & Overbaugh, R. C. (1993). The effects of prior experience and instructional format on teacher education students' computer anxiety and performance. *Computers in the Schools, 9*(2/3), 75-89.

Relan, A. (1992). *Motivational strategies in computer-based instruction: Some lessons from theories and models of motivation.* Proceedings of Selected Research and Development Presentations at the convention of the Association for Educational Communications and Technology and sponsored by the Research and Theory Division. (ERIC Document Reproduction Service No. Ed 348 017)

Riggs, I. M., & Enochs, L. G. (1993). A microcomputer beliefs inventory for middle school students: Scale development and validation. *Journal of Research on Computing in Education, 25,* 383-390.

Robbins, R. R. (1986). Efficacy and attributional factors affecting college students in a computer literacy class. *Dissertation Abstract International, 48.* (University Microfilms No. 87-24, 826)

Robinson, L. (1983-1984). The computer: An evolving instrument. *Current Issues in Higher Education, Report 1.* Washington: American Association for Higher Education, 1983-1984, 3-13.

Ronald, J. S. (1983). *Attitudes and learning needs of nursing educators with respect to computers: Implications for curriculum planning.* Unpublished doctoral dissertation, University of New York, Buffalo.

Rosen, L. D., Sears, D. C., & Weid, M. M. (1987). Computerphobia. *Behavior Methods, Instruments & Computers, 19,* 167-179.

Roszkowski, M. J., Devlin, S. J., Snelbecker, G. E., Aiken, R. M., & Jacobsohn, H. G. (1988). Validity and temporal stability issues regarding two measurements of computer aptitudes and attitudes. *Educational and Psychological Measurement, 48,* 1029-1035.

Russon, A. E., Josefowitz, N., & Edmonds, C. V. (1994). Making computer instruction accessible: Familiar analogies for female novices. *Computers in Human Behavior, 10,* 175-187.

Savenye, W. C. (1993). Measuring teacher attitudes toward interactive computer technologies. Proceedings of Selected Research and Development Presentations at the Convention of the Association for Educational Communication and Technology sponsored by the Research and Theory Division. (ERIC Document Reproduction Service No. ED 362 200)

Savenye, W. C., Davidson, G. V., & Orr, K. B. (1992). Effects of an educational computing course on preservice teachers' attitudes and anxiety toward computers. *Journal of Computing in Childhood Education, 3,* 31-41.

Schunk, D. H. (1981). Modeling and attributional effects on children's achievement: A self-efficacy analysis. *Journal of Educational Psychology, 73*, 93-106.

Schunk, D. H. (1985). Self-efficacy and classroom learning. *Psychology in the Schools, 22*, 208-223.

Schunk, D. H. (1989a). Self-efficacy and cognitive skill learning. In C. Ames, & Ames (Eds.), *Research on motivation in education: Vol. 3. Goals and Cognitions.* San Diego: Academic Press.

Shashaani, L. (1993). Gender-based differences in attitudes toward computers. *Computers and Education, 20*, 169-181.

Shaw, M. (1991). Informatics for a new century: Computing education for the 1990s and beyond. *Education and Computing, 7*, 9-17.

Shifflett, B., Richardson, L., Ghiasvand, F., Plecque, D., Verduzco, M., & Thomas, J. (1993). Computing needs among college educators. *Computers in the Schools, 9*(4), 107-117.

Simonson, M. R., Maurer, M., Montag-Torardi, M., & Whitaker, M. (1987) Development of a standardized test of computer literacy and a computer anxiety index. *Journal of Educational Computing Research, 3*, 231-247.

Smith, J. M. (1994). The effects of education on computer self-efficacy. *Journal of Industrial Teacher Education, 31*, 51-65

Sproull, L., Zubrow, D., & Kiesler, S. (1986). Cultural socialization to computing in college. *Computers in Human Behavior 2*, 257-275.

Swift, M. L., & Zielinski, T. J. (1995). What chemists (or chemistry students) need to know about computing. *Journal of Science Education and Technology, 4*, 171-179.

Szajna, B. (1994). An investigation of the predictive validity of computer anxiety and computer aptitude. *Educational and Psychological Measurement, 54*, 926-934.

Tabachnick, B. G., & Fidell, L. S. (1996). *Using multivariate statistics.* New York: HarperCollins.

Tannenbaum, R. S., & Rahn, B. J. (1985). Computer literacy for undergraduate humanities and social sciences majors. *Collegiate Microcomputer, 3*, 169-178.

Texas Higher Education Coordinating Board, Austin. Division of Community and Technical Colleges. (1993). *Project for Tech Prep curriculum in computer science technology.* (ERIC Document Reproduction Service No. 365 888)

Tuckman, B. W. (1994). *Conducting educational research* (4th ed.). Fort Worth: Harcourt Brace College.

Uhlig, G. E. (1982). *Microcomputer literacy and teacher education in the southeastern United States.* Mobile, AL: The College of Education at the University of South Alabama. (ERIC Document Reproduction Service No. 226 721)

Volet, S. E., & Styles, I. M. (1992). Predictors of study management and performance on a first-year computer course: The significance of students' study goals and perceptions. *Journal of Educational Computing Research, 8,* 423-449.

Walla, K., & Wendel, R. (1984). A model for computer literacy staff development in teacher education: Miami University meets the challenge. In C. L. Warger, & L. B. Murphy (Eds.), *The application of the microcomputers to teacher education* (pp. 28-32). (ERIC Document Reproduction Service No. ED 253 520)

Woodrow, J. J. (1991). A comparison of four computer attitude scales. *Journal of Educational Computing Research, 7,* 165-187.

Yoder, S., & Moursund, D. (1993). Do teachers need to know about computer programming? *Journal on Computing in Teacher Education, 9*(3), 21-26.

Zubrow, D. (1987). How computing attitudes change during the freshman year. In S. Kiesler & L. Sproull (Eds.), *Computing and change on campus* (pp. 195-211). Cambridge, England: Cambridge University Press.

APPENDIX A

REQUEST LETTER FOR PERMISSION TO USE THE INSTRUMENT

September 4, 1995

Dr. Marcia A. B. Delcourt, Dr. Mable B. Kinzie, and Dr. Susan M. Powers
Faculty of Education
McGill University
3700 McTavish Street
Montreal, PQ, Canada H3A 1Y2

Dear Dr. Delcourt, Dr. Kinzie, and Dr. Powers:

I have recently read your article *Computer Technologies: A attitudes and self-efficacy across undergraduate disciplines.* I am very interested in your research article.

I am a doctoral student in the Department of Secondary and Higher Education of East Texas State University. I am going to start my dissertation. I am writing you to request if you could send me the instruments you described and used in your research along with permission to allow me to use these instruments in my dissertation.

Thank you very much for your help in advance.

Sincerely,

Yixin Zhang
2305 Bois D' Arc St.
Commerce, Texas 75428
USA
Telephone: (903) 886-6865
E-Mail: yixin@orion.etsu.edu

APPENDIX B

Permission Letter for ACT

McGill

Department of Educational Psychology and Counselling

Faculty of Education
McGill University

3700 McTavish Street
Montreal, Quebec, Canada
H3A 1Y2

Tel (514) 398-4240
Fax: (514) 398-6968
Telex: 05 268510

September 11, 1995

Yixin Zhang
2305 Bois D'Arc Street
Commerce, Texas 75428

Dear Yixin,

As per your request, I have enclosed copies of both the ACT and SCT surveys developed by myself and Dr. Mable Kinzie. You have our permission to use the instruments for your research. We request that you keep us informed of your results so we may include your work in a bibliography. If you have any additional questions, please do not hesitate to contact me.

Sincerely,

Marcia Delcourt

Marcia A. B. Delcourt, Ph.D.
E-Mail: DELCOURT@EDUCATION.McGill.CA

APPENDIX C

REQUEST LETTER FOR PERMISSION TO USE THE INSTRUMENT

September 4, 1995

Dr. Christine A Murphy, Dr. Delphine Coover, Dr. Steven V. Owen
School of Education
University of Connecticut
Storrs, Connecticut 06269-2004

Dear Dr. Murphy, Dr. Coover, and Dr. Owen:

I have recently read your article *Assessment of Computer Self-Efficacy: Instrument Development and Validation.* I am very interested in your research article.

I am a doctoral student in the Department of Secondary and Higher Education of East Texas State University. I am going to start my dissertation. I am writing you to request if you could send me the instruments you described and used in your research along with permission to allow me to use these instruments in my dissertation.

Thank you very much for your help in advance.

Sincerely,

Yixin Zhang
2305 Bois D' Arc St.
Commerce, Texas 75428
USA
Telephone: (903) 886-6865
E-Mail: yixin@orion.etsu.edu

APPENDIX D

Permission Letter for CDK

THE UNIVERSITY OF CONNECTICUT

School of Education
Bureau of Educational Research and Service
U-4
249 Glenbrook Road
Storrs, Connecticut 06269-2004

27 September 1995

Yixin Zhang
2305 Bois D'Arc Street
Commerce, TX 75428

Dear Yixin Zhang:

Thank you for your inquiry about the Computer Self-Efficacy scale. You are certainly welcome to use the scale. Here are a few summary points about the scale. There is no technical manual. There have been a few studies referring to the scale, but the only published research describing its development is the article in *Educational and Psychological Measurement*.

In calculating subscores, we prefer calculating means rather than sums. With missing data (e.g., omitted items), a sum score is incorrect; the mean considers missing data without penalizing the respondent. Also, mean scores are in the original metric of the scale, so there is a simple frame of reference for interpreting scores. By the way, item 5 is missing from the article in *Educational and Psychological Measurement*. It should be scored on Factor 2, Advanced Computer Skills.

I would suggest changing the questionnaire title to some irrelevant title (for example, Computer Survey) to avoid a response set. Also, you may wish to change the questionnaire instructions to best fit your application. For example, if you need informed consent, you might say something like "Filling out this questionnaire is completely voluntary and confidential. There are no penalties for not participating, and you may quit at any time."

Best wishes for a productive dissertation. Please feel free to call or e-mail if you have more questions.

Sincerely,

Steven V. Owen

Steven V. Owen, Associate Director and
Professor of Educational Psychology
(203) 486-3322
Internet: svo@uconnvm.uconn.edu

An Equal Opportunity Employer

APPENDIX E

ANNOUNCEMENT SCRIPT OF DATA COLLECTION

My name is Yixin Zhang. I am a doctoral student in the Department of Secondary and Higher Education. Results of this survey will be used in my dissertation to help determine how computer technologies are perceived by university students. Although your participation is voluntary, I would greatly appreciate your participation and cooperation! Responses will be kept strictly confidential.

Please respond to ALL items. In Part Three, please respond to all items both on the LEFT and on the RIGHT sides.

Thank you very much in advance for your participation.

Vita

Yixin Zhang was born in Hefei, Anhui, on March 27, 1953, the son of Zhiren Zhang and Xia Jiang. He had his elementary and secondary education in the same city. After graduating from Anhui Teachers' University, he taught Chinese language arts and English as a second language in Wanzhong School from 1976 to 1980. He worked in the Foreign Affairs Office of the University of Science and Technology of China from 1980 to 1986 before he went to the University of Alaska Fairbanks to pursue a higher degree in education and shared his knowledge and skills with the classroom teachers and administrators of public schools in Fairbanks, Juneau, and Sitka. He returned to the University of Science and Technology of China and worked there for another two years from 1988 to 1990. He spent three years completing his Educational Specialist degree before entering the doctoral program of Supervision, Curriculum and Instruction-Higher Education, Texas A&M University-Commerce, where he was conferred a Doctor of Education degree in December, 1996.

From 1993 to 1996, Yixin worked as a computer lab assistant in the Education Computer Lab of the College of Education, where he helped and tutored students and faculty in learning and using computers. He obtained a Master of Science in Learning Technology and Information Systems with an Emphasis in Educational Computing in December, 1995.

Yixin married Jianhuai Wu in October, 1982. They have one son, Shihao Zhang, a eighth grader at the Commerce Middle School.

Permanent Address: 2305 Bois D' Arc Street
Commerce, Texas, 75428