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Factors correlating with teachers' use of computers in the classroom

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Abstract

This study examined several factors relating to the use of computers in the classroom by teachers. The factors examined in this study included teacher attitudes, emotions, beliefs and outside influences. This was done by a review of past studies, administering two surveys (demographics questionnaire and Computer Attitude Scale) and analyzing the survey data. Questionnaires were distributed to faculty at five randomly selected schools in the Chicagoland area participating in the study. Data from the surveys were then examined by principle components analysis, multiple correlation and multiple regression analyses to determine which factors correlate with teacher computer use in the classroom.

This study found that a greater amount of computer experience fostered more positive attitudes towards computers. Teachers with greater years of computer experience were more comfortable with computers. The study also found that usefulness is correlated with grade level taught, teaching experience and classroom use and that computer liking is correlated with grade level taught and teaching experience.

The main goal of this study was to examine the relationship between teachers' attitudes, emotions, beliefs, outside influences and teachers use of computers. The results should help administrators and teachers understand why faculty embrace or resist technology. The findings suggest that training professionals should consider many of the correlations between factors found in this study when designing professional development programs for teachers.

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S.A.W.

We are on the front porch of the 21^{st} century, and public education in the U.S. is facing both enormous changes and tremendous challenges. Our world is evolving faster than at any time in our history, and we are literally rocketing out of the Industrial Age into the Information Age.

Delaine Eastin, 1999

CHAPTER I

Introduction

Technology is becoming increasingly common in today's fast-paced society. Employers expect schools to prepare students for the modern workplace (Eastin, 1999). Jobs of the future will require higher order thinking and technology skills (Berliner & Biddle, 1995; Bradley & Russell, 1997; Chou, 2001; Davis, 1997; Fary, 1988; Fuller, 2000; Glennan & Melmed, 1996; Llorens, Salanova & Grau, 2002-2003; Necessary & Parish, 1996). "Some researchers have claimed that computer literacy, however defined, pays off in higher wages, further strengthening the educational rationale for using computers in schools" (Cuban, 2001, p. 178).

In an effort to prepare students for the future, teachers are being pressured to use computers in classrooms (Clark, 2000). Much of this pressure is coming from the business community and federal government (Besser, 1993; Cochran-Smith, 2000; Cuban, 2001; Decker, 1999; Kinslow, Newcombe & Goss, 2002; Nash & Moroz, 1997; Painter, 2001; Pinkston, 2000). According to the National Center for Educational Statistics (1995), implementing technology in schools is a national, state and local educational goal. Unqualified workers cost corporations billions in training each year (Campbell, 1998; McCune, 1999). Due to the lack of qualified workers in the United States, forty percent of human resource firms have already set up overseas recruiting operations (Eastin, 1999). Companies are searching for employees that are able to understand, interpret and apply concepts, analyze information, solve problems and use higher order problem-solving skills (Berliner & Biddle, 1995). Delaine Eastin, the California Superintendent of Public Instruction, states, "So it is no surprise to me that when I advocate for a more rigorous curriculum, the constituency that I have always been able to count on – without exception – has been the business leadership community" (p.19).

"Despite this rapid growth [of technology] surveys suggest that the average school still makes limited use of computers" (Glennan & Melmed, 1996, p. xv). Despite increased pressure to include technology in the classroom, not all teachers have integrated technology into their curricula (Bielefeldt, 2001; Brush et al., 2001; Clark, 2000; Ertmer, Addison & Lane, 1999; Kumar & Kumar, 2003; MacKenzie & Clay, 1995; Rosen & Weil, 1995). Research also shows that teachers are struggling to effectively use technology in the classroom (Clark, 2000; Cuban, 2001; Sandholtz, Ringstaff & Dwyer, 1997). Some research shows teachers view computers as a valuable educational tool but that they lack the time and skills to integrate computers in their curricula (Dupagne & Krendl, 1992; Hong & Koh, 2002). However, only a limited number of researchers have examined why teachers use or do not use computers in their teaching (Jaber & Moore, 1999; Kumar & Kumar, 2003; Lawless & Smith, 1997; Norton, McRobbie & Cooper, 2000; Office of Technology Assessment (OTA), 1995; Sandholtz, Ringstaff & Dwyer, 1997). Instead, researchers primarily have focused on examining how technology relates to student achievement, teacher training, resources, support staff and administration (Hoffman, 1996; Mittelstet, 1992; OTA, 1995).

A great deal of research has been devoted to understanding the effectiveness and disadvantages of technology in the classroom but the results are conflicting and unclear (Glennan & Melmed, 1996). The advantages and long-term effects of technology have yet to be determined. There is little research correlating student use of computers and increased achievement (Cuban, 2001). "The contribution that school courses and experiences have made to computer literacy and competitiveness in the workplace remains, at best, murky" (p. 178).

Other factors that may contribute to instructional computer use among faculty have been neglected by researchers. Such factors include teachers' attitudes, anxiety levels, self-efficacy, time commitment, competency, beliefs, perceptions, relevance and knowledge (Delcourt & Kinzie, 1993; Dusick & Yildirim, 1998; Fulton, 1998; Hadley & Sheingold, 1993; Hoffman, 1996; OTA, 1995; Rademacher et al., 2001; Willis & Sujo de Montes, 2002; Zhao et al., 2001). These factors are important because attitudes and beliefs may impact teachers' use of computers in classrooms.

The current investigation examined the correlation between teachers' instructional uses for computers and teacher attitudes, emotions, beliefs and outside influences. Teachers' computer use in the context of this study specifically examined teachers' instructional or pedagogical uses of computers when working with students. Teacher attitudes in this study examined teachers' thoughts and feelings towards educational computer use and teacher emotions to both positive or negative feelings about computers (i.e., confidence or anxiety).

Teacher beliefs about educational technology included beliefs about computer liking and usefulness. Outside influences that were studied include demographic data and access to computers.

Surveys were distributed at five urban schools. Teachers were asked to complete surveys related to their attitudes, emotions, beliefs, outside influences and computer usage. The resulting data were analyzed to examine correlations between these factors and teacher computer use. Principle components factor analysis with varimax rotation was performed on the survey data. The following five components emerged: Comfort with Computers, Usefulness of Computers, Instructional Computer Use, Computer Liking and Outside Influences. Correlation analysis and multiple regression analyses were conducted to determine any correlations among the five factors and the demographic variables.

The main goal of this study was to examine the relationship between teachers' attitudes, emotions, beliefs, outside influences and teacher computer usage. By better understanding why teachers use, or do not use, technology in their classrooms, administrators and faculty can better understand teachers' computer use in schools.

CHAPTER II

Review of Literature

During the past three decades, schools have devoted considerable resources to technology. All too often, this technology has been ignored and underutilized (Glennan & Melmed, 1996). At the same time, the importance of technology in society has increased dramatically. It has now become vital for students to learn how to use technology in order to be prepared for the increasingly technological workplace (Bybee & Loucks-Horsley, 2000; Bradley & Russell, 1997; Campbell, 1998; Chou, 2001; Cuban, 2001; Eastin, 1999; Fuller, 2000; Kozma & Schank, 1998; Necessary & Parish, 1996; Niederhauser, 2001; North & Noyes, 2002; Thomas & Cooper, 2000). "The demand for unskilled labor has almost disappeared in advanced economies as they have experienced the full impact of globalization and the technological revolution" (Hill & Crevola, 1999, p. 117). Educational reform and computers in the classroom have become bandwagons in the field of education today (Means, 1994).

Ninety-eight percent of American public schools now have Internet access (Kumar & Kumar, 2003). The ratio of students to computers in schools has steadily decreased from 125 students per computer in 1981 to 5 students per computer in 2000 (Cuban, 2001). Ninety-eight percent of schools and 15% of classrooms now have computers (Cadiero-Kaplan, 1999). Furthermore, the tasks that can be performed by computers have become almost limitless (Breithaupt, 1997). Despite this influx of technology in schools, many teachers avoid using computers in their classrooms (OTA, 1995; Rosen & Weil, 1995;

Wetzel, Zambo & Padgett, 2001). As noted by Paprzycki and Vidakovic (1994), " . . . teachers are more hesitant and less likely to embrace computer technology than other professionals" (p. 74). Further, as Bybee and Loucks-Horsley (2000) point out, "Because the technological literacy standards call for students to acquire deep understanding of important, fundamental, technology concepts and processes, teachers need to know technology as deeply – in fact, more so" (p. 2).

In a literature review conducted by Dusick (1998), several social-cognitive factors were examined that may influence teachers' use of technology. Some of the factors listed by Dusick were faculty attitudes, anxiety, self-efficacy, time commitments, risks involved in using technology, competencies, beliefs, and lack of knowledge (Dusick & Yildirim, 1998; Fulton, 1998; Hoffman, 1996; OTA, 1995).

Educational technology has been the subject of much debate over the past two decades (Cuban, 2001). Proponents suggest that computers are necessary in schools in order to prepare students for the future. Critics emphasize that there is no substantial evidence to support continued use of computers in the classroom. "The link between test score improvements and computer availability and use is even more contested" (Cuban, 2001, p. 178). Some educators have even referred to the computer as an expensive or glorified typewriter (Cuban, 2001; Sandholtz et al., 1997).

In this literature review, some of the factors that correlate with teachers' instructional use of computers in the classroom are examined. The factors in this study are teacher attitudes, emotions, beliefs and outside influences. Past studies show that these factors correlate with teachers' instructional computer use.

Teachers' Attitudes towards Technology

Studies of attitudes towards computers have spanned the past four decades. During the 1960's, Lee (1970) administered a 20 item scale to over 3000 Americans. Two perspectives that Lee examined were the "beneficial tool of man perspective" and an "awesome thinking machine" perspective. Attitude scales no longer focus on these science fiction types of items. The definition of attitude has evolved. Presently, attitudes are described as evaluative dispositions based on cognitions, affective reactions, behavioral intentions and past behaviors (Zimbardo & Leippe, 1991). Those dispositions can influence future cognitions, affective responses, intentions and behaviors. A number of reasons account for the minimal usage of technology by teachers but attitudes are the most influential (Francis, 1994). "The growth of technology as an instrumental tool will depend on teachers' attitudes about these technologies and their ability to use them for instruction and administrative purposes" (Clark, 2000, p. 181).

Attitudes and Experience. Many studies have concluded that enthusiasm increases as computer experience increases (DuPagne & Krendl, 1992). For instance, Yildirim (1997, 2000) concluded that there is a significant correlation between prior training and attitude and that competence is significantly related to prior training. In another study, Dusick and Yildirim (1998) found that computer competence and prior training predicted university faculty use computers in the classroom.

Rosen and MacGuire (1990) conducted a meta-analysis of 81 studies that contrary to other research found, " computer experience does not eliminate technophobia" (p.12). The purpose of their study was to examine many of the common myths about computer anxiety. The 81 studies were selected from nearly 200 studies. Sixty-five studies were published after 1980 and only 16 were published before. Half of the 81 studies examined college students. There were a total of 66 different measurement instruments used in the studies. As a result, a series of steps were taken in order to compare all of the studies. First, the effect sizes from each study were converted to Pearson Product Moment Correlation (r). Second, r's were combined using a weighted mean in those studies with more than one r. Third, a Q statistic was calculated to test the homogeneity of the r effect sizes. Fourth, effect sizes were converted from r to z statistics and combined to yield a weighted mean effect size. The final step was to use the weighted mean to test the hypothesis that the true population effect size was significantly greater than zero.

Rosen and MacGuire's findings note that up to one-half of college students, business people and school students may be computerphobic. Of that group, approximately 10% exhibit signs of severe anxiety disorders. In the meta-analysis, the authors examine many types of computerphobia and surrounding myths. For instance, when examining gender differences, the authors found that computerphobia is correlated with sex-role identity. They also found that there was little to support the myth that older adults are more computerphobic. There was also a lack of evidence to prove any correlation between math anxiety and computerphobia. Finally, Rosen and MacGuire discuss the computerphobic personality. They state, “most research has been unable to establish consistently any characteristics as comprising the computerphobic’s personality style” (Rosen & MacGuire, 1990, p. 186). Rosen and MacGuire concluded that most of the common myths about computers are not true. The authors did state that in persons displaying computerphobia additional computer experience may only exacerbate the problem resulting in more computer avoidance.

Responding to Rosen & MacGuire (1990), Bradley and Russell (1997) investigated the role of experience on the development of computer competencies and attitudes. Their study differed from many past studies in that they made a distinction between quantity and quality of past experiences. Bradley and Russell found that if the quality of the experience was good, then the attitudes towards technology were more favorable. Even if a teacher were to have substantial but bad experiences with technology, he or she may have unfavorable attitudes.

"Fundamental to the study of computer-related attitudes is the notion that understanding what these attitudes are and how they are formulated will help us predict actual behavior" (Pancer, George & Gebotys, 1992, p. 212). It is with this thought in mind, that many researchers have examined pre-service teachers' attitudes about technology (Balli, Wright & Foster, 1997; Bielefeldt, 2001; Dawson & Norris, 2000; Laffey & Musser, 1998; Paprzycki & Vidakovic, 1994;

Rademacher et al., 2001; Ropp, 1999; Rovai & Childress, 2002-2003; Thomas & Cooper, 2000; Wetzel, Zambo & Padgett, 2001; Willis & Sujos de Montes, 2002).

When comparing prospective teachers with students of other majors, Paprzycki and Vidakovic (1998) found no differences in overall attitudes towards computers. This may be because pre-service teachers' images of the classroom are derived from their own experiences as students (Balli, Wright & Foster, 1997). "One difficulty in changing the way teachers do things may be that our educational system self-replicates: a new generation of teachers inherits the last generation's classroom practices" (Willis & Sujos de Montes, 2002). Yet technology has progressed so quickly that the classroom of today is much more advanced that the classroom 10 years ago or even five years ago.

Attitudes and Gender. Research has found that females have less favorable attitudes towards technology than males (Bromfield, Clarke & Lynch, 2001; North & Noyes, 2002; Shashaani & Khalili, 2001; Siann et al., 1990; Brosnan & Davidson, 1994; Rosen & MacGuire, 1990). Female enrollment continues to be significantly lower than their male counterparts in high school and university computer classes (Shashaani & Khalili, 2001). "Some research has even traced attitudinal differences in Mathematics, Science and Computer Science as far back as early childhood. Mathematics and science are male dominated and subject to stereotypes that depict females as less able than males" (Bromfield et al, 2001, p. 286).

> Gender may be particularly salient to technophobia since computing is perceived as a 'masculinised' activity by both adults and children.

> Evidence for this includes the initial linkage between 'masculine' subjects such as mathematics with computing as well as male dominance in the industry combined with 'computer culture' which implies a 'technological gender gap'. (North & Noyes, 2002, p. 137)

In studies by Hess and Miura (1983, 1985), noticeable differences were seen in kindergarten summer technology camps. They found that the ratio of boys to girls was about three to one. Many women possess a dual perspective which means women strongly feel they can do just as well as men in the field of computer science but they feel uncomfortable using computers (Shashaani & Khalili, 2001)

Attitudes and Self-efficacy. Research has found that self-efficacy is correlated with computer use (Compeau, Higgins & Huff, 1999; Coffin & MacIntyre, 1999; Compeau & Higgins, 1995; Christoph, Schoenfeld & Tansky, 1998). For instance, Coffin & MacIntyre (1999) found that self-efficacy had a significant effect on learning in a programming course and Compeau and Higgins (1995) found a similar effect of self-efficacy on learning particular computer applications (i.e., WordPerfect, Lotus). Delcourt and Kinzie (1993) investigated teacher attitudes and self-efficacy in relation to computer technologies. They described the development and validation of two survey instruments, Attitudes Toward Computer Technologies (ACT) and Self-Efficacy for Computer Technologies (SCT), that were to be used with education students. The ACT consisted of 19 items and the SCT consisted of 25 items. Both instruments were designed with four-point Likert scales as the response format.

The instruments were given to 207 undergraduate and 97 graduate education students at six universities across the nation. Demographic data such as age, gender and educational level for the students were also collected. The mean age of the participants was 25 years. There were 67 males and 259 female students. Thirty-six percent of the participants used word processoring software at least once a week and 15% indicated that they had never used this type of software. Fifty-three percent of the students never used email and 45% never used CD-ROM databases. More than one-third of the students never used all three of the above applications. The survey data were used to perform a Principal Component Analysis (PCA) and to study the internal consistency reliability of each instrument. Additionally, exploratory hierarchical regression analyses were performed to examine the relationships between demographic variables, experiences in using technology, attitudes and self-efficacy feelings.

The PCA was calculated for both the ACT and the SCT. For the ACT, the PCA demonstrated a three-factor solution for 52.3% of the variance in the set of 19 items. Varimax and oblique rotations revealed similar results. For the SCT, the PCA showed 84.4% of the variance in the 25 items. Again, varimax and oblique rotations showed similar results.

Results of the study, " . . . suggest that experience with computer technologies, either through a course or through frequent use, is a critical area for examination in the study of attitudes and self-efficacy" (Delcourt & Kinzie, 1993, p. 40). The results further suggest enhancing teacher experience with technology can contribute to the formation of positive attitudes and self-efficacy.

Computer Attitude Scale. Loyd and Gressard (1984a, 1984b, 1985) developed the Computer Attitude Scale (CAS) to measure teacher and student attitudes as computers were introduced to schools in the early 1980's. The original CAS had three subscales, computer liking, computer confidence and computer anxiety. Each subscale had 10 questions totaling 30 questions for the survey instrument.

Loyd and Gressard (1984a) performed a study involving 155 students in grades 8 to 12 in order to examine the reliability and factorial validity of the CAS. All participants were students enrolled in a computer-based education program in a large school district. Once the surveys were administered, the data were analyzed for the means, standard deviations and estimates of internal consistency for each of the three subscales. The data were also examined for correlations among the subscales. In order to do this, a 30 x 30 matrix of item correlation was constructed. Factor analysis and principal-component analyses of the data were performed. Finally, coefficient alpha reliabilities for each of the subscales and the total were calculated. The reliabilities were 0.86, 0.91, 0.91 and 0.95 for the computer anxiety, computer liking, computer confidence subscales and the total score, respectively. Fifty-five percent of the total variation was accounted for by the three-factor solution and the first three eigenvalues were 1.30, 1.98 and 1.38. Loyd and Gressard concluded that the subscale scores may be used separately as suggested by the subscale reliability coefficients and factor analysis.

In another study, Loyd and Loyd (1985) administered a new form of the CAS to teachers and examined the reliability and validity of this new instrument. One hundred and fourteen K-12 teachers enrolled in professional development computer courses participated in the study. One additional subscale, computer usefulness, was added the original CAS creating a 40 item measure. The CAS was administered to participants by their computer course instructors. Means, standard deviations and internal-consistency coefficients were calculated for each of the subscales and a 40 x 40 correlation matrix was devised. The data were then subjected to principal-component analysis, factor analysis by varimax rotation and analysis of variance (ANOVA) for differential validity. Four one-way ANOVA's were performed for each of the subscales. The independent variable considered in each ANOVA was level of experience. The coefficient alpha reliabilities were 0.9, 0.89, 0.89, 0.89 and 0.95 for the subscales, computer anxiety, computer confidence, computer liking, computer usefulness, and the total score. A significant correlation of 0.83 was found between the computer anxiety and computer confidence subscales. This suggests that the two subscales of computer anxiety and confidence measure the same trait among teachers. The other two subscales, computer liking and usefulness, demonstrated correlation but were unique enough to be used as separate scores. Loyd and Loyd conclude that the CAS is both reliable and valid in assessing computer attitudes of adults similar to the teachers participating in this study.

Massoud (1990) performed a validation study of the Computer Attitude Scale. The study participants included 59 low-literate adults enrolled in GED programs in Texas. There were 23 male and 36 female participants. Their ages ranged from 16 to 45 and over. The participants were administered a Participant Inventory requesting demographic information and the Computer Attitude Scale. The instruments were completed during a GED session. The sample was found to be representative of the state of Texas when compared to a statewide survey performed by the Texas Education Agency.

The data were first used to test the reliability of the instrument's data. Coefficient alpha reliabilities were calculated for the Computer Attitude Scale and its subscales. The coefficients were very high proving that the scales were highly reliable. Next, factor analysis was performed to find examine the construct validity of the Computer Attitude Scale. "A test's construct validity is the degree to which it measures the theoretical construct or trait that is was designed to measure" (Massoud, 1990, p. 294). Analysis of the data revealed that a three-factor solution accounted for 47.2% of the variation as compared to 54% found by Gressard and Loyd (1986). The factors were then rotated by varimax rotation. Similar varimax rotated factor loadings to Gressard and Loyd were found. All of the factor loadings were at least 0.40 which is the minimum significant value.

Massoud found that the three subscale reliability coefficients and the factor analysis values suggested that the scores of the three subscales were sufficiently defined to be used as independent scores. This study supports the findings of Gressard and Loyd (1986) and Loyd and Gressard (1984a). In conclusion, the results demonstrated that low-literate adults had fairly positive attitudes towards computers.

Teacher Emotions

The most widely studied emotion towards technology is that of anxiety. "The ubiquitous observations that some individuals are unusually anxious about working with computers had led to the proposal of a condition called computer anxiety to describe this state" (Mahar, Henderson & Deane, 1997, p. 683). Furthermore, words such as cyberphobia, technophobia and computerphobia are used to describe the feelings and emotions of individuals who display negative reactions such as anxiety, agitation, discomfort or avoidance when thinking, talking or working with computers (LaLomia & Sidowski, 1993; North & Noyes, 2002; Rosen & MacGuire, 1990; Todman, 2000; Weil & Rosen, 1995).

McQueen (1999) addresses the computer anxiety faced by many university faculty. McQueen suggests that two out of three professors say they are stressed just trying to keep up with today's latest technology. In fact, this new form of stress surpasses the stress caused by regular teaching loads, research and publishing demands. Although many college professors are stressed about technology, approximately 85% use computers for email purposes.

Anxiety and Experience. Many studies have reported that computer experience decreases the anxiety of working with computers (Dyck & Smither, 1994; Lee, 1997). Likewise, lack of experience seems to contribute to computer anxiety (Sigurdsson, 1991). Further, if teachers are less anxious about computers, they are more apt to use them (DuPagne & Krendl, 1992). Going against this research, Anderson (1996) concluded that, "Perceived knowledge rather than experience is a predictor of microcomputer anxiety" (p.74).

Anxiety in Computer-Based Testing. Tseng, MacLeod and Wright (1997) discuss the relationship between computer anxiety and mood change. These researchers measured mood by using a paper-based or an identical computerized form of the Visual Analog Mood Scale (VAMS). The Veltan-type Mood Induction Procedure (VMIP) was then administered by computer to induce a mood change. A group of undergraduate student volunteers completed the VAMS before and after the VMIP. Tseng et al. found that there were significant differences between the moods of the subjects who were administered the computerized version and those were given the standard paper version of the VAMS. In the discussion of this study, the researchers questioned the equivalence of computer-based and paper tests. The presence of computer anxiety is very apparent in this study. "Generalization of computerized scores to those obtained from paper tests, without consideration of individual differences such as computer anxiety levels, will therefore not be uniformly acceptable" (Tseng et al., 1997, p. 315).

Development of an Anxiety Measuring Instrument. McInerny, Marsh and McInerny (1999) developed the Computer Anxiety and Learning Measure (CALM). The reason for the development of this questionnaire was based upon the need for a precise measurement instrument that would measure the multiple dimensions of computer anxiety in training scenarios for adult learners by providing both valid and reliable scores. Based on past research, both positive and negative cognitions about learning to use the computers were considered (Rosen, Sears & Weil, 1993). The authors collected research from the areas of clinical anxiety, educational psychology, computer anxiety and preexisting instruments of computer anxiety and attitudes (McInerny et al., 1999).

Once the past literature was collected, the authors devised and tested the instrument, which was administered to nearly 800 students enrolled in an Australian university. After administering the survey, the data were divided into three subgroups and examined using factor analysis. After computing the results of these three subgroups, it was concluded that the CALM instrument was both valid and reliable.

Anxiety in Relation to Learning Styles, Programming Instruction and Gender. Ayersman and Reed (1995/1996) investigated the effects of learning styles, programming and gender on computer anxiety. The study participants were 58 undergraduate education students who were asked to attend a computer module. After attending the module, three surveys were administered, the Computer Awareness Module, Kolb's Learning Styles Inventory and a modified version of Spielberger's Self-Evaluation Questionnaire. The results of this study indicated that programming instruction does decrease computer anxiety. However, no significant results were found for learning styles or gender.

Anxiety and Demographics. Studies conducted on computer anxiety among different age groups suggest very little if any correlation with age and computer-related anxiety. Massoud (1991) used adults above 45 and found no age differences in computer anxiety. In another study, Gilroy and Desai (1986) concluded no difference in anxiety among different age groups but did not disclose the ages of their study participants. Finally, Loyd and Gressard (1984b) found that younger students had positive attitudes about computers in a sample that was divided into 13-15, 16-18, 19-20 and above 21 years groups.

Dyck and Smither (1994) compared levels of computer anxiety between younger and older adults. One of their reasons for the study was to encourage and suggest that the technology innovation of the 20th century should be used to help the increasingly older population to maintain their independence and reduce the need for caregiving. The impetus for the study was that, "One of the factors likely to affect the acquisition of computer skills by older adults is computer anxiety" (p.240). This study examined computer anxiety in younger and older adults by using two different scales. Additionally, the relationship of computer anxiety to computer experience, gender and educational level were also investigated. The instruments administered to the participants in this study included the Computer Anxiety Scale, Computer Attitude Scale, demographic questions and computer experience questionnaire.

Findings revealed a main effect for age and gender and an interaction between age and gender. Contrary to these findings were the results showing that older adults responded as having less confidence than young subjects. Other items revealed by the data include that younger females liked computers less than younger males. However, no such difference was found for older females and males.

Dyck and Smither concluded that the reason older adults have more favorable views of computers than younger adults is because of their types of computer experience. The results may reflect the attitudes of older adults who have used computers at work and for recreational purposes whereas younger adults use computers primarily for school. The authors suggested that further study be done on the types of computer experience that lead older adults to have more positive attitudes about computers and the tendency of younger females to like computers less than their male counterparts as opposed to no difference in older adults.

Yang, Mohamed and Beyerbach (1999) conducted a study to investigate how computer experience affects the relationship of educators' computer anxiety and demographic variables. The variables were learning style, age, gender, ethnicity/culture, subject area, educational level and type of school. The participants of this study included vocational-technical educators from Dade County, Florida. The Kolb's Learning Styles Inventory (Kolb, 1985) and a short-form Computer Anxiety Scale (Oetting, 1983) were administered. It was found that a majority of the participants had positive attitudes towards the participation in computer training and computer use in the classroom. Furthermore, many of the participants were involved in computer-based training.

Analysis of variance (ANOVA) found that there were significant differences for anxiety among educational level and subject area and type of school. ANOVA also found significant differences for computer competence and computer training among educational level, gender, subject area and type of school. Finally, analysis of covariance (ANCOVA) found significant differences for computer anxiety, educational level and type of school.

Yang et al. concluded that computer-related experience influences computer anxiety. They also found that computer anxiety was not related to the demographic variables of age, ethnicity and subject area. Educational level and type of school did significantly affect computer anxiety. The researchers conclude the study by including a list of suggestions for reducing computer anxiety. Suggestions include increasing computer-based training, enhancing computer competence, increasing computer confidence and improving computer perception.

Brosnan (1998) performed a study examining the impact of psychological gender, gender-related perceptions, significant others and the introducer of technology on computer anxiety in students. The participants of this study included 119 undergraduate psychology freshman enrolled in several London universities. There were 39 males and 80 females in the age range of 18 to 53 years. The study began by assessing the psychological gender attributes. This was done by administering the Bem Sex Inventory. Next, computer anxiety was assessed using the Computer Anxiety Scale. The results of this study indicated that females were significantly more computer anxious than males. The male students also reported using computers twice as frequently as females during a week. Computer use negatively correlated with computer anxiety. Results also showed that both males and females perceived computing as a male activity. The mean age of first computer usage for the study participants was 15 years.

The study also found that although those introduced to technology by a teacher were more anxious than those introduced by a friend or family member, this was not significant at the 0.05 alpha level. In conclusion, Brosnan stated,

> The role of the introducer of technology has been emphasized in the development of students' computer attitudes and anxiety. As teachers represent by far the largest grouping of 'introducer,' it is imperative that this occupational group is adequately trained to reduce any anxieties they themselves might have. (p. 73)

In response to a nationwide study finding that teachers are not using computers as availability increases, Rosen and Weil (1995) examined computer availability, experience and technophobia among teachers. They chose to examine technophobia in an effort to explain the low levels of teacher technology use. First, a pilot study was performed to modify three existing technophobia instruments, the Computer Anxiety Rating Scale (CARS), the Computer Thoughts Survey (CTS) and Attitudes Toward Computers Scale (ATCS). All three instruments were previously used to measure the anxiety of students and were adapted to include questions for teachers. Additional data to be collected from the teachers included demographics, computer experience and computer availability. Over 2000 technophobia instruments were distributed to faculty mailboxes at 54 schools in five urban California school districts. Twenty-five percent of the questionnaires were returned. This low return rate was actually considered remarkable due to the length and sensitivity of the survey instrument.

Once the surveys were returned, five research assistants began to analyze the data. F-tests were performed to determine differences between the elementary and secondary teacher groups. Except for age, no groups differed significantly which was proven by Scheffe's Test. Teachers who used computers with students were compared to those who did not on each of the demographic variables. It was found that nearly twice as many White teachers used computers with students as non-White teachers. Others findings included, more White secondary humanities teachers used computers than non-White teachers, elementary teachers with more experience used computers less than those with less experience and male secondary science teachers used computers more for personal use than female science teachers. In regards to technophobia, Rosen and Weil found that over half of elementary teachers and about one-third of secondary teachers are technophobic. Many of the elementary technophobic teachers in the study were African American or Asian female teachers with several years of teaching experience.

Next, stepwise multiple regressions were performed for the three technophobia questionnaires and the demographics data. For all of the teachers, computer experience was the best predictor of computer anxiety. Both computer experience and present use were found to be predictors of computer cognition. For elementary teachers, present computer use, availability and ethnic background were stronger predictors of attitudes than computer experience. Interestingly, the predictors for secondary teachers were quite different. Predictors of secondary teachers' computer attitudes were present computer use, computer experience, computer availability, gender and school socioeconomic status. Computer experience was the strongest predictor of technophobia for all of the teachers.

Rosen and Weil (1995) concluded that the adapted versions of the CARS, CTS and ATCS were reliable and valid measures of technophobia. They were also concerned with the high levels of technophobia found among many of the teacher groups. Their concern stemmed from prior research on the importance of the introducer of technology (Weil, Rosen & Wugalter, 1990). "This study has demonstrated clearly that teachers do not hold a positive attitude and do not feel comfortable with computers" (Rosen & Weil, 1995, p. 25). This is a matter of concern because teachers' attitudes towards technology influence students' attitudes.

Anxiety and Attitudes Toward Computers. Hong and Koh (2002) examined computer anxiety and attitudes among secondary teachers in rural areas of Malaysia. The study focused on the relationship between computer anxiety and attitudes towards computers and the study also considered differences in anxiety and attitudes based on several demographic factors.

A questionnaire was devised using items from other instruments including the Anxiety Scale (Igbaria, 1990), the Computer Attitude Scale (Gressard & Loyd, 1986), the Computer Use Questionnaire (Griswold, 1983), the Attitudes toward Computers instrument (Reece & Gable, 1982), the Computer Survey instrument (Stevens, 1982) and the Students' Attitudes toward Computers instrument (Selwyn, 1997). The newly constructed survey instrument contained a total of 64 items to measure anxiety and attitudes and was used in a pilot study. The results of the study were then subjected to principle component factor analysis with varimax rotation. Task Anxiety, Social Anxiety and Hardware Anxiety, were the three factors extracted for the anxiety scale accounting for 63.8% of the variance. Cognitive Domain, Affective Domain and Behavioral Domain were the three factors extracted for the attitudes scale accounting for 44.3% of the variance. Next, independent *t*-tests were conducted to find any differences in computer anxiety and attitudes toward computers based on the demographic factors. Finally, one way analysis of variance (ANOVA) was performed to find any differences between anxiety and attitudes based on computer experiences.

Hong and Koh found that the overall computer anxiety among the teachers was low (M=1.87), however the hardware anxiety domain was high (M=2.11). They also found that the overall attitudes towards computers were positive (M=3.06). Of the three domains, the behavioral domain had the lowest mean (M=2.87). The low behavioral domain and higher affective and cognitive domains indicates that teachers were hesitant to use computers even though they believed that computers were useful. A scatter plot of computer anxiety and attitudes towards computers showed a strong negative linear relationship. The Pearson product moment coefficient (r=-0.639, p<0.01) revealed a significant relationship between anxiety and attitudes.

The only significant gender difference in computer anxiety or attitudes toward computers was found in hardware anxiety. Female teachers had significantly higher hardware anxiety levels than their male counterparts (t=-

3.074, *p*<.01). Teachers who owned computers had lower overall computer anxiety levels and more positive attitudes towards computers than teachers who did not own computers. Access to school computers and perceived school support did not have any significant relationships to anxiety or attitudes. There was a significant difference in overall computer anxiety levels and in attitudes towards computers between teachers with different levels of computer experience. Teachers with more than three years of computer experience had less computer anxiety and more positive attitudes towards computers compared to those with less experience. "The results confirmed the belief that the amount of computing experience has a strong relationship with computer anxiety and attitudes toward computers" (p. 44). This finding is consistent with several other studies (Bear, Richard & Lancaster, 1987; Bryd & Koohang, 1989; Kulik, Bangert & Williams, 1983; Levin & Gordon, 1989).

Teachers' Beliefs

Literature increasingly supports the idea that teacher beliefs are stronger predictors of decisions and behavior than knowledge (Pajares, 1992). Many teachers believe that technology implementation will not facilitate the educational process. "Recently there has been a growing interest in understanding what teachers believe about the nature of knowledge and learning and how these beliefs, or epistemologies, affect their curriculum implementation and instructional approaches" (Howard, McGee, Schwartz & Purcell, 2000, p. 455). Research suggesting that teachers adopt innovation in light of their goals and beliefs has not examined how teachers' beliefs and values influence successful technology integration (Honey & Moeller, 1990)

<u>Beliefs and Technology Implementation</u>. Ertmer et al. (1999), examined the relationship between first and second order barriers to technology implementation. This was done by observing and interviewing seven teachers in a school who had integrated technology to varying degrees.

> . . . first-order barriers to technology integration are described as being extrinsic to teachers and include lack of access to computers and software, insufficient time to plan instruction, and inadequate technology and administrative support. In contrast, second-order barriers are intrinsic to teachers and include beliefs about teaching, beliefs about computers, establishing classroom practices, and unwillingness to change. (Ertmer et al., 1999, p. 54)

The authors found that teachers' beliefs interacted with first-order barriers either to facilitate or limit the technology use of teachers. All of the teachers in the study described first-order barriers for varying reasons and degrees. The second-order barriers were noted only by those teachers who used technology in their curriculum.

Teachers usually adopt and use technology through a development process (Mancinkiewicz, 1993/1994). As teachers advance through these steps of the process, their technology use becomes more frequent as they learn how to use more applications, more effectively (Hadley & Sheingold, 1993).

The purpose of the study by Ertmer et al. (1999) was to examine the relationship between the first and second-order barriers. This leads to the primary research questions, which was not just how teachers use technology but why they use it. During the study, survey, interview and observational data were collected. Observations took place over six weeks and each teacher was interviewed three times. All teachers completed a survey at the beginning of the school year providing information such as years of teaching experience, computer experience, comfort with software applications, goals for classroom use and a personal defense of technology integration. As the data were collected, attention was given to teacher beliefs, especially those related to the role of technology in the classroom.

It was found that teachers' use of technology in the classroom ranged from rarely to daily. Computer applications included instructional games, exploratory software and specific software. About half of the teachers felt that technology should be used as a supplement to learning because there was already plenty of content for the teachers to cover. Every teacher made some statement about how technology should be used to supplement the curriculum. Few teachers made any reference to using technology beyond the curriculum.

Next, Ertmer et al. discussed incentives and barriers to technology use in the classroom. Five reasons that teachers stated for using computers in the classroom were motivation, preparation for the future, making lessons more interesting, helping students with learning or attention problems and personal enjoyment. Teachers complained of barriers to technology use as both first-order and second-order barriers. First-order barriers were lack of time, equipment and assistance and second-order barriers included lack of relevance, confidence and classroom management mismatch.

In the end, it was interesting to note that all the teachers mentioned first-order barriers. Second-order barriers, on the other hand, were mentioned most often by those teachers who used computers to supplement the curriculum. Understanding teachers' goals for technology use and beliefs about education may be necessary to support efforts to begin and maintain the second-order changes needed to become practice (Fullan & Steigelbauer, 1991). Furthermore,

> Increased attention is being paid to the idea that lasting change in the classroom must be accompanied by changes in teachers' beliefs about the purpose and nature of instruction and that these belief systems are remarkably resistant to change. (Ringstaff, Sandholtz & Dwyer, 1991, p. 15)

<u>Beliefs and Demographics.</u> A study performed by Harris and Grandgenett (1999) correlated data which represented one year of online use with questionnaire items about teacher beliefs and demographics for 558 respondents from an initial sample of 1000 randomly selected Internet account holders on TENET. TENET is the statewide K-12 educational telecomputing network in Texas. Therefore, all the teachers participating in this study did have some knowledge and experience of telecomputing.

The authors wanted to see if TENET use data had any significant correlation with the following variables: age, sex, number of years of teaching experience, type of school, job responsibility, certification, years of computing experience, years of telecomputing experience, highest degree awarded, beliefs about teaching, perceptions of degree of personal innovativeness and world view.

Harris and Grandgenett searched for statistical correlation between participant attributes and network use. After examining survey responses and network records, nine interval-level variables were included in the final correlational analysis matrix. These variables were years telecomputing experience, years computing experience, years in education, age, teacher attitude inventory, attitudes about reality scale, innovativeness scale, total network logins and total online time.

There was significant correlation with the chosen variables with either total network logins or total online time. Correlations did exist among the belief measures. Interestingly, age played a small role in the correlational patterns seen for the respondents who completed the survey on the Web rather than paper. One point that Harris and Grandgenett reiterated a number of times was that the sample used in this study was unique. All participants had been utilizing a telecomputing network for at least a year and therefore saw themselves as computer literate and innovative. This homogeneity of the sample explains the lack of correlation seen between the paper and Web-based respondents.

Beliefs and Pedagogy. The use of computers and the Internet is related to changes in teacher practices. Some teachers prefer to use technology in the classroom because they believe that it promotes a constructivist classroom (Howard et al., 2000; Willis & Tucker, 2001). It is the appeal of constructivist innovation that encourages teachers to invest the time and energy for technology implementation. Many teachers have reported that the Internet encourages students to work more independently.

Howard, McGee, Schwartz and Purcell (2000) examined a training course offered by the NASA Classroom of the Future. The program was a four week, six-credit graduate course for K-12 teachers and it focused on multimedia computer-based technologies and the Internet. The course was the first in an instructional design and educational technologies masters program. Teachers were chosen as participants of the training program from a national pool of 250 applicants. The study examined teacher epistemology and its effects on teacher instruction and searched for parallels with Schömmer's proposed epistemological dimensions and the constructivist and objectivist learning models. The purpose of the program was, ". . . to investigate how teacher epistemological beliefs might be changed as a result of the training program" (p. 458).

An epistemology questionnaire was administered before and after the course. One-tailed t-tests were performed and the data revealed that the teachers displayed significant changes in three out of four factors towards greater constructivist epistemology. The four factors examined were simple knowledge, quick learning, certain knowledge and fixed ability. Fixed ability was the one factor that did not show a significant change. The other three factors demonstrated negative valences which was expected. The results indicated that teachers evolved from objectivist epistemologies to more constructivist ones.

The study had two major implications: constructivist training techniques may lead to the adoption of more constructivist beliefs and epistemology may be less static than once believed. Howard et al. concluded, "the fact that epistemology, a trait assumed to be stable, changed so dramatically indicates that the training program was very effective and that certain epistemological dimensions are subject to change" (2000, p. 462).

Technology Self-Efficacy. "Those with low self-efficacy expectations in a particular situation will experience unpleasant feelings, such as anxiety, and will behave in unproductive ways, such as avoiding work, and may lack persistence" (Bandura, 1977). In a study by George and Camarata (1996), self-efficacy was used as an indicator of motivation. Furthermore, many of Bandura's (1977, 1988) studies have shown that the greatest influence on self-efficacy is vicarious experience.

Decker (1999) investigated influences on employee self-efficacy of technology as a result of training programs intended to serve the needs of individuals or organizations. The basis of his study was to determine the results of the effect of training influences on technology self-efficacy following training and the length of self-efficacy for the purpose of training usefulness. Following the training programs, Decker assessed employee self-efficacy and determined the usefulness of the technology education. A survey was administered to 2,597 university employees. Results revealed that employee computer self-efficacy levels remained constant for a two and a half year period. Factors such as frequency of computer use, home computer use and training responsibility were also considered. The survey instrument used in this study was the Self-efficacy of Computer Technologies Scale (SCT) developed by Kinzie and Delcourt (1991). Results of the study suggested that influences such as previous computer training, job required computer use, frequency of computer use, home use and training responsibilities should be considered when designing technology education training programs. Participants that responded as regularly using computers in the workplace report more steady and productive performance than those who rarely used computers at work. Decker states that being more technology self-efficacious requires some combination of home use, previous training, job related computer use and training responsibilities. In conclusion,

> This study re-emphasizes the necessitated role of organizations in equipping any and all human beings with technical workplace skills. Organizations that fail to provide employees with occasions to increase productivity will be negatively impacted by high turnover, more employee expenses, lower quality, and lost market share. (p.170)

<u>Outside Influences</u>

Faculty face a number of pressures to use technology in their classrooms. This pressure is coming from the federal government, school administration, professional organizations, parents and community (Besser, 1993; Clark, 2000;

Davidson & Ritchie, 1994; Llorens, Salanova & Grau, 2003; Pinkston, 2000). This pressure needs to take the form of support. "It is the combination of the teachers' motivation and long-term effort as professionals, the support they receive, and the access to technology that makes their accomplishments possible" (Hadley & Sheingold, 1993, p. 299).

Administration Pressure. In the case of York University of Canada, the pressure of the administration back-fired and resulted in a teacher strike (Young, 1997). The strike lasted for 55 days. The university faculty felt that the administration was moving too fast with technology that no one understood.

Often times, the presence of technology in a school presents a problem for educators and students. This problem may be caused by any of the following reasons: lack of administrative support, inadequate staff development and technical support, low quantity, quality and access of technology in the classroom, brief plans for implementation of technology, lack of technical supervisor or coordinator and use of traditional methods of teaching (Hoffman, 1996; Sandholtz et al., 1997). Of all these factors, lack of administrative support may be the most critical. For instance, when the principal does not support his or her teachers, problems often occur. If the principal supports the faculty, there is a much better atmosphere within the school.

Administration and faculty cannot ignore the presence of technology. More and more school districts are incorporating technology into their schools. In fact, 43 states have required or recommended the use of some technology in the school curriculum (Zehr, 1999). Even as computers become more commonplace, teachers may not always use them. Although the ratio of computers to students continues to decrease, most teachers report little or no use of computers in their classrooms (Bielefeldt, 2001; Brush et al., 2001; Ertmer et al., 1999; Clark, 2000; MacKenzie & Clay, 1995; Rosen & Weil, 1995; Rovai & Childress, 2002-2003). Often, students know more than their teachers. In order to place educational technology into the hands of the students, teachers need to have access to the technology and the understanding and confidence in their use of technology. Strong leadership is an essential component of this process (Fullan & Steigelbauer, 1991; Ritchie, 1996).

Community Pressure. Schools are important for economic development (Besser, 1993). Therefore, teachers are being pressured by businesses and companies in the community to educate students in the rapidly advancing field of technology (Eastin, 1999). Louis Gerstner, the CEO of IBM, stated, "[technology] is the force that revolutionizes business, streamlines government and enables instant communication and the exchange of information among people and institutions around the world" (Glennan & Melmed, 1996, p. xiv). Companies such as IBM are continuing to invest millions of dollars on technology only to later realize that employees are not using this state of the art technology (Campbell, 1998). In 1997, American companies spent approximately 12 percent of training budgets on teaching employees computer skills (McCune, 1999).

> A lot of this training focuses on simple applications such as email and spreadsheets. Americans overwhelmingly understand that technology can play a vital role in education, especially in providing access to information

> and preparing students for the jobs of the future. 85 percent of voters surveyed believe that schools well-equipped with technology have a major advantage over schools that are poorly equipped. 74% say that technology will have a positive effect on education, because it will provide students with equal access to information and knowledge. All demographic groups are optimistic that technology will break down society's barriers, not increase them. (Milken Family Foundation, 1997, p. 1)

Changes in Teacher Certification. The Office of Technology Assessment (1995) report found that many teacher education programs do not prepare teachers on how to use technology in their classrooms. Thirty-two states now require some computer training or coursework as part of the teacher certification process (Rosen & Weil, 1995; Yildirim, 2000). California, for instance, mandated that all "clear credentialed teachers" show that they have taken coursework in the use of computers (Rosen & Weil, 1995, p. 10). The California Education Code states that all teachers must take a course designed to introduce teachers to common computer applications and teach basic computer skills (Cuban, 2001; Yildirim, 2000). The main purpose of the course is to increase and improve teachers' experience with technology. "However, research suggests that although a single computer course may be enough to teach students some basic computer applications, this isolated course is not enough to prepare teachers to use technology in their instruction" (Kumar & Kumar, 2003, p. 87).

Studies have found that although technology is increasingly apparent in teacher education programs, these programs should do more to aid prospective teachers to integrate technology into future teaching (Bielefeldt, 2001; Brush et al., 2001; PCAST, 1997; Persichitte, Tharp & Caffarella, 1997) Education students do not always have experience applying technology into teaching (Lan, 2001; Bielefeldt, 2001). Most teachers are able to use simple applications such as word processors, email, Internet but not even 10% are able to use advanced instructional software such as multimedia, problem-solving and electronic network collaboration capabilities (Kumar & Kumar, 2003).

> If technology is to be integrated successfully into classroom instruction, teacher education must be able to exhibit successful technology use in pre-service coursework . . . . Pre-service education can provide rising teachers with the confidence and knowledge required to use the technological tools available to them. (Kent & McNergney, 1999, p. 4)

The Federal Government's Stance on Technology in Education. In 1994, Congress passed the Improving American Schools Act of 1994 (Ritchie, 1996). The act was passed on the basis that technology will help to improve the educational system and the growth of students. As a result, more and more schools are now attempting to incorporate technology into the curriculum.

President Clinton has addressed educational technology throughout his term. In his 1997 State of the Union Address, Clinton stated,

> To prepare America for the 21st century we must harness the powerful forces of science and technology to benefit all Americans. This is the first

State of the Union carried live in video over the Internet. But we've only begun to spread the benefits of a technology revolution that should become the modern birthright of every citizen . . . .

We must build the second generation of the Internet so that our leading universities and national laboratories can communicate in speeds 1,000 times faster than today . . .

But we cannot stop there. As the Internet becomes our new town square, a computer in every home – a teacher of all subjects, a connection to all cultures – this will no longer be a dream, but a necessity. And over the next decade, that must be our goal. (Clinton, Jan. 1997)

Clinton signed a bill in September 1996 funding the Department of Education for $26.3 billion for 1996-97. This is three billion more than the budget allowed. The additional money was needed because the Department of Education was designing a plan that aimed to have every teacher trained and every classroom up to speed by the year 2000. The three goals of this plan were to train all teachers, provide equipment, and make quality content software available. Of the $3 billion, $2 billion was to be used for the President's new Technology Literacy Challenge Fund (Cuban, 2001). President Clinton established the National Science and Technology Council to oversee his federal technology policy. Other organizations such as the Department of Education and the National Coordinating Committee for Technology in Education and Training have also been active in Clinton's plans for educational technology.

The government has invested significant funds for the purchase of school technology over the past decade (Painter, 2001). The most recent example of this support is the United States Department of Education Preparing Tomorrow's Teachers to Use Technology (PT^3) grants. The goal of the PT^3 program is to fund the training of both teacher education faculty and K-12 teachers. "Professional development will provide the opportunities for technology teachers and other educators to learn what they need to know and be able to do as they assist students in achieving the technology literacy standards" (Bybee & Louck-Horsley, 2000, p. 2).

Despite the interest and involvement of the government, education actually takes place at the local level. Each state determines its own policies. Ultimately, the President can only provide guidelines that he believes should be followed by each state, district and school.

Teacher Technology Education. Technology training is an essential step towards technology implementation in a school. Lack of training accounts for teachers' low confidence and negative attitudes when beginning technology activities (Cox, Rhodes & Hall, 1988; Kumar & Kumar, 2003). "Only 15% of teachers across the United States have received 9 or more hours of technology training . . . . Without question, technology education influences the level of use of technology in the classroom" (Kent & McNergney, 1999, p. 10). Additionally, teachers who were trained during the last 20 years were trained by faculty and training professionals who were themselves trained before computers appeared in schools (Roberts, Hutchinson & Little, 2003).

Many studies stress the importance of training to encourage teachers' technology use and to develop positive attitudes towards computers (Kumar & Kumar, 2003; Robert et al., 2003). "Further long-term research is needed in technology staff development to help us round out the picture of how aspects of and strategies for staff development affect teachers' current and future students" (McGrath & Thurston, 2001-2002, p.67). Although many studies have found that more experience and training will result in more positive attitudes about technology, some studies have proven the opposite (Rosen et al., 1993; Rosen & MacGuire, 1990). It is unfortunate that preservice teacher programs cannot keep up with the rapidly moving field of education (Valesey, 1999).

"Research on technology and teacher instruction suggests that teacher education programs need to model technology use if pre-service teachers are to acquire the necessary expertise to integrate technology into their own teaching" (Kent & McNergney, 1999, p. 13). Education faculty who are comfortable and confident with technology create teacher technology leaders (Falba et al., 1999). Furthermore, students who see technology use modeled in their classroom and have access to technology are more likely to apply technology within their own learning experiences.

Time commitment is a major issue for teachers (DuPagne & Krendl, 1992; Sandholtz et al., 1997). Teachers who feel their computer skills are inadequate are rarely willing to put forth the time and energy to learn. Teachers are already pressed for time and are unable to devote even more time to something that they may not need for teaching. Furthermore, most teachers who make the attempt to learn more about technology are self-taught and spend their own time and money (Hoffman, 1997; Sheingold & Hadley, 1990). This may be done through self-study, conferences and workshops. As stated previously, all of these methods require teachers to invest their own time and money. This can be very discouraging to teachers who feel that they are already overburdened with their work.

Schools need to invest the valuable time, effort and financial resources toward staff development. Unless teachers are properly trained and confident in their skills, they will not use technology in the classroom. Unless school districts invest more financial resources towards technology training, teachers will not be fully capable of using new technology in the classroom (OTA, 1995). In 1998, schools spent approximately $88 per student on computer equipment and only $6 per student on technology training for teachers (Nellen, 1999).

> Although traditional professional development still dominates most schools and districts . . . there is increasing awareness that new forms are both possible and desirable. The education we want for students – a wide array of learning opportunities, engagement and commitment to inquiry, access to real problems to solve, learning that connects to their prior experiences, opportunities to work with others – can be provided to teachers when they are the learners. (Lieberman & Grolnick, 1997, p. 192)

Most schools use one-day technology workshops or seminars to train their staff (Sandholtz et al., 1997). This method of training is often not effective. "What teachers actually need is in-depth, sustained assistance as they work to integrate computer use into the curriculum and confront the tension between traditional methods of instruction and new pedagogic methods that make extensive use of technology" (PCAST, 1997, p. 49). Research shows that ongoing staff development programs are more effective in training teachers and encouraging technology implementation in the classroom (PCAST, 1997).

Teachers also need onsite assistance from a full-time computer coordinator (PCAST, 1997; Sandholtz et al., 1997). Teachers need to have positive feedback and support especially after they are introduced to a new activity. Sandholtz et al. (1997) found,

> Teachers, like students, cannot be expected to engage in new skills or behaviors unless they have feedback and support soon after they are introduced to the new activity, We found that teachers' excitement and enthusiasm about integrating technology often faded if they did not receive support within a few weeks of attending the staff development program. (p.164)

Coordinator support provides both reinforcement and assistance when necessary. Sandholtz et al. describe many forms of administrator support including providing time for learning, arranging technical support, easing access problems, showing interest and creating a shared school vision.

Kinslow et al. (2002) describe how West Chester University (WCU) has integrated technology into its teacher preparation program. WCU received a Preparing Tomorrow's Teachers with Technology (PT^3) grant. This study follows the progress of the university faculty for one year. The goal of the program was to effectively prepare teacher education students with technology, encourage university faculty to use and model technology use and create a cadre of faculty that encourage other to use technology.

WCU faculty infused technology into both content and methods courses in order to encourage the students to integrate technology in their future teaching. The PT^3 grant helped finance new educational resources, new equipment and infrastructure, collaborative planning, faculty training, implementation strategies, PK-16 collaboration and communication of successful activities. The ultimate goal of this project and grant money was to make WCU a model in developing technology proficient teachers.

Nineteen WCU faculty participated in the PT^3 project. All participants were given a three-credit course relief to allow for more time to learn about technology which proved to be extremely valuable. Workshops, professional development opportunities and support sessions were planned throughout the year to show faculty how technology can be integrated into the teaching and learning process. The School of Education Dean also participated in many of the planned activities.

Surveys were distributed to faculty at the onset of the project. Data included technology use and habits. Most instructors reported using technology such as word processing software and email for their own work but not in their teaching. Seventy percent of the faculty expected their students to use word processors, 13% presentation software and 17% spreadsheets and/or graphics software. The faculty had a wide range of competencies ranging from novice to expert at the onset of the PT^3 project.

WCU faculty became more comfortable with technology during the course of the project. The ongoing support and training was helpful. Faculty began to better use pre-existing university resources. For example, faculty took advantage of training offered by the university Web instructional specialist. Frequent meeting with colleagues also encouraged more technology use and provided opportunities to share experiences. Overall, the PT^3 project was very successful in helping faculty learn how to use technology in their teaching. As a result of the project, faculty integrated technology into their courses and became models of technology use for the preservice teachers.

McGrath and Thurston (2002) conducted a long-term follow-up study of middle school teachers and their past and present students. Seventeen teachers had participated in a teacher staff development project during the 1988-1989 academic year. Topics included computers in the classroom and gender equity. At the time of the project, researchers questioned whether there would be long-term effects on the teachers or students.

At the start of the program in 1988, computers were just starting to appear in rural classrooms in Kansas and teachers had little knowledge of how to use computers in the classroom. The project provided much needed training and support for the teachers. The teachers were also encouraged to involve girls in computer activities. A computer anxiety scale was administered to the teachers at the beginning and end of the 1988-1989 schoolyear.

In 1996, the 17 teachers that were part of the original study were invited to participate in the follow-up study. Their former students who were now in high school and their present students were also asked to participate in the new study. The teachers took part in follow-up surveys and interviews. The Computer Opinion Study (Maurer & Simonson, 1984) was used in both the original study and the follow-up study. Groups of control students in the same grade levels as the past and present students were included in the follow-up study in order to compare self-efficacy levels and likes and dislikes. The Computer Self-Efficacy Instrument (Murphy, Coover & Owen, 1988) and the Common Item Survey were administered to all students. The Computer Self-Efficacy Instrument was not used in the initial study. Some brief student interviews were also conducted. Four female students from the original study were interviewed. Forty-two current students and 28 control students were interviewed.

During the years between the initial and follow-up study, the 17 teachers developed as leaders at a rate that seemed faster than their colleagues. The teachers became more comfortable with educational technology and demonstrated less computer anxiety. Analysis of the Computer Opinion Survey data shows a decrease in the mean anxiety score from 2.07 to 1.53. Most of the teachers attempted to keep up with the field of educational technology. Two completed Masters degrees in educational technology. As for the students, girls from the original study had significantly higher self-efficacy scores than their counterparts in the control group. Furthermore, girls in the experimental group liked computers more than boys in both 1989 and 1996. McGrath and Thurston (2002) concluded that both the teachers and students are more confident and technologically competent now because of participation in the original study. The initial study did have positive long-term effects.

Mentoring. A training program that has been proven effective is mentoring (Ali & Elmahdi, 2002; Franklin et al., 2001; Gilmore, 1994; Kamens, 2000; McArthur et al., 1995; Nellen, 1999; Reilly, 2000). In this method, faculty with more technology experience attend training programs and return to their schools to train their peers. This method has been proven effective because many teachers feel comfortable asking for assistance from their peers rather than an "expert" who appears for one time for a workshop or staff development program. It is also very cost effective because only a limited number of faculty and staff need to be trained initially. Research has found that mentoring and collaboration are also beneficial for student teachers. Kamens (2000) found that the support of peers helps develop student teachers into confident and capable teachers. Several researcher have also found that using students as mentors is an effective form of mentoring (Franklin et al., 2001; Ali & Elmahdi, 2002; Reilly, 2000) In most instances, students are more knowledgeable about computers than their teachers.

Franklin et al. (2001) examined one-on-one mentoring as a method for assisting teachers to learn how to integrate technology in their classrooms. An elementary school in Ohio was used for this study. Eight classrooms were observed by eight doctoral students who served as mentors over 21 weeks. Data included the classroom observations, teacher journals and mentor journals. The mentors modeled technology use in the classrooms for the teachers, helped provide technical support, helped design technology-enriched lessons and taught new technology skills. Most of all, the mentors provided training and help during class. Teachers are often hesitant to attend staff development programs outside school hours and learning from a mentor during class was convenient.

At the onset of the program, the mentors had a dominant role when the teachers used technology. This slowly changed and the teachers began to take more control of technology related activities. Some mentors commented that they were no longer needed towards the end of the 21 week period. Franklin et al. (2001) found that mentoring is an effective professional development technique for teachers. It provides the convenient ongoing support that teachers need as well as one-on-one attention.

Ali and Elmahdi (2002) describe the experiences of graduate students who mentored university faculty for six months on educational technology. Twelve graduate students chose to participate in this mentoring project as part of their practicum requirement. Twelve faculty were then selected to participate in the mentoring project. The student mentors and faculty were then matched according to needs, interests and abilities. The faculty was expected to set the agenda (select topics), set the time, commit to work with the mentor for at least one hour a week and work alongside the mentor. The faculty needs varied from learning basic technical skills to using more advanced applications.

The mentoring project emphasized an active role for the learner. This encouraged the learning to be project-based, problem-based, individualized, collaborative and active. Both the faculty and the students reported the mentoring project to be a successful and worthwhile experience. All of the faculty showed significant progress by the end of the project. The individualized approach was extremely effective. The mentoring relationship proved to be a mutual one. The students were able to practice and share their skills and the faculty were able to learn about educational technology at their own convenience.

Preservice Teacher Education. Dawson and Norris (2000) present the findings of a study examining the Technology Infusion Project (TIP). The program was a collaborative effort between the Curry School of Education at the University of Virginia and the Albemarle County Public Schools. TIP placed preservice teachers into technology-rich K-12 classrooms as part of their field experiences. The purpose of TIP was to prepare preservice teachers for the classroom and to develop positive relationships between the area schools and the university.

> Effective K-12 and university collaborations can bridge the gap between understanding the theoretical frameworks and the practical applications necessary for designing successful teaching and learning experiences. By participating in mutually beneficial relationships, university and K-12 faculty can share new teaching and learning models, expertise gained from current research and literature on classroom teaching , and additional resources in the forms of personnel, materials and support. (p.5)

Sixteen teacher education students participated in this study. Various forms of data were collected for triangulation. Data included journals, email communications, classroom observations, technical competencies and practicing teacher evaluations. The data revealed two primary advantages for the preservice teachers: development of positive attitudes toward educational technology use and increased competency in the use of educational technology. Upon further analysis of attitudes, it was found that the preservice teachers developed more confidence in using technology and recognized the value of technology in education. They acknowledged computers to be an instructional tool.

The teacher education students reported time constraints and computer access problems. Most of the students complained of incredible time commitments beyond typical field experiences. They were also frustrated about computer and software access. These factors have also been reported by many other researchers (Chiero, 1997; Ertmer et al., 1999; Franklin et al., 2001; Hadley & Sheingold, 1993; Hannafin & Savenye, 1993; Ringstaff & Yocam, 1994; Sandholtz et al., 1997). Overall, TIP was a success. The program improved classroom instruction, empowered teacher education, encouraged professional development and supported university and school collaboration.

Rademacher et al. (2001) reported how funding from Preparing Tomorrow's Teachers to Use Technology (PT^3) helped The University of North Texas faculty and local teachers work together in order to plan and create technology rich lessons for teacher education students in a professional development school (PDS). A PDS is a certification program that incorporates field-based experiences.

Final year teacher education students in this program were labeled as student interns. The students took methods courses two days a week and participated in field experiences two days a week. Each intern was expected to create a student-centered technology assignment which is known as the Student Choice Technology Assignment. The assignment was open-ended and developed to meet the needs of the intern, cooperating teacher and students of the cooperating teacher. Technology training was provided at the onset of the internship. The interns and cooperating teachers were required to record what they have learned as a result of the Student Choice assignment. Most interns felt they learned how useful technology was as a teaching tool and they felt the program encouraged them to use technology in their teaching.

Rademacher et al. concluded that preservice teachers can learn how to develop student-centered technology lessons, technology support is necessary for preservice teachers and everyone participating in this process learns with clear planning for how to develop technology assignments.

The Arizona Classrooms of Tomorrow Today (AZCOTT) project developed out of the government sponsored Preparing Tomorrow's Teachers to Use Technology (PT^3) project (Wetzel et al., 2001). Five schools worked with Arizona State University (ASU) West to make this project possible. Many PT^3 projects are attempting to identify technology rich classrooms for pre-service teacher internships. Due to the lack of such classroom environments, the

AZCOTT project attempted to create these classrooms for interns. The AZCOTT project focused on the effects on students and effects on teacher technology use in technology rich classroom environments. Teachers participated in ongoing staff development programs and received technical support throughout the program.

Teachers were to apply in order to participate in the program. The selected teachers received four to five computers, Internet access, software, a projector and technical support for their classrooms. The teachers were also to take part in 100 hours of technology training as part of the PT^3 program. The research accompanying the program was qualitative and data were collected from a variety of sources. Teachers' comments and reflections were audio- or videotaped during workshops and their classrooms were also taped on occasion. The PT^3 project manager also visited and observed classrooms. Categories of data included, "changes in teaching methods, curriculum changes, teacher leadership, teacher collaboration, student engagement, student noise, student disposition toward learning, student collaboration and students as helpers and coaches" (p. 7).

As teachers regularly met throughout the AZCOTT project, they were able to learn about new technologies, design technology-enriched lessons, share ideas and reflect on their teaching. All of this led to the greater use of technology in the classrooms.

Wetzel et al. (2001) discussed several results of the program. Teachers changed their teaching methods, thoughts about curriculum, roles as leaders, collaboration with peers and communication with parents. The most obvious change in teachers was the changing role of being providers of knowledge to facilitators of knowledge. Students exhibited more control of learning. Teachers changed their curriculum planning, procedures and materials as a result of the program. They learned how to better incorporate technology into the curriculum. "Technology for the sake of technology is not appropriate; rather, it is the use of technology to support curriculum that is desirable" (p. 8). Teachers investigated how to obtain or develop additional support for technology integration. They learned that working as a team members was a great experience and attempted to involve their peers.

Students also responded to the increasingly technological environment. Some results were increased collaboration, engagement, helping classmates and better attitudes toward learning. It was interesting to note that increased student noise seemed to represent more activity and collaboration among students. Students even helped teachers troubleshoot and correct technical problems during the project.

The AZCOTT program fulfilled its primary goal of creating model classrooms for interns. ASU West faculty also invited AZCOTT teachers to classes and presented videos of the teachers' classrooms. Both teachers and students at the five participating schools were excited with the results of the program. Wetzel et al. found that, "adequate staff development is a key support for change" (p. 10). These findings were consistent with previous research (Sandholtz et al., 1997; Becker, 2000 & Fullan & Steigelbauer, 1991).

Bielefeldt (2001) collected data on 416 school, colleges and departments of education in the country. Surveys were distributed to mostly college deans and education faculty. The survey respondents were to rate their institution, coursework, technology facilities, support, alumni skills and field experiences.

A factor analysis of the survey data revealed the following four groups: facilities, technology integration into the program, field experiences and application skills. Commitment and finances were found to help the most in providing adequate facilities. Interestingly, finances were also found to be a hindrance for creating facilities. College faculty initiative, skill and most of all professional development opportunities were found to promote technology integration. Other driving forces of technology integration were teacher expectations, administration and NCATE requirements. Lack of technology in K-12 schools and in the universities proved to be hindrances to successful field experiences. Technology coursework and the overall use of technology in the program helped students to apply skills.

"The survey data support our theory that integrating technology into teacher preparations programs requires an all-inclusive approach that includes plans for facilities, faculty professional development, coursework, and field experience" (Bielefeldt, 2001, p. 10). The four factors that emerged from the survey need to be addressed in order for an education program to be successful.

Thomas and Cooper (2000), methods professors in a teacher education program, developed a study in order to assess and detail the results of technology integrated in science and mathematics methods courses. They devised the study based on their belief that preservice teachers should be encouraged to use and witness instructors using educational technology. "Teaching and learning with technology, imbedded within methods course and student teaching requirements, presents the teaching and learning model expected of these future teachers in 21st century schools. Additionally, faculty members serve as role models for prospective teachers" (p. 14).

Twenty-six elementary teacher education students participated in the study as students in one section of a methods course. The students had class once a week and had four weeks of field experiences. The Computer Use Scale (Panero, Lane & Napier, 1997) and the Computer-Anxiety Scale (Cohen & Waugh, 1989) were administered to the students at the beginning and end of the methods course. T-test results of the Computer Use Scale data showed that the students had no significant change in enthusiasm ($T=.584$, $p<.562$) or entertainment ($T=-1.492$, $p<.142$) but did show significant changes in efficiency ($T=2.204$, $p<.032$) and communication ($T=2.906$, $p<.006$). T-test results of the Computer-Anxiety Scale showed a significant decrease in anxiety ($T=-3.897$, $p<.000$).

Throughout the course, Thomas and Cooper emphasized and encouraged critical thinking and problem solving skills with technology as an instructional tool. Thomas and Cooper learned the following from their experience:

- Teach with technology. Do not teach about technology.
- Guide students using goals and objectives. Let them manage their learning.

- Make the technology respond to student needs.
- Model the learning process as you desire to see in your students.

Willis and Sujos de Montes (2002) examined the effects of a technology course requirement on student teachers' use of technology in the classroom. The four factors that were examined during the study were student attitudes, self-efficacy, theoretical understanding and classroom technology use.

The course, ETC 447: Technology in the Classroom, was required for all preservice teachers by their program at a university in Arizona. The course focused on using technology and promoting constructivism. The students were required to work together to complete various content-centered group projects throughout the semester.

The students enrolled in ETC 447 completed three online surveys. Two instruments, Attitudes toward Technology and Self-Efficacy Using Technology (Delcourt & Kinzie, 1993), were administered twice for the purpose of collecting both pretest and posttest data. Statements were rated on a four point Likert scale. The third survey instrument, the Teaching Strategies Inventory, was constructed by Willis and Sujos de Montes. This instrument was administered during student teaching. A four point rating scale was used to rate either frequency or effectiveness of technology use.

T-tests on the pretest and posttest data showed no significant change in student attitudes. There was a significant change in the self-efficacy of technologies used such as word processing software, email and CD-ROM applications. Students also reported a significant increase in the amount of technology use after taking ETC 447. Results for the final instrument, the Teaching Strategies Inventory, indicated that the student teachers used technology primarily for student-centered activities but that technology use was reported as seldom/never to sometimes (range of 1 to 2 on a four point Likert scale).

Willis and Sujos de Montes concluded that a single technology course requirement is not enough to encourage and foster technology use in the classroom. Furthermore, they found that the cooperating teachers may, in fact, be preventing the student teachers from incorporating technology into their teaching. One suggestion was to add an additional lower level technology course as a prerequisite to the course taken by the student teachers in this study. The purpose being that the first course would teach technology skills and the second would concentrate on integrating technology into the curriculum.

Faculty Computer Use

Chiero (1997) found that 95% of teachers use computers for word processing and about half used computers to look up information or for lesson plans. According to Igbaria and Chakrabarti (1990), computer anxiety and stress possibly causes some people to avoid using computers altogether. Teachers also need onsite assistance from a full-time computer coordinator (PCAST, 1997; Sandholtz et al., 1997).

Past studies have identified skills as needed by teachers. These studies reveal that computer operation, programming, the role of computers in society, educational computer applications, terms and concepts, computer based-instruction and knowledge of hardware and software are important for teachers to know and master (Scheffler & Logan, 1999). "The most important competencies for teachers appear to be the knowledge and skills to make computers a seamless part of the school curriculum" (p.319).

Faculty Uses of Internet Communications. Henry (2002) investigated how university faculty members used the Internet in their scholarly work. The focus of his study was to explore the factors relating to Internet use. Faculty members at most institutions are provided with computer accounts providing access to network and communication applications. These applications have expanded and encouraged communication among faculty.

Full-time faculty from a research university participated in this study. The subjects were randomly selected from four schools within the university. Questionnaires were mailed and emailed a total of three times during an eight-week period. The faculty response rate was 58.3% with 91% of the returned surveys in the print rather than email form. The survey data were coded and subjected to factor analysis and correlational analyses. The factor analysis revealed seven factors of Faculty Uses of Network Communications that accounted for 72.6% of the variance. These factors were then further examined through three sets of correlations (Faculty Uses of Internet Communications with Years and Scope of Use, Faculty Uses of Internet Communications with Organizational Support Factors and Faculty Uses of Internet Communications with Personal and Professional Characteristics). The strongest correlations among Years and Scope of Use were between Contact Colleague and Years of

Use (r=.40, p<.001) and between Contact Colleague and Outside university (r=.46, p<001). The strongest correlations among Organizational Support Factors were between Contact Colleague and Peer Support (r=.34, p<.001) and between Contact colleague and Network access (r=.31, p<.001). The strongest correlation among Personal and Professional Characteristics was Contact Colleague and Age (r=-.36, p<.001).

The correlations suggest that faculty primarily used the Internet for communication with colleagues. "This underscores the potential value of this innovation in supporting faculty productivity, especially in the stimulation and refinement of ideas among scholars" (Henry, 2002, p. 54).

Exemplary Technology Using Teachers. Zhao et al. (2001) conducted a survey of exemplary technology-using teachers. The researchers attempted to, "paint a comprehensive portrait of this group in terms of their knowledge, skills, attitudes, behaviors, and beliefs" (p. 24). The purpose of the study was to find out what teachers should know in order to make effective use of educational technology and to help create educational technology professional development programs that connect theory and practice. Exemplary technology-using teachers were found through a grant program in which they were to propose an innovative project that uses instructional technology.

In order to gather a detailed picture of the teachers' technology use, the following six dimensions were considered: past and present technology use, future technology use, technology proficiency, attitudes and beliefs and pedagogical styles. Questions were devised and selected from previous survey instruments. Each dimension was labeled as a subscale of the survey instrument. Forty-three items were created for the dimension of past and present behavior. Forty-three items were also devised for future behavior. In order to measure proficiency, a 20 item Likert scale survey devised by Ropp (1998) was used. A revised version of Francis-Pelton and Pelton's (1996) instrument was used to assess attitudes. For computer anxiety, the researchers revised a scale constructed by Marcoulides (1989). In order to measure pedagogical practices, the instrument created by Bidwell, Frank and Quiroz (1997) was used.

A survey was administered to 118 teachers. There was a 79% return rate. Factor analysis with varimax rotation was performed on the survey data. For the first dimension, Past Technology Uses to Support Learning, the following four factors emerged: Internet Uses, Multimedia Technologies, Productivity Applications and Internet Dangers. The results showed that teachers used a wide variety of technology in their instruction. Most have used word processing software, presentation software, drawing applications and multimedia applications for instruction. In fact, word processing software is the most prevalently used software by the teachers. It was used for classroom management and to communicate with parents.

For the second dimension, Planned Technology Uses to Support Learning, the following four factors emerged: Internet Uses, Multimedia Technologies, Productivity Applications and Word Processing. This subscale was compared to the first subscale, Past Technology Uses to Support Learning.

The data revealed that most of the teachers planned to expand their use of technology in the future. There was a substantial increase for planned use of technology in every category.

For the third subscale, Teacher Technology Knowledge, the following four factors emerged: Productivity Software, Advanced Internet Use, Advanced Email and Technology Support. The results showed that most of the teachers were proficient in common applications such as word processing software, email, the Internet, spreadsheet applications and educational software.

For the fourth subscale, Attitudes and Beliefs about Technology, the following four factors emerged: An Aide to Student Learning, Personal Confidence with Technology, Technology is Harmful to Me and Students and Traditionalist. The teachers had positive attitudes about technology and felt it was very important. They believed that computers encourage students to develop positive attitudes towards education, be active learners and better thinkers. The teachers also believed, however, that they were lacking administrative support. In the area of perceived uses, the teachers greatly varied. Some felt the computer should be used for problem solving and others found the available information to be important. Less than one-third of the teachers felt that computers are good for basic skills and memorizing.

For the fifth subscale, Technology Anxiety, the following three factors emerged: Techie Talk, Asking for Help/Learning Technology and Study of Technology/Implications of Technology. Overall, the teachers had extremely low computer anxiety. The only area of concern was lack of student control when they are using the Internet.

For the sixth subscale, Pedagogical Styles, the survey items were grouped into the following four Bidwell factors: Moral Agent, Pal, Progressivist and Rigorist. Most of the teachers were classified as progressivist. They emphasized higher-ordered thinking and student control of learning.

Zhao et al. summarized that the exemplary technology-using teachers have the following characteristics:

- Frequent technology users
- Fairly proficient in technology use
- Positive attitudes towards educational technology
- Not anxious about using technology
- More likely to be progressivist

Zhao et al. state that these findings were not surprising and confirm the results of many previous studies. Additionally, they state that these findings are important for understanding classroom use of technology and its impact on education. It is important to note that these findings show that the use of technology is more than just knowing how to operate a computer. There are several other dimensions to educational technology.

Integrating Computers into the Curriculum. Ryba and Brown (2000) studied how technology proficient teachers integrated computers into their classrooms. The purpose of the study was to examine how these teachers used technology to enhance the teaching and learning process.

Ryba and Brown chose to collect data by administering questionnaires to 36 teachers, interviewing 12 teachers and observing two classrooms. The two main findings of the survey data were how teachers used computers in the classroom and what teachers valued most about using computers in teaching. Although the survey data revealed that 97% of the teachers used the word processor for writing activities, it did not provide details for how specific software such as the word processor was being used by each teacher. Thirty-nine percent of teachers ranked developing students' thinking and problem solving skills as their highest priority for using technology in teaching.

The interviews found that the teachers chosen for this study had taken educational technology coursework and they valued the social aspect of using computers in the classroom.

In the final stage of this study, two teachers were observed in their classrooms. The teachers differed in age, teaching experience, computer-related experience and student socio-economic level. Both teachers encouraged and facilitated group work in their classrooms. One teacher organized her curriculum just to create more opportunities for students to take control of their learning. Students were to set their own goals at the beginning of the week and report their progress the following week. The other teacher organized his curriculum to encourage students to work together in groups and actively participate in the learning process. His emphasis was on social interaction with classmates. In both cases, the teachers gave their students more freedom as well as more control over the learning process. They both encouraged learner-centered classrooms.

Ryba and Brown concluded that even though all of the teachers in this study were technology proficient, they all had their own unique approaches and methods of using computers in the classroom. Furthermore, the study showed that there is a substantial gap between theory and practice. Although all of the teachers incorporated computers into their curricula, most had no theoretical explanations for their approach.

Computer Use and Age. Rousseau and Rogers (1998) focused on university faculty in a wide age range. The purpose of their study was to investigate age-related computer use trends among a University of Georgia faculty. Fourteen hundred thirty faculty members were randomly selected to participate in this study. Five hundred faculty members returned the surveys for a response rate of 36.4%. The faculty questionnaires were organized by decades starting at 25 years of age up to 65 years.

The survey was developed to evaluate the computer and technology experience of the university faculty. The instrument included questions about demographic information, use of technology devices, computer experience, use of computer applications and use of the online library system. The survey instrument was mailed with a cover letter explaining the study.

At least 90% of the respondents stated that they used computers once a week or more. It was found that older faculty use computers as frequently as their younger counterparts, however the older faculty do not use as many computer applications as the younger faculty. As a result, there was an age-related decline in the number of computer application used. Analysis of variance revealed that the age-related trend was significant. The older faculty were not as comfortable using the online library system as the younger faculty. They, in fact, preferred to use the traditional card catalog system.

Although the focus of this study was to examine age differences in computer use, sex differences were also noted. There were no gender differences in the number of technologies used and the frequency of computer use. There was a difference, however, in the number of computer applications used by males and females. This was found to be true across all of the age groups as demonstrated by gender x age group ANOVA on the number of computer applications used. ANOVA was also performed to examine any gender differences in online library use. No statistical differences were found to support a difference in male and female online library use.

"If older faculty members avoid new technologies, then there is little hope of getting them to use these new tools. However, if they are simply selective of the technology that they use, they may be more amenable to training" (Rousseau & Rogers, 1998, p. 426). Rousseau and Rogers (1998) did find that the older faculty wanted to learn more about technology and were interested in training. This example and other similar examples led the researchers to conclude that if technology was useful and training was available, the older faculty would participate in technological advances. Thus, the survey data suggest that when a technology or computer application is useful and training is available, older adults attempt to use these items.

Computer Access, Training and Use. Jaber and Moore (1999) examined factors that influence teachers' use of computer-based technology. The study focused on finding what type of computer access and training affects teachers' use of computer-based technology. The participants in this study included K-12 public school teachers. A survey instrument was developed to include areas that past research did not address and administered to the teachers. These areas include teachers' access, training, planning time and Internet access.

The study found that 67% of teachers used computers in their teaching, 24% did not use computers, 6% did not have computer access and 3% did not have responses indicating computer use. The survey responses showed that when computer access was available teachers would use the computers. Eighty-six percent of teachers received training from peers and 80% were self-taught. Only 30% of the teachers stated that they had computers. Of this 30%, 67% of the teachers used computers in classroom instruction. Teacher anecdotal comments suggest that obsolete technology was a barrier to the instructional use of computers and emphasize the importance of classroom access of computers. Jaber and Moore concluded that computer and Internet access affects teaching and frequency of use in at least some instructional activities.

The Promise of Computers as Instructional Tools. Many of the early advocates of educational technology had envisioned the computer as an instructional tool and a possible means for individualized student learning (Reusser, 1996). Their views are best described by the following,

> Policy makers and practitioners alike are lured by the promise of finally achieving the engineer's dream of individual instruction through a machine that has the capacity to drill and tutor each student swiftly and cheaply without regard to the pace of classmates, while simultaneously recording and reporting achievement. (Cuban, 1986, p. 75)

> With the advent of the microcomputer in the early 1980's, high expectations rose with respect to its potential as a lever for the innovation and improvement of schooling. Today, over a decade later, it is obvious that the expectations ran too high, or at least that they have not been realized to a substantial degree. (De Corte, 1996, p. 129)

Papert (1990; 2000), an early supporter of computers in education, felt that computers would change the face of education. He believed that computers would eventually replace teachers and control individual student learning. Papert lived and studied with Piaget (Papert, 2000; Picciano, 2001). Like Piaget, he believed that children progress through a series of developmental stages. Furthermore, Papert proposed that children could benefit from computers at an early age. He developed LOGO, a programming language for young children, on the basis of potential benefits of computers for children. The LOGO programming strategy involves two stages: the planning stage in which the course of action is created and the coding and testing stage in which the program is entered and carried out (De Corte, 1996). Based on the ideas of Papert and others, schools began to invest in computers in the early 1980's.

Although the early expectations of computers were never fulfilled, computers have found their niche in schools across the nation. The ratio of computers to students has decreased from 125 computers per student to just 5 computers per student over the past 20 years (Anonymous, 2001; Cuban, 2001; Picciano, 2001). "Now that technology is becoming more common in schools, its potential for enhancing teaching and learning is being recognized" (Sandholtz et al., 1997).

The Apple Classrooms of Tomorrow Project. Apple Computers undertook an ongoing research project called the Apple Classrooms of Tomorrow (ACOT) Project (Sandholtz et al., 1997). The main goal of the project was to investigate the effect of routine computer use on teaching and learning. Other goals of the project included installation and maintenance of school computer labs, integrate state-of-the-art technology into the curriculum, encourage positive change and development and examine the impact of open computer access on teachers, students and instruction. Five schools were selected as representatives on the nation's schools.

During the first phase of the ACOT project, there was no significant change in classroom instruction. There were, however, interesting changes in teacher beliefs about the purpose of teaching and learning. Slowly, teacher-student interaction changed during the project. Teachers took on the role of mentor or facilitator. Student interaction became more cooperative and impulsive than ever before. In the later stages of the ACOT project, even more remarkable changes took place in the classrooms. Teachers began to share ideas and work together across the disciplines. Students were also encouraged to work together collaboratively. Teachers experimented with new instructional strategies and assessments.

Instructional Uses of Common Computer Applications and Software. Many ordinary computer applications and software have the potential to support learning (Doty, Popplewell & Byers, 2001; Howard et al, 2000; Johnston & Cooley, 2001; Jonassen, 2003; Jonassen et al., 2003; Jonassen, 2000; Jonassen, Peck & Wilson, 1999; Moursund, 2002; Norton & Sprague, 2001). Jonassen (2000) focuses on the use of computer applications as mindtools in his book, Computers as Mindtools for Schools. He has defined mindtools as, "Computer applications that require students to think in meaningful ways in order to use the application to represent what they know" (p. 4). Some examples of the computer applications that Jonassen refers to are database, spreadsheet and hypermedia applications. Jonassen, Peck and Wilson (1999) describe meaningful learning as active, constructive, intentional, authentic and cooperative. Computer software and applications that have been labeled as mindtools include spreadsheets, database management programs, hypermedia, synchronous communication and asynchronous communication.

Common applications such as online forums, chat rooms and email have become the basis of instruction. Many university distance learning programs have taken advantage of these types of applications for online courses

(Dewhurst, Macleod & Norris, 2000; Ndahi, 1999; Hammond, 2000; Pearson, 1999; Thelwall, 2000; Veerman, Andriessen & Kanselaar, 2000; Waller & Foster, 2000). In these programs, class interaction occurs solely through computer based communication methods.

Computers and the Constructivist Pedagogy. "An important characteristic of progressive technology-using educator is a dynamic, constructivist vision of technology integration" (Vannatta & Beyerbach, 2000, p. 144). Most of the research on constructivism and technology is in the early stages of development (PCAST, 1997). However the results of the existing research have been promising (Howard et al., 2000). For instance, research on a videodisc-based series of open-ended problem solving exercises developed at Vanderbilt University, The Adventures of Jasper Woodbury, reveal superior student performance on complex word problems and high-level planning tasks (PCAST, 1997; Williams et al., 1998). These students were able to advance their skills based on the constructivist methods of these exercises.

"In the constructivist model, learning is seen not as a transmission of information from teacher to student but as an active problem-solving process in which that learner builds on his or her own prior understandings to constructing new knowledge" (Barron & Goldman, 1994, p. 82). Constructivist learning environments place more responsibility on students for their own learning than traditional classrooms (Becker & Ravitz, 1999; Brooks & Brooks, 1993; Howard et al., 2000; Means, 1994; Sandholtz et al., 1997). As a result, students have control of their own learning experiences. Teachers become facilitators of the learning process rather than just knowledge providers. By posing problems of emerging relevance to students, teachers are providing an impetus for students to search for knowledge (Brooks & Brooks, 1993). The use of technology further enables teachers to create constructivist classrooms.

Barriers to Teachers' Computer Use. Despite the increase of computers in schools and classrooms, educators' use of technology in the classroom has not significantly increased over the last 20 years. Research has proven various barriers to technology implementation. Some examples include limited equipment, training, time, assessment, preferred teaching methods, professional development and beliefs about the teaching and learning process (Chiero, 1997; Dawson & Norris, 2000; DuPagne & Krendl, 1992; Franklin et al., 2001; Fuller, 2000; Hadley & Sheingold, 1993; Ringstaff & Yocam, 1994; Hannafin & Savenye, 1993).

"Full integration of computers into the educational system is a distant goal unless there is a reconciliation between teachers and computers. To understand how to achieve integration, we need to study teachers and what makes them use computers" (Marcinkiewicz, 1993/1994, p. 234).

Cuban (1986) suggests that it is easy to blame teachers for lack of use or inefficient use of technology even when other reasons such as the role of the administration may play a greater role than teacher avoidance of technology. The lack of technology support is one issue that many teachers are worried about. Approximately 75% of teachers say that the only technology support available is other teachers (Chiero, 1997). Furthermore, these teachers say that their main source of help was their colleagues. Kotrlik and Smith (1989) found that vocational teachers who did not have the support of their principal had higher levels of computer anxiety than teachers who did have their principal's support.

The biggest obstacle in using technology was the time involved in learning how to use it (Sandholtz et al., 1997; Dawson & Norris, 2000). In fact, 83% of teachers said it was a barrier to technology integration to some degree (Chiero, 1997).

Teachers share a number of concerns about technology implementation. The availability of modern computers and the latest software are just two concerns (DuPagne & Krendl, 1992; Jonassen, 2000; Sandholtz et al., 1997). As technology rapidly advances, computers quickly become obsolete. It is difficult to continuously upgrade hardware. Schools often do not account for regular upgrades when planning their technology budgets. Likewise, software is expensive. Institutional licensing for a product can prove to be expensive and therefore the variety of software can be limiting.

<u>The Ongoing Debate about Computers in the Classroom.</u>

> Much of the current impetus to bring more technology into schools is not motivated by a desire to improve the learning of students in academic areas. Instead it is motivated by the sense that information and computational technology has become so ubiquitous in our lives that schools must develop the basic skills in students so that they can function in further schooling and work. (Glennan & Melmed, 1996, p. 47)

Many studies have been done on the advantages and disadvantages of the computer in the classroom. Educators have taken a stance either for or against its integration into the curriculum (Noble, 1996). Whether the computer should be used so widely has become a question of ongoing debate. The majority of educators support computer use. Many are welcoming the computer into their curricula. Many teachers are including this technology in their lesson plans.

There are many advantages in integrating technology into the curriculum. Computers motivate students to become involved and interested in a wide range of activities (Clark, 2000; Cuban, 2001). This motivation factor increases engagement of the students, which is essentially the goal of every teacher. Word processors encourage and promote better writing skills (Papert, 2000). Additionally, it has been found that writing skills displayed by students for remote peers over the Internet are better than those normally seen by the teacher (Levin & Thurston, 1996). Furthermore, students are able to connect with people all over the world.

Fang (1996), a bilingual Chinese teacher in San Diego, wrote about his group of Chinese students. His students traveled the Internet in Chinese. Fang stated many positive outcomes of his experiences. He said the computer connection renewed cultural bonds, boosted academic prowess, improved language skills, and raised self-esteem. As a result of the experience, his students became the first to publish an on-line newspaper in Chinese. In addition, they used the computer to develop concepts and explore new topics.

The critics of computers, on the other hand, have their own arguments against its usage. There is no strong evidence that links computer use with increased student achievement (Cuban, 2001). "As for enhanced efficiency in learning and teaching, there have been no advances (measured by higher academic achievement of urban, suburban, or rural students) over the last decade that can be confidently attributed to broader access to computers" (p. 178). Furthermore, research indicates that most teachers are simply using computers for existing classroom management tasks such as developing lesson plans, record keeping and communication with parents.

Despite the lack of evidence that computers are helping students, politicians, businessmen, school administrators and parents are continuing to push for the increased use and availability of computers (Cuban, 2001; Decker, 1999; Nash & Moroz, 1997; Painter, 2001; Pinkston, 2000). Postman (2000) states, "I am not arguing against using computers in schools. I am arguing against our sleepwalking attitudes toward it, against allowing it to distract us from more important things, against making a god of it" (p. 294).

Noble (1996, 2002) has plenty of reasons against new technology. He believes that school technology has been looked upon as big business. Billions of dollars are being spent each year based on the assumption that computers are a necessary part of teaching and learning (Cuban, 2001). Researchers have estimated the annual costs of educational technology from $6 to 28 billion dollars (PCAST, 1997). At one time, Compaq became the largest manufacturer of personal computers and aggressively went after the educational market. In fact, Compaq had designed computers specifically for schools. Explicitly, Noble has used the heading, "Education as Technology's Servant", in an article. Noble terms the information highway as the entertainment highway. After all, educational software is marketed alongside computer games, electronic mail, books, magazines, movies, pornography, and television shows.

Distance education has also become yet another marketplace for the technology industry. Technology has become the key to more profits.

> In essence, the current mania for distance education is about the commodification of higher education, of which computer technology is merely the latest medium, and it is, in reality, more a rerun than a revolution . . . then as now, distance education has always been not so much technology-driven as profit driven, whatever the mode of delivery. The common denominator linking the two episodes is not technology but the pursuit of profit in the guise and name of higher education. (Noble, 2002, p. 1)

Summary and Current Investigation.

The objective of conducting the survey is to collect data in order to determine the reasons behind the present extent of technology use by teachers in schools as stated in the hypotheses. From the data collected, correlations of several factors with teacher computer use will be better understood. The use of technology raises a great deal of controversy in the community of education. The debate revolves around the question that instigated this study, what factors correlate with teachers' computer use?

Research Questions. This study will examine four factors that may correlate to teachers' instructional use of computers in the classroom. This will be done by examination of past research on teacher attitudes, emotions, beliefs, outside influences and technology use and the administration of a survey to further examine each of the factors correlating to teacher computer use. The study will provide data to better understand teachers' use of technology.

This study will explore the following questions:

1. Are teachers' attitudes related to teachers' instructional use of computers?
2. Are teachers' emotions related to teachers' instructional use of computers?
3. Are teachers' personal beliefs related to teachers' instructional use of computers?
4. Are outside influences related to teachers' instructional use of computers?

This cross-sectional study will explore the relationship between teacher attitudes, emotions, beliefs and outside influences and computer use.

There is a need to understand the reasons behind teachers' use of technology in the classroom. Despite all the time and money that has been invested on educational technology, teachers have not taken advantage of the numerous, available technological resources (Bielefeldt, 2001; Brush et al., 2001; Clark, 2000; Cuban, 2001; De Corte, 1996; Ertmer et al., 1999; Rovai & Childress, 2002-2003). Most of the existing research on educational technology focuses on student benefits (Sandholtz et al., 1997). This study will focus on a needed area of research, factors correlating with teachers' instructional use of computers. This literature review has discussed some of the possible factors why this teacher resistance to computers continues to occur.

CHAPTER III

Methodology

Participants

The participants in this study included public middle school and public high school teachers in the Chicagoland area. The survey questionnaires were distributed at three randomly selected middle schools and two randomly selected high schools. Twenty-five teachers from each middle school and 50 teachers from each high school were randomly selected to participate in this study. There were a total of 175 participants from the five schools. Seventy-seven teachers completed and returned the surveys for a response rate of 44%. Demographic information for the sample is provided in Table 1. Fifty-seven percent of the respondents were between the ages of 41 and 55 with 33% under the age of 41 and only 9% above the age of 55. Seventy-three percent of the respondents

Table 1
Demographic Information

1	Age	
	22 or less	0%
	23-25	3%
	26-30	14%
	31-35	9%
	36-40	7%
	41-45	18%
	46-50	22%
	51-55	17%
	56-60	8%
	61-65	1%
	66 or more	0%

Table 1 (cont.)
Demographic Information

2	Gender	
	Male	27%
	Female	73%
3	Race	
	African-American	16%
	American Indian	0%
	Asian or Pacific Islander	3%
	Hispanic	5%
	White	72%
	Other	4%
4	Level of Education	
	Bachelors	24%
	Masters	73%
	Doctorate	3%
5	What grade level do you teach?	
	Middle School	51%
	High School	49%
6	Years of teaching experience	
	0-5 years	14%
	6-10 years	18%
	11-15 years	9%
	16-20 years	16%
	>20 years	43%
7	Years of computer experience	
	0-5 years	26%
	6-10 years	30%
	11-15 years	25%
	16-20 years	14%
	>20 years	5%
8	Do you have access to a computer?	
	Yes	100%
	No	0%
9	Do you have access to the Internet?	
	Yes	83%
	No	17%

Table 1 (cont.)
Demographic Information

10	How many hours a week do you use a computer outside the classroom?	
	0-5 hours	48%
	6-10 hours	25%
	11-15 hours	16%
	16-20 hours	6%
	>20 hours	5%
11	How many hours a week do you use a computer in the classroom?	
	0-5 hours	52%
	6-10 hours	27%
	11-15 hours	6%
	16-20 hours	4%
	>20 hours	10%
12	Number of computer uses.	
	1	18%
	2	14%
	3	20%
	4	18%
	5	19%
	6	6%

were females. Seventy-two percent of the respondents were White teachers and the remaining 28% were minorities (i.e., African-American, Asian or Pacific Islander, Hispanic and Other). Grade levels taught by the respondents were almost equivalent with 51% teaching middle school and 49% teaching high school. Forty-three percent of the respondents had over 20 years of teaching experience. Seventy-six percent of the teachers held graduate degrees. All of the respondents had access to a computer at school and 92% had access at home. Ninety-nine percent had Internet access at school and 83% had access at home. Forty-eight percent of the teachers used computers for 0-5 hours outside of the classroom and 52% used computers for 0-5 hours in the classroom. The teachers varied greatly in their number of computer uses (i.e., computer applications) with 18% having one use, 14% having two uses, 20% having three uses, 18% having four uses, 19% having five uses and 6% having six uses.

The surveys were placed in teacher mailboxes at each of the schools. Confidentiality and anonymity was assured to all teachers participating in this study as explained in the consent letter. The teachers had the option to withdraw at any point without penalty.

Measures

Survey List. The questionnaires that were used for this study included a brief demographics questionnaire (Appendix B) and a modified form of the Computer Attitude Scale (CAS, Appendix C) (Loyd & Gressard, 1984a). The first part of the survey instrument consisted of 14 questions asking about demographic data and the frequency of computer use for school related tasks. Demographic data such as age, gender, years experience and educational level was also collected.

Loyd and Gressard (1984a) developed the CAS for the purpose of measuring the computer attitudes of teachers and students. The CAS has been widely used in the field of education and it has even been translated into other languages (Francis, Katz & Jones, 2000). In over two decades of use, several forms of the CAS have been devised. The original survey consisted of 30 questions measuring the constructs of Confidence, Anxiety and Liking (Loyd & Gressard, 1984a). Loyd and Loyd revised the CAS to later include 40 items and the additional construct, Usefulness. The revised form was used in this study. The survey was constructed using Likert type scales based on a five point scale ranging from 1=strongly agree to 4=strongly disagree (Popham, 1993). This type of scale is the most commonly used when evaluating attitudes and is more reliable than a yes/no response. Popham has recommended the survey method for the collection of data from a large population.

The CAS used in this study has been modified to include 10 questions measuring the construct of teachers' pedagogical computer use and 10 questions measuring the construct of outside influences on computer use increasing the total number of questions to 60. The survey constructs were Comfort with Computers, Usefulness of Computers, Instructional Computer Use, Computer Liking and Outside Influences. The construct of Comfort with Computers represented teachers' attitudes and emotions about computer use (i.e., "I have a lot of self-confidence when it comes to working with computers", "I would feel comfortable working with a computer"). Usefulness of Computers characterized how the teachers felt about using the computers for work, pleasure and beyond (i.e., "I think using a computer would be very hard for me", "Working with computers will not be important in my life's work"). Instructional Computer Use represented how useful teachers felt that computers were as a teaching tool (i.e., "Computers make it easier to develop lesson plans", "Using computers increases student achievement"). Computer Liking reflected whether the teachers actually liked (or did not like) using computers (i.e., "I don't think I would do advanced computer work", "Once I start to work with a computer, I would find it hard to stop"). Outside influences represented issues outside of the teachers' classrooms such as hardware, software, training and parental involvement (i.e., "Staff development events often address the implementation of computers in the curriculum", "Parents actively support instructional computer use in our school").

Threats to Validity and Reliability. As in any research, threats to validity and reliability need to be examined. Such threats could produce error in the individual teacher questionnaires or to the study as a whole. A pre-existing survey instrument was selected in order to avoid these threats to validity and reliability as much as possible. The CAS has been tested repeatedly for reliability and validity (Francis et al., 2000; Gressard & Loyd, 1986; Loyd & Gressard, 1984a; Loyd & Loyd, 1985; Massoud, 1990; Nash & Moroz, 1997; Woodrow, 1991). Loyd and Gressard developed the Computer Attitude Scale in order to examine the attitudes of teachers and students towards computers. The original CAS had three subscales: Computer Anxiety, Computer Liking and Computer Confidence.

Loyd and Gressard (1984a) first tested the CAS for reliability and factorial validity in a study involving 155 students in grades 8 to 12. The original CAS had three subscales: Computer "Anxiety, Computer Confidence and Computer Liking. The alpha coefficient reliabilities for the three subscales were .86 for Computer Anxiety, .91 for Computer Liking and .91 for Computer Confidence. The overall reliability for the CAS was .95. The CAS was later revised to include four subscales: Computer Anxiety, Computer Liking, Computer Confidence and Computer Usefulness. Loyd and Loyd (1985) and Loyd and Gressard (1986) again tested the reliability and factorial validity of the CAS but with teachers. Loyd and Loyd administered the CAS to 114 teachers and performed a factor analysis on the data. The coefficient reliabilities were .90 for Computer Anxiety, .89 for Computer Confidence, .89 for Computer Liking and .82 for Computer Usefulness. The overall CAS reliability was .95. Loyd and Gressard (1986) administered the original CAS to teachers enrolled in a staff development program. The coefficient alpha reliabilities were .89 for all three subscales and .95 for the entire scale. The results of all three studies showed that the CAS can be used both reliably and validly.

The CAS has also been used in a number of studies by many different researchers. Nash and Moroz (1997) examined the subscales of the revised CAS. They found an internal consistency of .97 for the CAS. The internal consistencies for each subscale were .92 for Computer Anxiety, .90 for Computer Confidence, .91 for Computer Liking and .84 for Computer Usefulness. Nash and Moroz also found a significant correlation between Computer Anxiety and Computer Confident (r=.91). Massoud (1990) studied the factorial validity of the original CAS by examining the attitudes of low-literate adults towards computers. The coefficient alpha reliabilities were .79 for Computer Anxiety, .83 for Computer Confidence and .75 for Computer Liking. The overall coefficient was .91. These studies show that other researchers have also found the CAS to be both reliable and valid.

Some threats to validity and reliability in this study may have been the timing of the survey administration. This may have been the time of the day or school year. The small sample size may also be a threat to validity or reliability. Of the 175 surveys that were distributed, 77 were completed and returned for a response rate of 44%. If the questionnaires were administered during a faculty meeting or any other group setting, teachers may have hesitated to participate. In such cases, the resulting sample does not accurately represent the school's faculty.

Participants may have misunderstood the structure of the questionnaires. They may not have read the survey properly seeing 1 as strongly disagree and 4 as strongly agree. Several questionnaire items were negatively worded which may have also contributed to misunderstanding. Altogether, these threats to validity and reliability will be taken into consideration.

Procedures

Letter of Consent. A consent letter was attached to the questionnaire of this study explaining the objectives, confidentiality and anonymity. Informing the participants of confidentiality and anonymity provided for more honesty and less bias in answering the questionnaires. Participants were asked to sign the letter of consent and continue on to the survey sections only if they completely understood the letter. The letter also addressed benefits of the research and possible risks. The benefits of the participants were contribution to research, understanding of research design and better understanding of their own computer use. This study benefits the fields of research and education by increased understanding of teachers' educational computer use. The questionnaires were distributed in teacher mailboxes and returned at the main office to ensure anonymity.

The teachers had the option to discontinue participation in the survey at any time without penalty. As appreciation for participation in this study, all teachers had the opportunity to participate in a raffle for a $50 gift certificate at a popular educators' resource store.

Data Collection and Analysis. The final steps in this investigation were collecting the questionnaires and interpreting the data. Administrators at each of the schools were asked to make announcements before and after the questionnaires were distributed. Survey response rates tend to be higher when the participants are informed ahead of time and reminded to return the questionnaires.

Analyses

All data were entered into SPSS. These data were then subjected to factor analysis to determine constructs for the revised version of the CAS created for this study. Then correlational analyses (i.e., zero-order correlations and multiple regressions) were conducted to examine relationships between teacher attitudes, emotions, beliefs and outside influences and teacher computer use.

Survey Outcomes

The outcomes of this study may be of interest to a wide variety of people. The data from the correlational analyses illustrate the relationships of certain factors to teacher technology use. These results can then be used by administrators and teacher educators for staff development, planning or just understanding teacher behavior. The results may also be used in redesigning teacher education programs and revising teacher certificate requirements.

Rationale for Study Design

The design of this study was chosen in order to collect data from a large sample and examine the relationships of several items. Popham (1993) has recommended the survey method for the collection of data from a large population. Administering the questionnaires at five schools rather than one may allow generalization of the findings.

CHAPTER IV

Results

Seventy-seven surveys were collected from five Chicagoland public schools. The original CAS had the following choices for the Likert scale: 1-strongly agree, 2-agree, 3-disagree and 4-strongly disagree. Negatively worded items were reverse scored so that a response with a higher number signified a stronger, positive response. These data were then entered into SPSS.

A number of analyses were performed using these data in order to examine how certain factors relate to teachers' use of computers in the classroom. First, a principle components analysis with varimax rotation was conducted on the CAS data. Next, correlational analysis was conducted to examine relationships among the demographic questions and the CAS questions. Finally, multiple regression analysis was used to further examine the relationships among the demographic and CAS questions.

Factor Analysis of the CAS

Principle components analysis with a varimax rotation was performed on the CAS data. Five factors with eigenvalues greater than two emerged. These factors accounted for 58.3% of the variance. Each factor represented groupings of questions or subscales of the CAS. Previous studies of the CAS have grouped the questions into four factors: Computer Confidence, Computer Anxiety, Computer Liking and Computer Usefulness. Factor loadings greater than 0.4 were considered significant. Six different factor analysis were conducted.

Table 2

Factor Analysis and Descriptive Statistics for the Computer Attitude Scale

		Components					n = 77	
		1	2	3	4	5	M	S.D.
	Component 1 - Comfort with Computers							
55	I have a lot of self-confidence when it comes to working with	.81					3.22	.84
31	I could get good grades in computer courses	.79					3.56	.68
3	I would feel comfortable working with a computer	.77					3.65	.56
45	Computers make me feel uncomfortable	.76					3.51	.80
39	Computers make me feel uneasy and confused	.70					3.51	.85
33	I would feel at ease in a computer class	.69					3.52	.70
51	Computers do not scare me at all	.69					3.38	.87
7	Generally, I would feel OK about trying a new problem on the	.68					3.25	.81
57	I get a sinking feeling when I think of trying to use a computer	.68					3.60	.75
9	Working with a computer would make me very nervous	.64					3.44	.82
16	It is important to me to do well in computer class	.63					3.48	.68
8	I would like working with computers	.63					3.52	.77
56	If a problem is left unresolved in a computer case, I would	.60					2.97	.90
1	I am sure I could learn a computer language	.59					3.39	.76
49	I am sure I could do work with computers	.58					3.77	.43
2	When there is a problem with a computer that I can't	.57					3.03	.93
44	I think working with computers would be enjoyable and	.57					3.44	.73
21	I feel aggressive and hostile toward computers	.55					3.75	.57
58	I will use computers many ways in my life	.49					3.58	.73
15	It wouldn't bother me at all to take computer courses	.47					3.44	.79
27	I do not feel threatened when others talk about computers	.47					3.27	.88

Table 2 *Continued*

Factor Analysis and Descriptive Statistics for the Computer Attitude Scale

		Components					n = 77	
		1	2	3	4	5	Mean	SD
	Component 2 - Usefulness of Computers							
25	I think using a computer would be very hard for me		.95				1.55	1.01
13	I'm not the type to do well with computers		.90				1.79	1.10
19	I do not think I could handle a computer course		.90				1.55	.97
50	I will do as little work with computers as possible		.88				1.73	1.06
4	Learning about computers is a waste of time		.88				1.53	1.10
43	I'm no good with computers		.84				1.90	1.10
28	I expect to have little use for computers in my daily life		.83				1.71	1.04
34	Working with computers will not be important in my life's work		.82				1.83	1.09
46	I can't think of any way that I will use computers in my career		.79				1.86	1.18
38	I don't understand how some people can spend so much time		.76				1.81	1.04
36	I use computers in my classroom because of pressure from the		.65				1.71	.90
40	Anything a computer can be used for, I can do just as well		.63				1.82	.94
14	I do not enjoy talking with others about computers		.58				2.08	1.05
	Component 3 - Instructional Computer Use							
41	Computers make it easier to develop lesson plans			.71			3.16	.84
29	Using computers increases student achievement			.69			3.32	.70
59	The behavior of my students is much better when using			.67			2.81	.90
11	My students benefit academically when they use computers in			.62			3.31	.75
23	Computers are essential for helping me organize daily			.62			2.92	1.06
17	Computers facilitate the teaching and learning process by			.61			3.61	.65

Table 2 *Continued*

Factor Analysis and Descriptive Statistics for the Computer Attitude Scale

		Components					n = 77	
		1	2	3	4	5	M	S.D.
	Component 3 - Instructional Computer Use *Continued*							
35	Computers are a good teaching tool for students of varying			.59			3.66	.50
52	Knowing how to work with computers will increase my job			.59			3.61	.67
47	I use computers to keep students focused and on task			.57			2.68	.83
5	I value using computers for when I am instructing students			.48			3.38	.78
53	I organize or plan my curriculum with the aid of a computer			.46			3.09	1.02
18	I use computers in my teaching because technology support is			.44			3.14	.85
	Component 4 - Computer Liking							
37	I don't think I would do advanced computer work				.68		2.47	1.08
26	Figuring out computer problems does not appeal to me				.63		2.83	1.08
20	The challenge of solving problems with computers does not				.61		2.87	1.06
32	Once I start to work with a computer, I would find it hard to stop				.49		2.92	.93
	Component 5 - Outside Influences							
42	Our school has a large variety of educational software					.80	3.18	.87
60	Staff development events often address the implementation of					.76	3.14	.84
30	Computer access is readily available to faculty in our school					.69	3.65	.66
54	Parents actively support instructional computer use in our					.61	3.23	.81
24	Parents repeatedly voice concerns about educational					.46	2.14	1.04

Each time, one question with a coefficient less than .4 was removed from the CAS. (Questions 6, 10, 12 and 48 were omitted.) Finally, questions were grouped and labeled according to components and factor loadings as shown in Table 2. The table also displays the means and standard deviations for each question. The names of the five constructs are Comfort with Computers, Usefulness of Computers, Instructional Computer Use, Computer Liking and Outside Influences. The alpha reliability coefficients for the five CAS factors were strong (.94 for Comfort with Computers, .96 for Usefulness of Computers, .88 for Instructional Computer Use, 0.85 for Computer Liking and .72 for Outside Influences) as shown in Table 3.

The means and standard deviations were calculated for the five components and are displayed in Table 3. The data suggests that the participants generally had positive attitudes towards computers. Higher means for a factor indicate positive attitudes with the exception of the second factor where a lower score indicates more positive perceptions (factor 1=3.44, factor 2=1.76, factor 3=3.22, factor 4=2.77, factor 5=3.07). The table also shows the amount of variance that each component accounts for totaling 58.3% and the reliability coefficient for each component.

Table 3

Analysis of the Components

	Component					Total
	1	2	3	4	5	
Variance accounted for	26.8%	16.0%	6.4%	4.6%	4.1%	58.3%
Mean	3.44	1.76	3.22	2.77	3.07	
SD	.51	.84	.54	.86	.59	
Reliability coefficient	.94	.96	.88	.85	.72	

Questions from the CAS subscales of confidence and anxiety grouped together in the factor analysis. Previous studies have shown that these two subscales are highly correlated. Despite this association and repeated finding, it has not been recommended to combine the two factors or eliminate one of the factors (Loyd & Loyd, 1985).

Correlation of Demographic Data and the CAS Factors

Correlation analysis were conducted to examine the relationships that exist among several variables. These data are presented in Table 4. Table 4 shows the correlation matrix and the Pearson correlation coefficients among the demographic questions and the CAS factors.

Correlations among the Demographic Questions. The correlational analysis revealed a modest association between age and hours a week computers were used in the classroom (r=.26, p<.05). As expected, there was a strong association between age and years of teaching experience (r=.74, p<.001). There was a modest association between race and grade level taught (r=-.31, p<.01) as well as race and level of education. There were also significant correlations between computer experience and race (r=-.23, p<.05) and level of education and grade level taught (r=.30, p<.01).

Correlations among the CAS Factors. Examination of the CAS factors revealed several interesting relationships. The strongest correlation among the factors was between Comfort with Computers and Instructional Use (r=.66, p<.001). The relationship suggests that teachers who are more comfortable in using computers are more likely to use computers in the classroom.

Computer liking was significantly correlated with comfort (r=.42, p<.001) and strongly correlated with instructional use (r=.66, p<.001) and usefulness

Table 4

Correlation Matrix for Demographic Survey Questions and CAS Factors

Variable	1	2	3	4	5	6	7	8	9	10	11	12
Demographic Survey Questions												
1 Age	–											
2 Gender	-.08	–										
3 Race	.01	.13	–									
4 Level of Education	.21	-.10	-.08	–								
5 What grade level(s) do you teach?	.11	-.01	-.31[b]	.30[b]	–							
6 Years of teaching experience	.74[a]	-.05	-.05	.19	.04	–						
7 Years of computer experience	-.04	-.19	-.23[c]	.27[c]	.28[c]	.07	–					
8 Do you have access to a computer?	[d]	[d]	[d]	[d]	[d]	[d]	[d]	–				
9 Do you have access to the Internet?	.17	-.16	.19	-.19	-.11	-.19	-.14	[d]	–			
10 Hours of use outside the classroom.	.06	-.12	.02	.36[b]	.30[b]	.08	.53[a]	[d]	-.09	–		
11 Hours of use in the classroom.	.26[c]	.03	.05	.30[b]	.01	.29[c]	.28[c]	[d]	-.08	.37[b]	–	
12 Number of computer uses.	-.19	.03	.13	.17	.14	-.08	.42[a]	[d]	-.17	.48[a]	.29[b]	–
CAS Factors												
A Comfort	-.16	-.04	.18	.10	-.12	-.17	.48[a]	[d]	.06	.38[b]	.29[c]	.38[b]
B Usefulness	-.02	.13	.13	.08	.35[b]	-.17	-.01	[d]	.02	-.02	.11	-.02
C Instructional Use	-.05	.01	.15	.05	-.12	-.02	.24[c]	[d]	.04	.21	.35[b]	.26[c]
D Liking	.15	-.18	.11	.14	-.16	.24[c]	.11	[d]	.03	.18	.05	.07
E Outside Influences	.11	.06	-.05	-.09	.14	.10	.10	[d]	-.01	-.05	.09	.19

[a] $p<.001$, [b] $p<.01$, [c] $p<.05$, [d] cannot be computed because one variable is constant

Table 4 *Continued*

Correlation Matrix for Demographic Survey Questions and CAS Factors

Variable	A	B	C	D	E
Demographic Survey Questions					
1 Age					
2 Gender					
3 Race					
4 Level of Education					
5 What grade level(s) do you teach?					
6 Years of teaching experience					
7 Years of computer experience					
8 Do you have access to a computer at school?					
9 Do you have access to the Internet at school?					
10 Hours of use outside the classroom.					
11 Hours of use in the classroom.					
12 Number of computer uses.					
CAS Factors					
A Comfort	–				
B Usefulness	-.19	–			
C Instructional Use	.66[a]	-.12	–		
D Liking	.42[a]	-.59[a]	.37[b]	–	
E Outside Influences	.01	.11	.10	-.04	–

[a] p<.001, [b] p<.01, [c] p<.05, [d] cannot be computed because one variable is constant

(r=-.59, p<.001). This suggests that teachers who like computers are comfortable using computers, find computers to be useful and use computers for instructional purposes.

None of the CAS factors displayed an association with outside influences. All of the Pearson product correlation were weak and insignificant. This finding suggests that teachers use or do not use computers based on intrinsic rather extrinsic factors.

Correlations between the Demographic Questions and the CAS Factors. The strongest correlation among the demographic questions and the CAS factors was between years of computer experience and Comfort with Computers (r=.48, p<.001). Several researchers have reported similar findings between these constructs with the CAS and other survey instruments (Bradley & Russell, 1997). The CAS factor, Comfort with Computers, also correlated with hours a week a computer was used outside the classroom (r=.38, p<.01), hours a week a computer was used in the classroom (r=.29, p<.05) and number of computer uses (r=.38, p<.01). The number of demographic questions correlating with Comfort with Computers suggests that this was the most important CAS factor measuring teachers' attitudes about computers in the classroom.

Instructional Use was another CAS factor that had several noteworthy relationships with demographic questions. Instructional use was significantly correlated with years of computer experience (r=.24, p<.05), hours a week a computer is used in the classroom (r=.35, p<.01) and number of uses of computers (r=.26, p<.05). These results suggest that teachers will have more instructional use of computers if they have more computer experience, use a computer for several hours a week in the classroom and have a variety of computer uses. It is interesting to note that all of the demographic questions that correlated with instructional use also correlated with the first factor, Comfort with Computers. Other significant associations included grade level taught with Usefulness (r=.35, p<.01) and years of teaching experience with Liking (r=.24, p<.05).

Multiple Regression of the Demographic Data and the CAS Factors

Multiple regression can be used to examine either correlational or experimental data (Kachigan, 1991). This study used regression analysis to further investigate the correlations among the demographic data and the CAS factors. This procedure is useful because regression analysis allows for an examination of direct relationships while controlling for other variables.

Multiple regression analyses were conducted for the demographics questions and each of the five CAS factors. For each of these analyses, general demographic questions were first entered as a single block of predictor variables. Next, the demographic questions concerning computer access and use were entered as a second block of predictor variables. This was repeated five times with each of the CAS factors entered as a criterion variable. Table 5 shows the standardized beta coefficients and significance for all of the demographic questions in relation to the five CAS factors. The multiple regression analyses revealed many of the same relationships as the correlational analyses.

Comfort with Computers. Overall, general demographic and computer related demographic variables accounted for 45% percent of the variance in Comfort with Computers. Block one accounted for 10% of the variance [F=1.3(6, 70), p=.28] and block two accounted for an additional 35% of the variance [F=4.8(11, 65), p<.0001].

Table 5

Multiple Regression Analyses on the CAS Factors for the Demographics Survey Questions

Predictor	Comfort	Usefulness	Instructional Use	Liking	Outside Influences
Demographic Survey Questions					
Block 1					
1 Age	.00	.11	-.06	-.10	.17
2 Gender	.04	.05	.03	-.12	.04
3 Race	.16	.29[c]	.10	.07	-.09
4 Level of Education	.01	.00	-.03	.14	-.17
5 What grade level(s) do you teach?	-.24[c]	.50[a]	-.14	-.25[d]	.18
6 Years of teaching experience	-.22	-.33[c]	-.04	.33[d]	.02
Overall R^2	.10	.23	.04	.15	.06
Block 2					
7 Years of computer experience	.47[a]	.04	.19	.05	-.09
8 Do you have access to a computer?	[e]	[e]	[e]	[e]	[e]
9 Do you have access to the Internet?	.07	-.06	.08	.09	.00
10 Hours of use outside the classroom.	.14	-.20	.03	.19	-.19
11 Hours of use in the classroom.	.15	.25[c]	.30[c]	-.15	.09
12 Number of computer uses.	.08	-.14	.09	.02	.34[c]
Overall R^2	.45	.30	.22	.19	.15

[a] $p<.001$, [b] $p<.01$, [c] $p<.05$, [d] $p<.10$, [e] cannot be computed because one variable is a constant

Note. Standardized beta weights are displayed. Overall R^2 represents the total variance explained for each of the criterion variables when entering all of the demographic questions into the regression equation at one time.

The results show that even after controlling for other variables, Comfort with Computers and computer experience were strongly associated (β=.47, p<.001). A similar relationship was observed between grade level taught and usefulness (β=.50, p<.001).

Usefulness of Computers. Overall, general demographics and computer related demographics accounted for 30% of the variance in Usefulness of Computers. Block one accounted for 23% of the variance [F=3.5(6, 70), p<.01] in Usefulness of Computers and block two accounted for an additional 7% of the variance in Usefulness of Computers [F=2.5(11, 65), p<.01]. After controlling for all other variables, demographic factors were associated with Usefulness of Computers. There was a strong relationship between grade level(s) taught (β=.50, p<.001), race (β=.29, p<.05), teaching experience (β=-.33, p<.05), hours of classroom use (β=.25, p<.05) and Usefulness of Computers.

Instructional Use of Computers. Overall, general demographics and computer related demographics accounted for 22% of the variance in Instructional Use of Computers. Block one accounted for 4% of the variance [F=0.48(6, 70), p=0.82] and block two accounted for an additional 18% of variance in Instructional Use [F=1.66(11, 65), p=0.10]. After controlling for other variables, hours of classroom use was significantly associated with Instructional Use (β=.30, p<.05).

Computer Liking. Overall, general demographics and computer related demographics accounted for 20% of the variance in Computer Liking scores. The first block of variables accounted for 15% of the variance [F=2.0(6, 70), p<.10] while the second block accounted for 5% of the variance [F=1.4(11, 65), p=.20].

After controlling for other variables, two variables, grade level(s) taught (β=-.25, $p<.10$) and teaching experience (β=.33, $p<.10$) were significantly associated with Computer Liking scores.

Outside Influences. Overall, general demographics and computer related demographics accounted for 15% of the variance in Outside Influences. Block one accounted for 6% of the variance [F=.71(6, 70), p=.64] and block two accounted for 9% of the variance [F=1.0(11, 65), p=.43]. After controlling for other variables, number of computer uses (β=.34, $p<.05$) accounted for a significant amount of variance in Outside Influence scores.

CHAPTER V

Discussion

In this study, middle school and high school teachers (N=77) throughout the Chicagoland area completed a brief demographic survey and the CAS in order to assess several factors that correlate with teacher computer use. The factors that were examined in this study included demographic variables and CAS factors.

Discussion of Findings

Factor analysis was used to determine and label the CAS factors. The five factors that emerged in the principle components analysis were Comfort with Computers, Usefulness of Computers, Instructional Computer Use, Computer Liking and Outside Influences. Correlational analyses were used to examine relationships between the demographic variables, computer usage variables and the CAS factors. In addition, multiple regression analyses were performed to further examine significant correlations among the demographic questions, CAS factors and teacher computer use. Findings indicated that there were significant associations present between computer experience and Comfort with Computers (r=.48, p<.001; β=.47, p<.001), grade level taught and Usefulness of Computers (r=.35, p<.01; β=.50, p<.001), hours of classroom use and Instructional Use (r=.35, p<.01; β=30, p<.05) and teaching experience and Computer Liking (r=.24, p<.05; β=.33, p<.10). It is important to note that all of these relationships were significant in both the correlational analyses and the multiple regression analyses.

Comfort with Computers. Examination of the correlation matrix indicates that teachers with greater years of computer experience were more comfortable with computers (*r*=.48, p<.001). Further, results of the multiple regression analyses showed that even after controlling for all other variables, computer experience and Comfort with Computers were strongly associated (β=.47, p<.001). This suggests that teachers who have spent more time with computers feel more comfortable with computers.

Loyd and Gressard (1984b) reported similar findings among high school and college students. As a result of this finding, Loyd and Gressard suggested that computer experiences be provided to students as early as possible and be gradually increased from grade to grade. Koohang (1989) reported experience with computers predicted attitudes on all of the CAS subscales. Specifically, he found that students with more experience in keyboarding, programming, word processing, databases and spreadsheets had higher reported CAS scores. Finally, Bradley and Russell (1997) found that individuals with positive computer experiences feel more comfortable with computers. Based on similar studies with teachers, researchers have suggested a need for more professional development opportunities addressing educational technology (Yang et al., 1999).

This study supports previous findings and suggests that teachers should spend more time with computers (Bradley & Russell, 1997; Brosnan, 1998; Dyck & Smither, 1994; Igbaria & Chakrabarti, 1990; Lee, 1997; Loyd & Gressard, 1984b). The main goal of increasing exposure to computers should be to encourage better and more positive attitudes towards technology. Teacher education programs should infuse more technology and computer use opportunities. It may also be important to provide preservice teachers and education students with increased opportunities to use computers in their coursework on a regular basis before entering the classroom (Kent & McNergney, 1999; Kumar & Kumar, 2003; Lieberman & Grolnick, 1997; Sandholtz et al., 1997). Similarly, school districts and schools should encourage teachers to use computers both inside and outside of the classroom. Chiero (1997) reported that the largest barrier to teacher technology use was the time required to learn how to use technology. This may mean that schools should devote more time and more opportunities for training as part of the investment in educational technology. Staff development can be a means of "alleviating 'computerphobia' and generally improving the computer attitudes of teachers" (Loyd & Gressard, 1986, p. 302).

Researchers have also found that increased computer experience helps to diminish computer anxiety (Brosnan, 1998; Dyck & Smither, 1994; Lee, 1997; Necessary & Parish, 1996). This is an important point because most teachers who avoid using computers do so because they possess anxiety towards computers and towards computer-related discussions (Igbaria & Chakrabarti, 1990). DuPagne and Krendl (1992) and Rovai and Childress (2002-2003) suggest that decreasing teachers' anxiety and building confidence towards using computers will make teachers more likely to actually use computers. As Rovai and Childress (2002-2003) point out, " . . . given technology availability and requisite skills and knowledge to use it, performance may not occur without positive attitudes about computers, particularly high computer self-efficacy and low computer anxiety" (p. 226).

Bradley and Russell (1997) examined a different dimension of computer experience. They studied the quality of computer experiences as well as the amount of experience. Bradley and Russell found that if the computer experiences were positive then the attitudes would also be positive. On the other hand, negative experiences would only exacerbate negative attitudes towards computers. This finding is significant to teacher technology training because university faculty and professional development providers may want to make technology training experiences as pleasant and positive as possible for teachers.

It also may be important to provide professional development opportunities on an ongoing basis. Professional development providers need to change isolated, intermittent workshops to more ongoing, supportive programs (Bybee & Loucks-Horsley, 2000). Ongoing programs provide more exposure to computer use and more time between sessions to master computer skills. Researchers have reported that ongoing programs are more effective than one-time programs (Sandholtz et al., 1997).

Finally, administrator support may also be an essential ingredient of increasing exposure to technology. Administrators should involve teachers in technology planning and support teachers through the technology adoption process. Lack of administrator support results in lower levels of teacher job satisfaction (Fullan & Steigelbauer, 1991; Wright & Custer, 1998a). By being part of the decision-making process, teachers will be able to request hardware and software that is best-suited to their student needs and classroom use.

The results of the multiple regression analyses in this investigation showed a negative correlation between grade level taught and Comfort with Computers ($\beta=-.24$, $p<.05$). This relationship suggests that middle school teachers are more comfortable with computers than their high school counterparts. Rosen and Weil (1995) concluded the opposite. They found that a larger percentage of elementary teachers exhibited technophobia than high school teachers. Further research in this area is needed to clarify the relationships between these variables prior to making any claims about the importance of this finding.

Usefulness of Computers. Examination of the correlation matrix revealed an association between grade level taught and Usefulness ($r=.35$, $p<.01$). Further, results from the multiple regression analyses indicated a significant relationship between grade level taught and Usefulness ($\beta=.50$, $p<.001$). This finding suggests that high school teachers find the computer to be more useful than middle school teachers. This finding is new to the field. There has been research examining the general attitudes of elementary, middle and high school teachers but no research has specifically examined teachers' perceived Usefulness of Computers in relation to grade level taught. Further investigation of the relationship between grade level taught and Usefulness needs to be performed to better understand the significance of this finding.

There was also a significant relationship between race and Usefulness ($\beta=.29$, $p<.05$). This relationship indicated that White teachers were more likely to report computers to be useful than were minority teachers. A similar finding was reported by Rosen and Weil (1995) who found that minority teachers were less likely to use computers with students than White teachers. Discrepancies in computer use between White and minority teachers may be a product of the lack of equitable access (PCAST, 1997).

> Equitable access, of course, depends not only on the number of computers available within a given school, but on the extent to which those computers (along with other educational technologies) are actually used by various groups and the modes of usage associated with each group. (p. 68)

In order to determine whether equitable access was an issue in this study or in any future studies, the data would have to be compared by schools or neighborhoods. Schools or school districts located in lower income neighborhoods would have to be compared to other schools located in middle or upper class neighborhoods. It is important to note that researchers have reported that schools in lower income neighborhoods have more minority students and greater limitations related to the availability of technological resources according to PCAST (1997).

The multiple regression revealed an association between teaching experience and Usefulness of Computers ($\beta=-.33$, $p<.05$). This finding suggests that teachers with less classroom experience view computers to be more useful than teachers with greater experience. This finding is unique because this may mean that teachers who are newer to the classroom have used computers more in their teacher preparation programs as compared to more experienced teachers who may have had little or no computer exposure in their training programs. Forty-three percent of the participants in this study have over 20 years of experience as compared to 32% of the participants having 10 or less years of experience. The type of teacher preparation programs that these two groups of teachers attended may have had completely different approaches to computers. This is an important differentiation because there have been a lot of developments in the field of educational technology in just the past decade. Alternatively, it is also possible that more experienced teachers do not feel a need to rely on technology because they already have better teaching skills.

In either case, it may be important to provide technology training should be designed to meet the needs of all teachers. Training should demonstrate to teachers of every grade level, amount of experience and subject area how useful the computer is to the classroom. Possible training program topics could include educational software, commonly used software application, and Internet use relating to the classroom curriculum.

The results of the multiple regression analysis in this study also revealed a relationship between classroom use and Usefulness of Computers (β=.25, $p<.05$). This means that teachers who find computers to be useful devote more time to classroom computer use. Research needs to be performed to investigate why these teachers find computers to be useful and how they use the computers in the classroom. These teachers could serve as models for others because they practice their belief that computers are useful in the classroom.

Instructional Use of Computers. Examination of the correlation matrix indicates that teachers who use computers for a greater amount of time in the classroom believe the computer has greater value for instructional use (r=.35, p<.01). The multiple regression shows that even after controlling for all other variables, hours of classroom use was associated with Instructional Use (β=.30, p<.05).

Over two decades ago, educators saw computers as instructional tools that would eventually replace teachers (Cuban, 1986; Papert, 1980; Picciano, 2001). Today, there is a wide variety of educational software available compared to 20 years ago. Furthermore, educators have developed innovative uses of ordinary software application such as word processors, databases, spreadsheets, Internet and hypermedia (Jonassen, 2000; Moursund, 2002; Norton & Sprague, 2001). Some educators are implementing computers in their classrooms because computers support the constructivist model of learning. Constructivism encourages students to take on a more active role in their own learning (Barron & Goldman, 1994; Becker & Ravitz, 1999; Brooks & Brooks, 1993; Means, 1994; PCAST, 1997; Sandholtz et al, 1997; Vannatta & Beyerbach, 2000). The teacher becomes more of a facilitator than a provider of knowledge in the constructivist classroom. Professional development programs are just beginning to address all types of software. Teacher education programs need to expose students to the large variety of education software presently available. Schools should also continuously update teachers on the latest software available.

Much research examining technology proficient teachers has been performed recently (Ryba & Brown, 2000; Zhao et al., 2001). By understanding how this select group of teachers use computers, training programs may be developed to educate preservice and practicing teachers.

Computer Liking. Examination of the correlation matrix shows that years of teaching experience is associated with Computer Liking ($r=.24$, $p<.05$). The multiple regression shows that after controlling for other variables, teaching experience is associated with Computer Liking ($\beta=.33$, $p<.10$). This finding suggests that teachers with more years of teaching experience have better attitudes, specifically Liking, towards computers. Examination of the demographic survey results shows that 43% of the teachers possessed over 20 years of teaching experience.

There has been plenty of research focusing on the relationship of age and computer attitudes. Fifty-seven percent of the teachers participating in this study were between the ages of 41 and 55. Research has shown that older adults have more positive attitudes towards computers than their younger counterparts. Massoud (1991) examined computer anxiety among different age groups and found no differences in anxiety levels. Gilroy and Desai (1986) also reported that they did not find any differences in the anxiety levels among different age groups. Dyck and Smither (1994) found that older adults had more favorable attitudes towards computers than younger adults because of their context of use. Older adults tend to use computers for recreational or work use. Younger adults, on the other hand, use computers primarily for school-related assignments. Rosseau and Rogers (1998) found that older adults use computers as frequently as younger adults but they use fewer computer applications.

The findings connecting teaching experience and Computer Liking and the research relating age and positive attitudes should be applied to professional development programs. Training should take advantage of more experienced teachers' attitudes towards computers. It is important to help these teachers learn and master new applications and for these teachers to share their enthusiasm with less experienced teachers.

The multiple regression analysis displays an association between Computer Liking and grade level taught ($\beta=-.25$, $p<.10$). This finding shows middle school teachers like computers more than high school teachers. This finding is unique and new to the field. Perhaps, middle school teachers have more positive views about computers because of the large variety of software that is now available for the middle school curriculum. At the National Educational Computing Conference (NECC) held in Chicago in 2001 (www.neccsite.org), many of the booths in the main exhibit hall were for vendors selling educational software geared for elementary and middle school classrooms. It is also possible that middle school teachers like computers more because computers support constructivist learning. Constructivism is more commonly implements in the elementary and middle school classrooms (Brooks & Brooks, 1993).

Outside Influences. The multiple regression analysis shows that Outside Influences is associated with number of computer uses ($\beta = .34$, $p < .05$). This means that the number of computer applications teachers use correlates with Outside Influences.

Cuban (2001) reported that despite the massive investment in educational technology, teachers use computers for simple tasks such as record keeping, lesson planning and communication with parents and administrators. Some teachers even refer to computers as fancy typewriters due to word processing capabilities (Sandholtz et al., 1997). University faculty use email to communicate with colleagues and use the Internet for scholarly research (Henry, 2002).

In recent years, politicians, businessmen, administrators and parents have been increasing pressure for teachers to use educational technology (Eastin, 1999). These groups may be positively or negatively pressuring teachers to use computers in the classroom. Negative influences may cause teachers to use computers but develop negative attitudes towards computers. Positive influences, on the other hand, may be a result of encouragement, support, technology availability and effective training. The finding that teachers' use correlates with Outside Influences needs to be further examined.

Gender. Gender and computer use has been the topic of much research over the past two decades (Bromfield et al., 2001; Loyd & Gressard, 1986; Marcoulides, 1988; Massoud, 1990; North & Noyes, 2002; Rosseau & Rogers, 1998; Shashaani & Khalili, 2001). Gender studies have been performed since the advent of educational technology. No significant correlation was found between gender and the five CAS factors in this study. Even after controlling for all other variables, the multiple regression did not reveal any significant correlations between gender and the CAS factors. This finding is both supported and refuted by past studies (Brosnan & Davidson, 1994; Koohang, 1989; Marcinkiewicz, 1993/1994; Sheingold & Hadley, 1990). Loyd and Gressard (1984b) did not find any significant differences between the two genders in their computer attitudes. Based on this finding, they state, "The lack of significant finding related to sex should leave open the possibility that females may be as interested as males in computers, and that females do not necessarily have more anxiety than males about working with computers" (p. 76). Brosnan and Davidson (1994), on the other hand, suggest that computerphobia is more prevalent among females. North and Noyes (2002) state that Computer Science is seen as a masculine field.

In another study by Loyd and Gressard (1986), the differences in male and female computer attitudes among public school teachers were found to be statistically significant. Loyd and Gressard performed ANOVA's on each subscale of the CAS. The gender differences were found in Computer Anxiety and Computer Confidence. Studies by other researchers have revealed similar gender differences. Furthermore, studies have found that computer attitudes correlate with math attitudes (Massoud, 1990; Marcoulides, 1988; Munger & Loyd, 1989). Mathematics has been traditionally recognized as a male dominated field.

Koohang (1989) found no significant gender differences on Computer Anxiety, Computer Confidence and Computer Liking. He did, however, find a significant difference on the Computer Usefulness subscale. Overall, Koohang found that male students have better attitude scores than female students. Siann et al. (1990) also found that males generally had more positive attitudes towards computers and were less anxious around computers than their female counterparts. However, their study found that with proper encouragement female students developed positive attitudes towards computers.

The teaching profession has long been recognized as a "female profession". In this study, 27% of the participants were male teachers and 73% were female teachers. All teachers regardless of gender should be encouraged to use computers for both personal and school use. For example, education students and preservice teachers should be exposed to educational technology throughout their coursework on a regular basis before entering the classroom. Educational computer use should be modeled and encouraged by university faculty and administrators. Female preservice and practicing teachers should especially be encouraged to make use of computers. Wright and Custer (1998b) found technology education teachers and courses as two factors influencing future computer use and career decisions for high school students. University faculty were also highly rated as a reason to pursue a career in the technology field.

Research has shown that boys take more interest in technology than their female counterparts (Massoud, 1991; Shashaani & Khalili, 2001). This means that teachers must make an extra effort to encourage girls to use computers. Additional encouragement and increased computer use will lead to better attitudes towards computers.

Female attitudes towards computers have slowly been changing. Schumacher and Morahan-Martin (2001) studied the computer attitudes of female students over an eight year span. They found that as computer exposure and computer use increased over the years, gender differences decreased. University faculty and professional development providers need to provide more computer experience to preservice and practicing teachers and teachers need to provide more computer experience to students. It is important for female teachers to model computer use for their female students. "Women make up half of the workforce, but only 20% of these women are working high-tech jobs" (Shashaani & Khalili, 2001, p. 364). More computer experiences for students today will create a future generation of teachers with positive computer attitudes.

<u>CAS Validation Studies</u>

The original three factor CAS was developed from a pool of 78 questions. Thirty questions were selected by a panel of judges to represent three factors, Computer Anxiety, Computer Confidence and Computer Liking (LaLomia and Sidowski, 1993). The CAS has been used to examine the computer attitudes of teachers and students (Koohang, 1989; Loyd & Gressard, 1984a, 1984b, 1986; Gressard & Loyd, 1986).

Research examining the CAS has shown that the Computer Confidence and Computer Anxiety subscales measure the same construct (Nash & Moroz, 1997). In this study, questions measuring confidence and anxiety grouped together in the factor analysis. The newly created factor was labeled as Comfort with Computers. This factor accounted for 26.9% of the variance and had a reliability coefficient of 0.937. Similar factor groupings were reported by Bandoles and Benson (1990). Bandoles and Benson administered the original three factor CAS to 375 college students in order to examine the factor structures of the instrument. Their results revealed a computer liking factor, a computer achievement factor and a computer confidence factor. Their computer confidence subscale, however, was a combination of the confidence and anxiety factors as reported by Loyd & Gressard (1984b). Bandoles and Benson concluded that the three factor CAS could be reduced from 30 questions to only 23 questions and still measure the same factors. Another CAS validation study was conducted by Woodrow (1991). Woodrow also concluded that the Computer Confidence and Anxiety subscales were highly correlated and therefore measure the same construct.

Loyd and Loyd (1985) added a fourth subscale in 1985 and performed another validation study. The new CAS was administered to 114 teachers. Nine computer anxiety questions and seven confidence questions had coefficients greater than 0.40 on the first factor. Loyd and Loyd concluded that the confidence and anxiety subscales were measuring the same construct. However, they did not recommend a reduction of CAS factors by combining the two subscales or eliminating one of the subscales.

Gressard and Loyd (1986) performed validation studies of their own three factor Computer Attitude Scale. The CAS was administered to 192 elementary, middle and secondary school teachers enrolled in professional development programs that provided computer instruction and experience. Principle components analysis with varimax rotation was performed on the survey data. The coefficient alpha reliabilities were .89 for Computer Anxiety, .89 for Computer Liking, 89 for Computer Confidence and .95 for the Total Scale. Gressard and Loyd concluded that the factor analysis and coefficient alpha reliabilities show that the three CAS subscales are sufficiently defined and measure three separate constructs.

Massoud (1990) performed a study examining the factorial validity of the original three factor CAS. The survey instrument was administered to low-literate adults enrolled in GED classes. A factor analysis with varimax rotation was performed on the survey data. Loyd and Gressard's (1984a) three factors emerged accounting for 47.2% of the total variation. Only factor loadings greater than .40 were considered significant in this study. Eigenvalues for the factors were 8.75, 3.37 and 2.05. Reliability coefficients were .79, .83, .75 and .91 for computer Anxiety, Computer Confidence, Computer Liking and the Total Score. The factor analysis and reliability coefficients suggested that the three factors revealed three separate scores and measured three separate constructs. In addition, Massoud concluded that low-literate adults generally had positive attitudes towards computers.

Study Limitations

The findings of this study were based primarily on correlational and multiple regression analyses and no cause-effect relationships may be assumed from the data. For example, the demographic variables and the CAS factors may be correlated with teacher computer use but neither group of variables affects the other. Pre- and post-test would need to be collected in order to determine any causal relationships.

Sample size was a concern of this study. The survey response rate was 44%. Voluntary surveys usually have poor return rates (Judd, Smith & Kidder, 1991). In this study, the population of interest is generally very busy and may not have the time or motivation to complete and return a voluntary survey administered by someone outside of their school. Other disadvantages of questionnaires include the context of question answering and inability to clear misunderstandings. Participants were unable to clarify any misunderstandings when completing the questionnaires. Additionally, the questionnaire used in this study was subjective, measuring participants' attitudes toward technology. "Expressed attitudes are dependent on details of question wording, question sequence and interviewer effects to a greater extent than are responses involving facts, for instance" (Judd et al., 1991, p. 231).

Another concern of this study is the reliability of the survey data. Participation in the survey was completely voluntary. This may have resulted in a self-selected sample. Teachers who had more time and/or interest completed and returned the surveys. Possibly, the data would have been more reliable if the survey was administered to a captive audience and/or collected from every faculty member. Furthermore, this study relied on data reported by the teachers. Teachers' responses reflect how teachers perceive their own computer use and attitudes. It is not based on actual teacher computer use or attitudes.

Further Investigation

Research has shown that teachers are not making adequate use of educational technology. This study examined a limited number of variables that correlate with computer use. Further research may reveal other factors that should be investigated and/or focused on.

The CAS was designed by Loyd and Gressard (1984) and has been used for nearly two decades. Although this instrument measures several important constructs, these constructs may presently be considered outdated or irrelevant to teachers' technology use. For this reason, new constructs were added to the instrument in this study. Other constructs were also considered but not included.

One of the most significant findings of this study was the correlation of computer experience and Comfort with Computers (r=.48, $p<.001$; β=.47, $p<.001$). This correlation should be further examined to find what types of experience correlate with increased Comfort with Computers. Research showing specifically what type of experiences correlate with Comfort with Computers can help better design or revise training programs for both preservice and practicing teachers.

There is little research about grade level taught and Usefulness of Computers. In this study, there was a significant correlation (r=.35, $p<.01$; β=.50,

$p<.001$) that needs to be further examined. If a particular group or grade level of teachers believe that computers are useful, it would be helpful to know why in order to design future professional development programs or revise teacher education.

There have been many conflicting studies on gender and computer use. This study found no significant gender differences. Some researchers have found that as females accumulate more computer experience, gender differences diminish (Schumacher & Morahan-Martin, 2001). More studies need to be performed in order to determine whether gender differences continue to exist and why this is occurring.

Teachers as a group have been labeled as resistant to new technologies and change. A long-term study examining teacher attitudes and computer use needs to be performed. It would be interesting to examine the progress of the past two decades. Additionally, politicians, businessmen, administrators and parents need to ascertain whether the billions of dollars that have been invested in educational technology have been worthwhile and how to plan for the future (Eastin, 1999).

This study used correlational analyses to investigate the relationships of several factors with teacher computer use. No cause and effect relationships were determined. The survey could be administered more than once in order to determine any change over time. The survey could also be administered to a control group and an experimental group receiving technology training. In either case, the data could be analyzed by analysis of variance.

Conclusions

Teacher computer use has been the focus of much research ever since the computer was introduced to the classroom over 20 years ago. Computers in the classroom have been a topic of ongoing debate. Despite what critics say, the computer is definitely here to stay. School districts across the country have invested both time and resources into educational technology in an attempt to prepare students for the modern workplace. The findings of this study will help create better technology training programs for preservice and practicing teachers. Some of the findings reinforce previous research and other findings were unique to this study.

As further research is performed in the area of educational technology, better utilization and investment can be planned. Hopefully, the better planning will lead to increased teacher computer use and better teacher attitudes towards computers.

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Appendix A

Survey Cover Letter

DEPAUL UNIVERSITY

School of Education
2320 North Kenmore Avenue
Chicago, Illinois 60614-3250
773/325-7740
FAX 773/325-7713
www.depaul.edu/~educate

January 2000

Dear Teacher:

I am a doctorate student at the School of Education of DePaul University. I am presently working on my dissertation and collecting data to examine teachers' computer use in the classroom. My research is dependent on the survey method. As an education student and former high school teacher, I feel there is a need to understand teachers' computer use because most of the present research on educational technology focuses on students. Therefore, I am asking for the participation of high school teachers in the Metropolitan area.

I will be distributing the survey materials to you and your colleagues in the near future. At the time of the survey distribution, you will be given a consent form and two surveys. Please read the consent form carefully before proceeding to the surveys. The consent form will further detail the surveys and explain your role as a participant in this study. As a participant, you will also have the opportunity to enter your name in a raffle for a $50 gift certificate that may be used at a popular educators' resource store. All information collected during the course of this study will be kept confidential and will only be used for research purposes. You may choose not to participate in this study or you may discontinue participation at any time without any consequences.

Please call me at 312-922-5005 or email me at swahab@students.depaul.edu if you have any further questions about my research. Thank you for your cooperation.

Sincerely,

Samia A. Wahab

Appendix B

Survey Consent Form

DEPAUL
UNIVERSITY

School of Education
2320 North Kenmore Avenue
Chicago, Illinois 60614-3250
773/325-7740
FAX 773/325-7713
www.depaul.edu/~educate

CONSENT TO PARTICIPATE IN RESEARCH
Factors Correlating with Teachers' Computer Use

My name is Samia A. Wahab. I am a doctorate student at DePaul University and am presently working on my dissertation.

Description of the Research Project: I am asking you to take part in a research study because I am trying to learn more about teachers' use of computers in teaching and learning. You have been asked to participate in this study because I am particularly interested in your thoughts as high school teachers in a Metropolitan area about computers.

There are two surveys in this study. The first survey asks questions about your background as a teacher and your computer use. The second survey asks questions about how you feel about computers. Most of the survey responses will be in the form of a Likert scale (i.e., 1 2 3 4). The two surveys will take approximately 15 to 20 minutes to complete.

Participation: If you agree to be in this study, carefully read and sign this consent form and complete the two surveys about your computer use and thoughts about computers. As a participant, you will also have the opportunity to enter your name in a raffle for a $50 gift certificate that may be used at a popular educators' resource store.

You may choose not to participate in this study or you may discontinue participation at any time without any consequences. Your participation in this study is entirely up to you.

Confidentiality: Many of the survey questions deal with your private thoughts about computers and education. Survey responses will be kept confidential and will only be used for research purposes. Completed surveys will be handled by my dissertation committee and myself. The signed consent forms, however, will only be handled by me. This will ensure that your identity will not be disclosed to anyone other than myself. All information that you provide in this study will be kept strictly confidential and any report of this research will not identify you personally in any way.

Risks and Benefits: This study does not involve any physical risks. Furthermore, your confidentiality will be maintained. It is anticipated that this study will contribute to the understanding of how certain factors relate to computer use among teachers. You may

also better understand your own computer use after completing the surveys. You may or may not directly benefit from participation in this study, but I hope the results will lead to improvement in research about teachers and computers and future application of this subject.

Contact Information: Please feel free to ask any questions that you may have about the study. Please call me at 312-922-5005 or email at swahab@students.depaul.edu if you have any questions later.

Signing your name at the bottom of this page means that you agree to be in this study. You will be given a copy of this form. Thank you for your cooperation.

Investigator's Responsibility: I have fully explained to (participant) _____________ the nature and the purpose of the above described research procedures and the risks and benefits involved in its performance. I have answered all (and will continue to answer all) questions to the best of my ability. I will inform the participant of any changes in the procedures or risks and benefits if they should occur during or after the course of this study. I have provided a copy of the consent form for the participant.

Investigator's signature ____________________ Date_________

Participant's Consent: I have been satisfactorily informed of the above described procedure with its possible risks and benefits. I agree to participate in this research study. If I have any questions regarding my rights as a participant in this research study, I may request to speak to a member of the DePaul University Institutional Review Board for the Protection of Research Participants by calling (773) 325-7388. I understand that my participation in this research study is voluntary and that I am free to stop participating at any time, without any consequences, even after signing this form. I have been offered a copy of this form.

Name of Subject_________________________ Date_________

Signature_____________________________

DPU-IRB approval number _________

Appendix C

Demographics Survey

DEMOGRAPHICS QUESTIONNAIRE

	Please circle the answer that best represents your response.	
1	Age	22 or less 23-25 26-30 31-35 36-40 41-45 46-50 51-55 56-60 61-65 66 or more
2	Gender	Male Female
3	Race	African-American American Indian Asian or Pacific Islander Hispanic White Other
4	Level of education	Bachelors Masters Doctorate
5	What grade level(s) do you teach? (Circle all that apply).	9 10 11 12
6	Years of teaching experience	0-5 6-10 11-15 16-20 >20
7	Years of computer experience	0-5 6-10 11-15 16-20 >20
8	Do you have access to a computer at school?	yes no
9	Do you have access to a computer at home?	yes no
10	Do you have access to the Internet at school?	yes no
11	Do you have access to the Internet at home?	yes no
12	How many hours a week do you use a computer outside of the classroom?	0-5 6-10 11-15 16-20 >20
13	How many hours a week do you use a computer in the classroom?	0-5 6-10 11-15 16-20 >20
14	Primary use(s) of computer (Circle all that apply).	Word Processing Spreadsheet Presentation Internet Email Other

Appendix D

Computer Attitude Scale
Devised by Loyd and Gressard (1984)
Revised by Loyd and Loyd (1985)
Revised for this study

COMPUTER ATTITUDE SCALE

Please circle the number that best represents your answer to each question.

		Agree	Agree	Disagree	Disagree
1	I am sure I could learn a computer language	1	2	3	4
2	When there is a problem with a computer run that I can't immediately solve, I would stick with it until I have the answer	1	2	3	4
3	I would feel comfortable working with a computer	1	2	3	4
4	Learning about computers is a waste of time	1	2	3	4
5	I value using computers for when I am instructing students	1	2	3	4
6	Parents often ask me about computer use in my teaching	1	2	3	4
7	Generally, I would feel OK about trying a new problem on the computer	1	2	3	4
8	I would like working with computers	1	2	3	4
9	Working with a computer would make me very nervous	1	2	3	4
10	I'll need a firm mastery of computers for my future work	1	2	3	4
11	My students benefit academically when they use computers in my classroom	1	2	3	4
12	Our principal encourages us to use computers within the classroom	1	2	3	4
13	I'm not the type to do well with computers	1	2	3	4
14	I do not enjoy talking with others about computers	1	2	3	4
15	It wouldn't bother me at all to take computer courses	1	2	3	4
16	It is important to me to do well in computer class	1	2	3	4

		Strongly Agree	Slightly Agree	Slightly Disagree	Strongly Disagree
17	Computers facilitate the teaching and learning process by engaging and motivating students	1	2	3	4
18	I use computers in my teaching because technology support is available	1	2	3	4
19	I do not think I could handle a computer course	1	2	3	4
20	The challenge of solving problems with computers does not appeal to me	1	2	3	4
21	I feel aggressive and hostile toward computers	1	2	3	4
22	Learning about computers is worthwhile	1	2	3	4
23	Computers are essential for helping me organize daily activities in the classroom	1	2	3	4
24	Parents repeatedly voice concerns about educational technology in our school	1	2	3	4
25	I think using a computer would be very hard for me	1	2	3	4
26	Figuring out computer problems does not appeal to me	1	2	3	4
27	I do not feel threatened when others talk about computers	1	2	3	4
28	I expect to have little use for computers in my daily life	1	2	3	4
29	Using computers increases student achievement	1	2	3	4
30	Computer access is readily available to faculty in our school	1	2	3	4
31	I could get good grades in computer courses	1	2	3	4
32	Once I start to work with a computer, I would find it hard to stop	1	2	3	4

		Strongly Agree	Slightly Agree	Slightly Disagree	Strongly Disagree
33	I would feel at ease in a computer class	1	2	3	4
34	Working with computers will not be important in my life's work	1	2	3	4
35	Computers are a good teaching tool for students of varying abilities	1	2	3	4
36	I use computers in my classroom because of pressure from the administration	1	2	3	4
37	I don't think I would do advanced computer work	1	2	3	4
38	I don't understand how some people can spend so much time working with computers and seem to enjoy it	1	2	3	4
39	Computers make me feel uneasy and confused	1	2	3	4
40	Anything a computer can be used for, I can do just as well some other way	1	2	3	4
41	Computers make it easier to develop lesson plans	1	2	3	4
42	Our school has a large variety of educational software available	1	2	3	4
43	I'm no good with computers	1	2	3	4
44	I think working with computers would be enjoyable and stimulating	1	2	3	4
45	Computers make me feel uncomfortable	1	2	3	4
46	I can't think of any way that I will use computers in my career	1	2	3	4
47	I use computers to keep students focused and on task	1	2	3	4
48	Our principal requires us to integrate computers into the curriculum	1	2	3	4

		Strongly Agree	Slightly Agree	Slightly Disagree	Strongly Disagree
49	I am sure I could do work with computers	1	2	3	4
50	I will do as little work with computers as possible	1	2	3	4
51	Computers do not scare me at all	1	2	3	4
52	Knowing how to work with computers will increase my job possibilities	1	2	3	4
53	I organize or plan my curriculum with the aid of a computer	1	2	3	4
54	Parents actively support instructional computer use in our school	1	2	3	4
55	I have a lot of self-confidence when it comes to working with computers	1	2	3	4
56	If a problem is left unresolved in a computer case, I would continue to think about it afterward	1	2	3	4
57	I get a sinking feeling when I think of trying to use a computer	1	2	3	4
58	I will use computers many ways in my life	1	2	3	4
59	The behavior of my students is much better when using computers	1	2	3	4
60	Staff development events often address the implementation of computers in the curriculum	1	2	3	4

Appendix E

Permission to use the CAS

Date: Tue, 24 Oct 2000 20:41:04 -0400
From: Doug Loyd **Block Address** | **Add to Address Book**
To: Samia Wahab
Subject: Loyd/Gressard Computer Attitude Scale

Thank you for your inquiry about the Computer Attitude Scale.

As you may know, Brenda Loyd, author of the CAS, was President of the National Council on Measurement in Education (NCME) at the time of her death in 1995. Dr. Loyd's co-author, Clarice Gressard, has asked me to handle all requests for permission to use their survey, and to provide the
CAS survey and scoring protocol to researchers who wish to use their scale.

Therefore, in response to your inquiry, I am attaching a copy of the Loyd/Gressard survey of attitudes towards computers, in an MSWord document (survey.doc). If you have any problem reading it please let me
know. Unfortunately I have no further information about the use of the CAS beyond that provided in this message and the attached document.

The survey is scored according to the following:

For questions 1, 3, 4, 6, 9, 11, 12, 14, 16, 17, 19, 22, 25, 27, 28, 30,
33, 35, 36, 38 (Strongly Agree=4, Slightly Agree=3, Slightly Disagree=2,
Strongly Disagree=1).

For questions 2, 5, 7, 8, 10, 13, 15, 18, 20, 21, 23, 24, 26, 29, 31, 32,
34, 37, 39, 40 (Strongly Agree=1, Slightly Agree=2, Slightly Disagree=3,
Strongly Disagree=4).

The questions are coded so that the higher the score, the more positive the attitude.

Four subscores can also be obtained from the questions.

Anxiety:	1, 5, 9, 13, 17, 21, 25, 29, 33, 37
Confidence:	2, 6, 10, 14, 18, 22, 26, 30, 34, 38
Liking:	3, 7, 11, 15, 19, 23, 27, 31, 35, 39
Usefulness:	4, 8, 12, 16, 20, 24, 28, 32, 36, 40

Again, higher scores correspond to more positive attitude, e.g., a higher
confidence score means more confidence and a higher anxiety score means less anxiety.

Permission is granted for use of this scale. In any publications arising
from its use, please be sure to credit the authors, Brenda H. Loyd and Clarice P. Gressard.

Thanks for your interest. Best wishes.

Doug Loyd

Attachment: Survey.doc (MSWord)

--
Doug Loyd, Technical Resources Coordinator
Departmental Computing Support, ITC
115 Astronomy Building 804-924-0629
University of Virginia

Attachment

Survey.doc
Type .doc : Scanning recommended

Scan With Norton Antivirus

Download File

View Attachment

Remember: You need to scan and clean your attachments **every** time you download or open them.

Appendix F

The Computer Attitude Scale
Devised by Loyd and Gressard (1984)
Revised by Loyd and Loyd (1985)

SURVEY OF ATTITUDES TOWARD LEARNING ABOUT AND WORKING WITH COMPUTERS

Brenda H. Loyd and Clarice P. Gressard
University of Virginia

The purpose of this survey is to gather information concerning people's attitudes toward learning about and working with computers. It should take about five minutes to complete this survey. All responses are kept confidential. Please return the survey to your instructor when you are finished.

Please check the blank which applies to you.

1. Age: ❑ 22 or less ❑ 23-25 ❑ 26-30
❑ 31-35 ❑ 36-40 ❑ 41-45
❑ 46-50 ❑ 51-55 ❑ 55+

2. College level completed: ❑ 1st year ❑ 2nd year ❑ 3rd year ❑ 4th year
❑ Bachelors ❑ Masters ❑ Doctorate

3. Major area of study:______________________________

4. Sex: ❑ Male ❑ Female

5. Experience with learning about or working with computers:
❑ 1 week or less ❑ 1 week to 1 month ❑ 1 month to 6 months
❑ 6 months to 1 year ❑ 1 year or more

Briefly state the type of computer experience: ______________________

COMPUTER ATTITUDE SCALE

Below are a series of statements. There are no correct answers to these statements. They are designed to permit you to indicate the extent to which you agree or disagree with the ideas expressed. Place a checkmark in the space under the label which is closest to your agreement or disagreement with the statements.

		Strongly Agree	Slightly Agree	Slightly Disagree	Strongly Disagree
1.	Computers do not scare me at all.	❑	❑	❑	❑
2.	I'm no good with computers.	❑	❑	❑	❑
3.	I would like working with computers	❑	❑	❑	❑
4.	I will use computers many ways in my life.	❑	❑	❑	❑
5.	Working with a computer would make me very nervous.	❑	❑	❑	❑
6.	Generally, I would feel OK about trying a new problem on the computer.	❑	❑	❑	❑

		Strongly Agree	Slightly Agree	Slightly Disagree	Strongly Disagree
7.	The challenge of solving problems with computers does not appeal to me.	❑	❑	❑	❑
8.	Learning about computers is a waste of time.	❑	❑	❑	❑
9.	I do not feel threatened when others talk about computers.	❑	❑	❑	❑
10.	I don't think I would do advanced computer work.	❑	❑	❑	❑
11.	I think working with computers would be enjoyable and stimulating.	❑	❑	❑	❑
12.	Learning about computers is worthwhile.	❑	❑	❑	❑
13.	I feel aggressive and hostile toward computers.	❑	❑	❑	❑
14.	I am sure I could do work with computers.	❑	❑	❑	❑
15.	Figuring out computer problems does not appeal to me.	❑	❑	❑	❑
16.	I'll need a firm mastery of computers for my future work.	❑	❑	❑	❑
17.	It wouldn't bother me at all to take computer courses.	❑	❑	❑	❑
18.	I'm not the type to do well with computers.	❑	❑	❑	❑
19.	When there is a problem with a computer run that I can't immediately solve, I would stick with it until I have the answer.	❑	❑	❑	❑
20.	I expect to have little use for computers in my daily life.	❑	❑	❑	❑
21.	Computers make me feel uncomfortable.	❑	❑	❑	❑
22.	I am sure I could learn a computer language.	❑	❑	❑	❑
23.	I don't understand how some people can spend so much time working with computers and seem to enjoy it.	❑	❑	❑	❑
24.	I can't think of any way that I will use computers in my career.	❑	❑	❑	❑
25.	I would feel at ease in a computer class.	❑	❑	❑	❑
26.	I think using a computer would be very hard for me.	❑	❑	❑	❑

		Strongly Agree	Slightly Agree	Slightly Disagree	Strongly Disagree
27.	Once I start to work with the computer, I would find it hard to stop.	❑	❑	❑	❑
28.	Knowing how to work with computers will increase my job possibilities.	❑	❑	❑	❑
29.	I get a sinking feeling when I think of trying to use a computer.	❑	❑	❑	❑
30.	I could get good grades in computer courses.	❑	❑	❑	❑
31.	I will do as little work with computers as possible.	❑	❑	❑	❑
32.	Anything that a computer can be used for, I can do just as well some other way.	❑	❑	❑	❑
33.	I would feel comfortable working with a computer.	❑	❑	❑	❑
34.	I do not think I could handle a computer course.	❑	❑	❑	❑
35.	If a problem is left unsolved in a computer class, I would continue to think about it afterward.	❑	❑	❑	❑
36.	It is important to me to do well in computer classes.	❑	❑	❑	❑
37.	Computers make me feel uneasy and confused.	❑	❑	❑	❑
38.	I have a lot of self-confidence when it comes to working with computers.	❑	❑	❑	❑
39.	I do not enjoy talking with others about computers.	❑	❑	❑	❑
40.	Working with computers will not be important to me in my life's work.	❑	❑	❑	❑

SAMIA A. WAHAB

6546 Rodgers Drive, Willowbrook, IL 60527
630-887-0808, 630-887-0505 fax samiawahab@yahoo.com

Education	**Doctor of Education** in Curriculum Studies, June 2003 DePaul University, Chicago, IL
	Master of Arts in Instructional Technology and Media, February 2003 Teachers College, Columbia University, New York, NY
	Master of Education in Teaching and Learning Biology, March 1998 DePaul University, Chicago, IL
	Bachelor of Science in Biological Sciences with a minor in Mathematics and Computer Science, May 1993 University of Illinois, Chicago, IL
Certifications and Endorsements	Illinois Secondary Biology Certificate
	Endorsements in Secondary Chemistry and Junior High/Middle School General Science, Mathematics and Social Science.
Experience	**Museum and the Public Schools Program Facilitator**, January to June 2001 Education Department, John G. Shedd Aquarium, Chicago, IL
	Professional Development Facilitator, June to August 2000 Urban Education Department, DePaul University, Chicago, IL
	Graduate Assistant, February 1999 to June 2000 Ed.D. Program, DePaul University, Chicago, IL
	Student Teacher, January to March 1997 Science Department, St. Ignatius College Prep, Chicago, IL
	High School Chemistry Teacher, March 1995 to June 1996 **Middle School Science Teacher**, September 1993 to March 1995 The College Preparatory School of America, Lombard, IL
Professional Affiliations	American Educational Research Association Association for Supervision and Curriculum Development Illinois Science Teacher Association International Society for Technology in Education Kappa Delta Pi International Honor Society in Education National Science Teacher Association Phi Delta Kappa International
Publications	Wahab, S. (2003). *Factors Correlating with Teachers' Use of Computers in the Classroom.* (Doctoral Dissertation.)
	Wahab, S. *Technology in Education: A Review of Literature.* (In progress.)
References	Provided upon request.