A GENERAL COMPUTER SURVEY MEASURING THE USER'S COMPUTER ATTITUDE AND COMPUTER KNOWLEDGE

A GENERAL COMPUTER SURVEY MEASURING THE USER'S COMPUTER ATTITUDE AND COMPUTER KNOWLEDGE

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Table of contents

List of Tables vi

List of Figures vii

Introduction 1

The personal computer revolution 1

The problem with computers 4

The computer users 6

The teachers 6

The children 7

The college students 8

The employees and the retirees 10

The computer measures 12

Assessing the computer measures 18

The new computer scale 23

Computer anxiety scale 24

Computer liking/interest scale 24

Purpose of study 25

Related measures 25

Computer knowledge and computer experience 25

Method 28

Subjects 28

Materials 29

Procedure 30

Results 31

Computer Anxiety Scale 31

Computer Liking/Interest Scale (CLS) 35

Computer Knowledge Scale 40

General Computer Survey (GCS) 45

Discussion 60

Validation of the constructs 60

Computer Anxiety, computer liking/interest, computer knowledge, and computer experience 62

External correlates 63

General computer survey 65

Directions of future research 66

References 67

Appendix A 75

Appendix B 86

Appendix C 87

List of tables

Table 1. Preliminary computer anxiety scale (18 items) 32

Table 2. Preliminary computer liking/interest scale (20 items) 37

Table 3. Preliminary computer knowledge scale (17 items) 42

Table 4. General Computer Survey (33 items) 47

Table 5. Final General Computer Survey (24 items) 53

Table 6. Intercorrelations Between Computer Anxiety, Computer Liking/Interest, and computer Knowledge Factors 55

Table 7. Coefficient Alpha and mean factor scores of the subscales of general computer scale 56

Table 8. Coefficient Alpha and mean factor scores of the subscales of general computer scale 57

List of Figures

Figure 1. Factor loadings and t-values of the preliminary computer anxiety factor (18 items) 34

Figure 2. Factor loadings and t-values of the improved computer anxiety factor (12 items) 36

Figure 3. Factor loadings and t-values of the preliminary computer liking/interest factor (20 items) 39

Figure 4. Factor loadings and t-values of the improved computer liking/interest factor (11 items) 41

Figure 5. Factor loadings and t-values of the preliminary computer knowledge factor (17 items) 44

Figure 6. Factor loadings and t-values of the improved computer knowledge factor (10 items) 46

Figure 7. Factor loadings and t-values of the preliminary general computer survey (33 items) 50

Figure 8. Factor loadings and t-values of the final general computer survey (24 items) 52

Introduction

The latter half of the twentieth century has seen a remarkable technological breakthrough in the form of computers. Computers have affected almost every aspect of our lives. They can be found in virtually every device we use. The microwaves we use may have a computer component in them. The cars we drive have parts controlled by computers. One of the promises of this technology for all of us is that the computer will make our lives easier. For example, we now have computers to help us when we shop for groceries, when we work, or even when we bank at our local banks. The dawn of electronic age means instant information in the form of digital data at our fingertips. For most of us it also means we become more productive and our lives easier in terms of convenience. For example, we can work at home, access a wealth of information in a matter of seconds, shop for almost anything through the Internet and have the items delivered to our homes without ever stepping out our door. In fact, we can communicate with friends, family, and relatives in the form of e-mail, chats or public chat rooms, Internet phones, Internet based video-phone, and so on. Another remarkable use of computers that may have a far greater social impact is the fact that we can meet new people and socialize without ever leaving the comfort of our home. This can all be achieved through the usage of a personal computer and a simple access to the Internet.

The personal computer revolution

The field of personal computers is one of the fastest growing industries of this century. A mere ten years ago not many people knew what a personal computer was;

whereas today, we talk about the personal computer as a necessity. This rapid penetration of personal computers into the consumer's consciousness in part stems from the rapid growth of the industry itself. The first personal computer introduced more than two decades ago was very expensive and had limited functions. It was aimed at the corporations. The personal computer then was limited in its capacity to perform tasks and was not very user-friendly. The first ones to take advantage of this technology were large corporations and universities which had the means and needs for those personal computers.

The trend quickly changed when the chip makers started to produce faster and better computer chips. More than that, the industry also saw another major change in terms of how we interface with the computer when graphical-based operating systems were introduced. The personal computer now has a more attractive and user-friendly look to it. In addition, the personal computer also can now play sound and display colors on the screen. The most significant change is in terms of the price of a personal computer, which continues to drop, thus making it an attractive product for the average consumer.

The decade of the late eighties and early nineties saw a rapid movement of personal computers from the business sector into homes. While the business sector is still leading in terms of computer sales, the consumer market has seen a tremendous increase as well. There are more and more people who own computers at home today. The personal computer today has evolved into something that a whole family can use and enjoy, just like a television set. In fact, it is predicted that the flexibility of a personal computer will soon replace the television set in that we will watch television programs, do our taxes, and surf the Internet, all using a personal computer. The emergence of computers and television is a reality today as some companies are selling computers that are television compatible. The computer technology continues to evolve and will play an even bigger role in our lives in the near future.

Another impact of the personal computer technology is the rapid expansion of the Internet technology. With literally information at our fingertips, this is one of the most powerful tools that can be utilized by just about anyone. The Internet was initially used primarily as a research tool where researchers could share data and information. Lately, however, the Internet has witnessed a rapid growth in the commercial realm. The common perception among the companies is that they must have a presence on the Internet to stay competitive. The Internet is being accessed by more and more people each day. This trend will continue as people young and old learn to use the Internet. The main attraction of the Internet is that there are endless possibilities in its usage. Today, we can research virtually any topic we want, we can share ideas, we can conduct business, we can meet new people, and so on. For example, a student can use the Internet to research a homework assignment while a retired person can keep track of his or her investment, keep in touch with family, friends and relatives. In addition, we can shop for almost anything on the Internet. Today, there are virtually all kinds of shops, from grocery stores to bookstores, on the Internet. Also, the Internet seems to bring people together from around the world because we now have the capability to meet new people over the Internet. Every day we seem to find new ways to utilize the Internet.

One can only guess how else this technology will be used in the future.

The affordability, flexibility, and capability of personal computers make this technology a necessity. It is a tool as well as an entertainment center. We use computers to balance our checkbooks, as an educational tool for our children, to do our work, and so on. There is no doubt that personal computers today are regarded a necessity at home as well as at work. For example, the US Department of Labor predicted that by 1995 there would be at least two million jobs related to computers and countless millions of others would be using computers in the work place (Reed, Ervin, Oughton; 1995). The usage of personal computers in the workplace will continue to grow at a rapid pace, and the same is expected for the mass consumer market. It should be noted that, while personal computers may be seen as a necessity, they are not yet as common as television sets. However, majority of people can gain access to a personal computer with little or no trouble at all. One can have access to a personal computer at work, at school, at a public library, a business setting, at home, or even at a friend's home.

The problem with computers

The personal computer has generated a lot of excitement and has influenced almost everyone in some ways. The evidence is in the way consumers have taken to the personal computers and the way the usage of the Internet has grown. However, the new excitement also creates many concerns and anxieties. The anxieties range from fears of using a computer to suspicion of the technology. The most obvious concern is the fact that most consumers are computer illiterate. In other words, many people find that learning to use a personal computer can be a daunting task. It is true that today's personal computers are more user-friendly than those from a decade ago; however, a personal computer or the Internet is unlike a television set in that a personal computer can generate some real concerns, fears, and stress in some users while the likelihood of a television set to do so is remote.

One of the most common causes of computer related concerns and fears is having to learn to use a computer. Learning to use a computer is a challenging task for anyone who has never had any previous experience using a computer. These concerns and fears can stem from simply not knowing what to do when faced with the fact that one has to use a computer. The result may be that the user develops computer anxiety (e.g., Loyd & Gressard, 1984; Kernan & Howard, 1990; Ray & Minch, 1990; Chu & Spires, 1991), computer alienation (Minch & Ray, 1986), computer aversion (Meier, 1985), or in most extreme case computer phobia (Rosen & Maguire, 1990).

Psychologists and researchers realized early on that the computer can become one of the most important tools in our lives, but it also poses a real challenge to its users. It makes intuitive sense that the anxieties stem in part from not knowing how the computer works or how to operate the computer. Anxiety can be disastrous because some may avoid learning to use a computer in all situations, or anxiety may adversely influence the learning process. Anxiety has serious implications educationally as well as in the workplace. A student who has avoided learning how to use a computer is at a disadvantage. For example, a student who has real anxieties about computers may form an unfavorable attitude about computers in general. This attitude may in turn determine the student's choice of education and career. The student may choose to avoid anything that has to do with a computer. In addition, this student will be at a real disadvantage upon leaving school to find a job since the workplace is beginning to require that its employees have basic knowledge in using a computer.

The computer users

The teachers

While there are some concerted efforts to educate the students and the public to use a computer as well as making the computer easier to use, there are a lot of students and teachers who are computer illiterate and are concerned at the prospect of having to learn to use a computer. One of the potential problems pointed out by Rosen and Weil (1995) is that while schools are making computers available to its students, many teachers failed to utilize it because many teachers are themselves 'techno-phobic.' One of the causes of this computer phobia seems to be the lack of computer experience. In particular, the teachers in elementary and secondary classrooms do not know how to encourage their students to use computers because they themselves are paralyzed with concerns such as learning to use a computer and having to deal with computer errors.

Heller and Martin (1987) found that teachers showed concerns that are characteristic of nonusers. In other words, the teachers themselves are not equipped to teach the students to use the computer. This fact is reflected in an earlier survey by Norris and Lumsden (1984) in which most teachers agreed that computers are valuable tools but less agreed that computers should be used in the classroom.

The children

One of the concerns educators have is children's attitude toward the computer because of the obvious implications on their future. Davidson and Ritchie (1994) found that successful implementation of utilizing computers in the classroom is related to teachers, parents, and students having positive attitudes and low anxiety. The study was based on a first year implementation of computers in the classroom for an elementary school (K-5). The researchers found that students, after one year of experiencing computers in the classroom, demonstrated a significant decrease in computer anxiety. In addition, the students also showed a significantly higher interest and usage of the computer.

Researchers early on also suspected that there may be a gender difference in terms of computer attitude, computer knowledge, and computer usage. One of the variables investigated in the area of gender differences is computer anxiety. Collis and Williams (1987) found that eighth grade boys were significantly more positive in their attitude toward computers than girls of the same age. Todman and File (1990) also found that boys have a more positive attitude than girls. Miller and Varma (1994), on the other hand, argued that this is far from a universal occurrence. They found that there was only a small gender difference and that girls in this case had a more positive attitude toward computers. As with the other findings, Miller and Varma reasoned the differences could be due to the differences in computer experience. This certainly makes intuitive sense in that if computer anxiety, aversion, or phobia is caused by lack of familiarity with computers, one of the ways to rectify this problem is to increase one's exposure to computers. Miller and Varma's research, seems to suggest that having more experience with computers decreases one's anxiety toward computers. Thus, computer education or higher exposure to computers should decrease this negative attitude. Ray and Minch (1990), for example, found that computer alienation and anxiety are negatively correlated with computer experience. This finding is consistent with studies conducted by Howard and Smith (1986) and Morrow, Prell, McElroy (1986). Both studies found that there is a negative correlation between computer anxiety and computer experience and education.

The college students

The college age group is by far the most extensively researched group. From undergraduate freshmen to graduate students, the findings have not been uniform or consistent. Early on, some researchers have found that while students are generally enthusiastic, they also exhibit anxiety when required to use computers (Loyd & Gressard, 1984; Marcoulides, 1985). Furthermore, Marcoulides (1988) found that computer anxiety can affect computer achievement or performance.

Chu and Spires (1991) investigated the computer ratings of MBA students and undergraduate students. In general, they found that MBA students had lower computer anxiety ratings than undergraduates. In addition, they also found that individuals who have experience or own a computer have lower computer anxiety ratings than those without experience or do not own a computer. Chu and Spires reasoned that MBA students are more likely to demonstrate less computer anxiety than undergraduate students because MBA students have more computer experience than undergraduate students. The MBA students may have obtained the computer experience on the job or by simply taking computer courses as undergraduate students.

Massoud (1991) investigated GED students and found that males had more positive attitude toward computers than females. In addition, Massoud also found that computer knowledge is significantly related to computer attitudes such as anxiety, liking, and confidence. However there was no significant relationship between computer attitudes (such as anxiety and confidence) and age. The age range of the subjects was from 16 to 45 and over. In other words, computer knowledge, not age, determines a student's attitude toward the computer.

Meier and Lambert (1991) found that younger, female students, and students with lower computer experience tend to experience more discomfort with computers. Harrison and Rainer (1992) studied university personnel and found that those with little computer skills experience higher computer anxiety. Gouveia-Oliveira, Rodrigues, and Galvao de Melo (1994) found that in general men have more computer knowledge than women.

However, there are findings to the contrary. Pope-Davis and Twing (1991) found that their college samples (those who enrolled in an introductory computer course) generally have a positive attitude toward computers. They found that computer experience does not lead to higher computer attitudes. Nor was there a gender difference. Taylor and Mounfield (1994) found that, while males outnumbered females by a ratio of 4 to 1 in majoring in computer science, the computing experience of both genders for all subjects is similar. That is, both genders have almost identical prior computing experience.

McInerney, McInerney, and Sinclair (1994) found that while computer training seems to lead to reduction of computer anxiety for some teacher trainees, the fact that some students remain computer anxious after the computer training demonstrated that computer experience alone cannot account for the reduction of computer anxiety. Todman and Monaghan (1994), using a path model, suggested that an early introduction to computers is associated with a better initial computer experience which in turn leads to lower anxiety.

The employees and the retirees

What of the workers already in the workforce who suddenly find themselves having to learn to use computers? Will worker retraining be in order? And, if so, will it be enough? How does computer anxiety affect the workers' ability to learn about and to use computers? Gardner, Young, and Ruth (1989) in their study of 462 managerial and other professional workers found that 3% were computer phobic and 11% were computer anxious. Henderson, Deane, Barrelle, and Mahar (1995) found that their subjects, who consisted of health care workers and banking employees, demonstrated a decrease in computer anxiety with increasing computer experience.

The issue of retirees is becoming increasingly important since it is estimated that the population of Americans who are 65 years of age or older will be about 40 million strong by the year 2000 (Ogozalek, 1991). Retirees have a slightly different approach to using computers. Their focus is on health care and social communications. The elders will also have to learn to use computers albeit for different reasons. One of the proposed uses of computers is to provide remote health care via computers thus cutting down on health care cost (for example, medical services such as blood pressure checks and speech therapy). In addition, we are beginning to see the technology called computerized personal emergency response systems for at-distance monitoring of elders being implemented across the country. The advantages include independence for the older population. On the social aspect, it has been suggested that computers will enable the elders to socialize with friends and keep in touch with family and relatives. Dyck and Smither (1994) found that older adults generally tend to be less computer anxious and like computers more than younger adults. However, the older adults also had less computer experience and indicated less computer confidence.

Overall, the computer has influenced every facet of the population. Psychologists and researchers alike realized the impact and problems created by computers early on. Many have been trying to identify the factors that prevent one from being able to take full advantage of this technology, namely, our attitudes and knowledge of the computer. It is obvious that computer anxiety influences the liking of the computer and the enthusiasm in learning to use a computer. The attitudes toward the computer such as anxiety are in turn influenced by the knowledge one possess of computers and one's experience with computers. This knowledge can range from knowing the mechanics of the computer to the usage of it. Computer ownership seems to have an impact on one's attitude toward computers as well since is highly correlated with computer experience. These factors warrant further investigation. One needs to determine the nature of the relationships of these various factors so that all can utilize the computer to their particular needs more effectively.

The computer measures

Educators and businesses realized early on that the computer can be a very useful tool but not many knew how to use it. Researchers, psychologists, and educators all saw the potentials of the computer and the need to find a way to get people to use it. Early in the decade of the eighties, while the computer was not widely used, researchers were busy working at measuring people's attitudes such as anxiety, fear, and liking/avoidance. Most researchers agree that these attitudes, among other factors, can impede a person from fully utilizing the computer.

Loyd and Gressard (1984) argued that, if anxiety toward the subject of mathematics can affect learning, then it is possible that a student's attitude can also affect learning about the computer. They reasoned that there needs to be an instrument that can identify the potential problems as well as evaluate an educational program geared toward learning about the computer. Thus, they designed a 30-item attitude scale that would measure one's fear or anxiety of the computer, liking or enjoying working with a computer, and confidence in one's ability to learn about the computer. Their sample consisted of students ranging from ages 13 to 18. About two-thirds of the sample of 151 students were females.

A factor analysis using varimax rotation with a three factor solution was performed on the attitude scale. The factor analysis showed not all items loaded on factors in the way hypothesized by the authors. Correlations among the subscales revealed that the confidence and liking factors had a correlation of .80. The factor analysis revealed that many items loaded on both the confidence and liking factors. The authors went on to conclude the factors are fairly stable and the high correlations of the subscales indicate that they are measuring a general attitude toward the computer.

Bear, Richards, and Lancaster (1987), on the other hand, used a slightly different approach. They decided to test the predictive validity of their computer attitude scale called Bath County Computer Attitude Survey (BCCAS). A total of 38 items was constructed and tested. Bear et al concluded the scale to be unidimensional based on their factor analyses. The BCCAS was trimmed to 26 items which had a reliability of .94. Their subjects consisted of elementary students (grades 4 through 6) and secondary students (grades 7 through 12). It is interesting to note that they found a significant difference in the students' attitude toward the computer: The elementary students had a significantly more positive attitude toward the computer than the older students. However, no explanation was given.

Bear, Richards, and Lancaster (1987) did find that computer experience and usage to be related to the computer attitude. Those who were more experienced or used the computer more had a more favorable attitude toward the computer. When asked about whether they planned to enter into a career that uses computers, those who responded 'yes' had a significantly more positive attitude toward the computer than those who responded 'no.' In addition, when asked what career would they like to go into after they are done with their schooling, those who planned to become computer programmers or enter scientific careers, had the most positive attitude toward the computer. When asked about their favorite subjects in school, those who indicated computer science or science classes scored higher on the BCCAS than those who selected vocational or physical education. Bear et al concluded that the BCCAS is a unidimensional scale and has some predictive validity especially with the elementary and secondary school students.

Some early research has indicated that computer anxiety can influence the utilization of the computer and computer achievement (Byrnes & Johnson, 1981; Marcoulides, 1988). Computer anxiety seems to affect achievement. However, one needs to develop a reliable and valid scale to measure computer anxiety. One such effort was reported by Marcoulides (1989), who administered the Computer Anxiety Scale to a group of college students. The anxiety scale was designed to measure the subjects' anxiety on situations such as working on the computer, learning about programming, watching a movie on an intelligent computer, and so on. Marcoulides utilized exploratory factor analysis and found that the anxiety scale consists of two factors, a general factor which measures anxiety stemming from direct experience with a computer and an operating equipment anxiety factor. The factors were then validated using confirmatory factor analysis. Marcoulides had used LISREL to confirm the CAS. This was a relatively new method in validating a scale in this area of research. Marcoulides argued that the CAS is an instrument well suited for the study of computer anxiety.

In 1986, Bandura proposed the theory of self-efficacy. Self-efficacy is defined by Bandura (1986) as an estimation of one's ability to successfully perform target behaviors to produce outcomes. In other words, those who judge themselves as capable of performing certain tasks will tend to attempt and successfully execute them. Naturally, researchers in the computer area extend the self-efficacy theory to the computer users arguing that self-efficacy will affect the learning process and the effective utilization of the computer in school and the workplace.

Murphy, Coover, and Owen (1989) developed a 32-item Computer Self-Efficacy Scale (CSE). The CSE consists of 3 subscales which are beginning level computer skills, advanced computer skills, and mainframe computer skills. The 32 items consist of statements regarding one's knowledge or ability to perform a certain task on the computer. The subjects were then asked to indicate their degree of confidence in performing each of those tasks. Using the exploratory factor analysis, Murphy et al decided on a three factor solution. The third factor labeled mainframe computer skills consisted of 3 items, logging on, logging off, and working on the mainframe. This last factor may not replicate in today's computing world simply because most college freshmen are capable of logging on and off the mainframe.

One of the problems facing researchers is the inconsistencies of the correlations between computer anxiety and factors such as gender, math anxiety, and general anxiety (Erickson, 1987; Howard and Smith, 1986; Loyd and Gressard, 1984; Maurer, 1983). One of the concerns pointed out by Kernan and Howard (1990) is the fact that the construct of computer anxiety is not very well defined. In addition, the computer anxiety scale may not be a unidimensional scale (Marcoulides, 1989).

To further complicate the problem, it may be difficult to differentiate the construct computer anxiety from the construct attitude toward the computer. Kernan and Howard (1990) tried to answer this question by factor analyzing several anxiety/attitude scales. The measures were taken from several studies (Dambrot, Watkins-Malek, Silling, Marshall, & Garver, 1985; Popovich, Hyde, Zakrajsek, & Blumer, 1987; Raub, 1981; Morrison, 1983). By factor analyzing these measures, Kernan and Howard concluded that there are five factors in measuring computer attitude, and computer anxiety is clearly a separate factor that can be measured reliably. In addition, the computer anxiety factor significantly correlates with other anxiety indices such as state anxiety, trait anxiety, and math anxiety.

Some researchers agreed that computer anxiety should be treated as a separate construct from computer attitude and should be measured separately. For example, Howard, Murphy, and Thomas (1986) define computer anxiety as the "fear of impending interaction with a computer that is disproportionate to the actual threat presented by the computer" (p. 630). However, what is more common is that the computer anxiety factor is embedded among some other factors. For example, Ray and Minch (1990) argued that computer anxiety is a sub-component of the computer alienation factor. They failed to find a clear distinction between computer anxiety and computer alienation.

One of the difficulties faced by researchers in trying to measure computer anxiety is to define the domain or range of the anxiety that they wish to measure. Some assume that they are measuring a general anxiety (Heinssen, Glass, and Knight, 1987; Chu & Spires, 1991) while others focus on the extremes of computer anxiety as in the case of computer-phobics (Rosen & Maguire, 1990). The anxiety reaction to the computer can range from acutely phobic and intensely anxious to mild level of discomfort at the prospect of working with a computer. According to Rosen and Maguire (1990), there is a segment of the population which is uncomfortable with the computer and computer related technology and will avoid the computer when necessary.

Nunnally and Bernstein (1994) argued that there is a relationship between the domain size and how the construct is defined: "The larger the domain of observables related to a construct, the more difficult it is to specify the variables that belong in the domain" (p. 86). Thus one of the major aspects to construct validation is to specify the domain. It makes intuitive sense that computer anxiety is part of the computer attitude domain. However, computer anxiety is a construct that can be reliably measured as a separate construct from the general computer attitude. It is then the researcher's responsibility to carefully define the construct being investigated. While the computer anxiety construct remains unclear, other researchers have focused their efforts on measuring attitudes toward the computer.

The problem of defining the computer attitude construct is the almost infinite domain range. Many researchers have failed to define the computer attitude construct while others have different definitions of attitudes toward the computer (Loyd & Gressard, 1984; Igbaria & Parasuraman, 1991; Nickell & Pinto, 1986; Bear, Richards, & Lancaster, 1987; Lalomia & Sidowski, 1991; Massoud, 1991). One of the early studies, such as one by Loyd and Gressard (1984), asserts that computer attitude consists of sub-components such as computer anxiety, computer liking, and computer confidence. Zoltan and Chapanis' (1982) measures of attitudes toward computers assessed the individual's beliefs, reactions and potential uses of the computer. Reece and Gable (1982) attempted to measure the three attitude components: cognitive, behavioral, and affective.

Igbaria and Parasuraman (1991) defined attitudes toward computers as individual's predisposition to react in a certain way toward the computer. The scale consisted of items written to measure the three attitude components. Igbaria and Parasuraman generated a scale which consists of 66 items. The factor analysis revealed five factors: perceived utility, limited hardware/software capacity, problems in use, time requirements, and user-friendliness.

Todman and File (1990) identified the following general areas in measuring computer attitudes: usefulness, fun, importance, friendliness, importance, aid to learning, reliability, locus of control, cleverness, and ease of use. The scale was administered to school children, and they found that exposure or experience with computer can lead to a more positive attitude toward the computer.

Assessing the computer measures

Two of the more commonly used computer scales are the computer attitude scale (CAS) by Loyd and Gressard (1984) and Nickell and Pinto (1986). Rainer and Miller (1996) attempted to assess the scale developed by Nickell and Pinto (1986). This scale was used to measure the general positive and negative attitude toward the computer. However, an earlier factor analysis by Harrison and Rainer (1992) found that the scale actually contains three underlying dimensions: positive attitudes toward the computer, negative attitudes toward the computer, and feelings of intimidation toward the computer. Using the three dimension approach, Rainer and Miller (1996) attempted to evaluate the scale using confirmatory factor analysis. They reported an adjusted chi square of 1.50, a goodness of fit index (GFI) of .861, a root mean square residual (RMSR) of .041, a normed fit index (NFI) of .823, and an adjusted goodness of fit index (AGFI) of .779. Rainer and Miller concluded that the three-factor model fits data moderately well. They proposed that this scale is useful in measuring general attitude toward the computer.

Miller and Rainer (1995) attempted to assess the computer anxiety rating scale (CARS) developed by Heinssen, Glass, and Knight (1987). The original CARS consisted of 19 items. However the authors of the original study did not factor analyze the scale. Harrison and Rainer (1992) factor analyzed the scale and concluded that the scale contained two underlying dimensions, high anxiety and confidence, enthusiasm, and/or anticipation toward computer use. Miller and Rainer (1995) renamed the second factor as low anxiety toward computer. The confirmatory factor analysis of the original 19 items revealed a poor fit and the scale was eventually trimmed to a seven-item model.

In the attempt to evaluate computer scales, the use of confirmatory factor analysis is the exception rather than the rule (Murphy, Coover, Owen, 1989; Kernan & Howard, 1990; Zakrajsek, Waters, Popovich, Craft, & Hampton, 1990; Chu &Spires, 1991;

Gardner, Discenza, & Dukes, 1993). To further complicate the issue, many of the scales have been used in subsequent research looking into the effects and impact of the computer; and many of the studies assumed that the measures are valid and reliable.

Anderson and Hornby (1996) studied the attitudes of students who are enrolled in various psychology courses that use computers for different purposes. The usage of computers ranges from having students engaged in tutorial assignments in a statistics course to programming experiments in another class. Anderson and Hornby were primarily interested in the effect of the course experience on computer attitudes. To measure the students' computer attitude, the Computer Attitude Scale (Loyd & Gressard, 1984; Gressard & Loyd, 1986) was used. Anderson and Hornby concluded that the initial differences in computer experience and/or attitude do not affect the students' ability to benefit from using computers nor do they affect their performance (final grades). In addition, gender and age appeared not to be related to the computer attitude scale.

Henderson, Deane, Barrelle and Maher (1995) investigated the working population, specifically health care and banking employees, on their computer anxiety as well as computer attitude. Among the scales used was the CAS developed by Loyd and Gressard (1984). By comparing their samples to those reported by other studies (Loyd & Gressard, 1984; Loyd & Gressard, 1985; Roszkowski, Devlin, Snalbecker, Aiken, & Jacobson, 1988; Glass & Knight, 1988; Massoud, 1991; Woodrow, 1991) using the same CAS measure, Henderson et al concluded that the working population in general may have the same, or even slightly less, computer anxiety than the student or the teacher population. They have similar computer liking but the working population has slightly higher computer confidence. Henderson et al also suggested the possible usage of the CAS to screen and identify individuals at risk of having problems associated with using a computer.

Both the Anderson and Hornby (1996) and Henderson et al (1995) assumed and concluded that the CAS measure is a relatively reliable and valid measure. Both Anderson and Hornby (1996) and Henderson et al (1995) cited the study by Woodrow (1991) as one of the main studies establishing the validity of the CAS. Anderson and Hornby (1996) quoted Woodrow as saying that the CAS "appears to give an excellent, reliable measure of overall computer attitude" (p. 342). Anderson and Hornby argued that the CAS provided scores for four subscales of computer anxiety, computer liking, computer confidence, and computer usefulness (a subscale added to the CAS by the original designers in a later study). Henderson et al (1995), on the other hand, argued that CAS consisted of three subscales, computer anxiety, computer liking, and computer confidence, based on the original study (Loyd & Gressard, 1984). However, Woodrow had used the original CAS measure in her study and concluded that "the Computer Attitude Scale is two dimensional, not three dimensional as claimed" (p. 181). The reason for this conclusion is based on the fact that there was a relatively high correlation between the subscales. In fact, the correlations of the three subscales with each other were all above .80. When Woodrow factor analyzed the original 30 items of the CAS scale in a follow-up study there were a lot of cross loadings among the items. Only two items (one from the computer anxiety subscale and one from the computer confidence subscale) loaded on the third factor. The author went on to suggest that " the scores of the three subscales may not be stable enough to be used as separate scores" (p. 179). The Woodrow study clearly did not provide evidence that the CAS can be used to measure different dimensions of the computer attitude. Woodrow did cite the fact that her study only consisted of 98 subjects, a relatively small sample; thus, one should be cautious in interpreting the results. However, in a later study by Woodrow herself (Woodrow, 1994), she again used the CAS and treated the measure as having three separate distinct subscales, each measuring a different dimension of the computer attitude.

Another study cited by Anderson and Hornby (1996) as establishing the validity of the CAS scale was by Gardner, Discenza, and Dukes (1993). Gardner et al combined four separate scales in their attempt to assess the superiority of one or more scales over the others. By combining the four measures and their subscales, Gardner et al, through exploratory factor analysis, found that the items seem to measure eight different dimensions of the computer attitude. However, the authors did not find pure loadings for the subscales. The authors argued that " some items clearly were better than others with respect to loading on the appropriate factors" (P. 493). The result hardly supports the validity of the CAS in terms of its ability to measure computer anxiety, computer liking, and computer confidence reliably.

Both the Woodrow (1991) and Gardner et al (1993) studies suggested that, at best, the different measures developed by different researchers, if used together, seem to measure several different dimensions of the computer attitude. However, one can hardly conclude that an individual measure such as the CAS can reliably measure the different dimensions on the computer attitude as it has purported to measure.

The alternative approach then is to shift one's focus to specific dimensions of the computer attitude. Each dimension of computer attitude must be carefully defined and measured. The traditional definition of the attitude toward the computer may be too broad to serve any real function. The strategy should be to develop a sound scale and properly evaluate it. One of the approaches in validating scales is to use confirmatory factor analysis (Marcoulides, 1989; Miller & Rainer, 1995; Rainer & Miller, 1996). One of the goals of this study is to develop and validate a computer scale. The present study will focus on two particular dimensions of computer attitude, namely computer anxiety and computer liking or interest, which seem to affect computer usage.

In addition to developing a sound and valid scale, the computer field has evolved significantly in the last decade, there is a need to update the items to reflect the changes. The most significant change that has occurred in the last few years is the Internet. Having to learn to use the computer is quickly becoming synonymous with learning to navigate the Internet, therefore, a computer scale needs to reflect this latest development.

The new computer scale

Based on a preliminary work (Lim, 1996), the focus of the present study is to develop a reliable and valid computer scale. The computer scale will consist of items that measure two different dimensions of computer attitude (computer anxiety and computer liking/interest). The new computer scale is intended to provide a clear profile of the state of the college population.

Computer anxiety scale

One dimension of computer attitude is anxiety toward the computer. Howard, Murphy, and Thomas (1986) define computer anxiety as " fear of impending interaction with a computer that is disproportionate to the actual threat presented by the computer" (p. 630). Computer anxiety in this case is the feeling of dread, apprehension, or fear of the unknown. This negative emotional reaction toward the computer can influence the degree to which computers can be effectively utilized. In addition, computer knowledge can influence the computer anxiety in that it can decrease this anxiety over time.

The items which will be examined to measure this construct will be drawn from different anxiety scales developed over the years and some new items to reflect the current state of the computer field.

Computer liking/interest scale

Computer liking/interest means the user not only enjoys or likes to use the computer but also shows an interest in reading about and/or discussing computers. One would assume that computer liking/interest correlates negatively with computer anxiety. Also, a user who likes to use the computer may not necessarily know a lot about the computers. This construct should reflect the positive aspect on the computer attitude. Using an approach similar to Lim (1996), a computer liking/interest scale will be constructed based on the above definition. In the past, many researchers (e.g., Woodrow, 1994; Busch, 1995; Anderson & Hornby, 1996) include positive attitude scales such as those similar to computer liking/interest but such scales have not been validated or properly evaluated.

Purpose of study

Many of the studies to date seek to measure computer attitude. These attempts seem problematic given the fact that the construct is generally poorly defined. Others have focused their attention on measuring specific dimensions of the computer attitude such as computer anxiety and computer liking/interest. However, most studies fail to establish the validity of their measures. In addition, the rapid changes in the computer field, such as the development of the Internet, means that any new instrument measuring specific dimensions of the computer attitude should reflect this latest development. The new computer attitude measure in this study will include updated items to reflect the changes in this field. The present study seeks to establish computer anxiety and computer liking/interest as separate constructs that can be measured reliably. While both constructs are dimensions of the computer attitude, they can be measured separately. Confirmatory factor analysis will be used to establish the factorial validity of the constructs.

Related measures

Computer knowledge and computer experience

Massoud (1991) investigated the computer attitudes and computer knowledge of GED students. Massoud found that the students in general have positive attitudes toward the computer. Computer knowledge was found to be significantly related to the computer attitudes. In addition, there was a significant gender difference in computer attitudes (males have more positive attitudes than females). While this particular study investigated computer knowledge, most researchers have investigated computer experience (Dyck & Smither, 1994; Taylor & Mounfield, 1994; Colley, Hill, Hill, & Jones, 1995; Reed, Ervin, & Oughton, 1995).

There is a distinction between computer knowledge and computer experience. A person may have a specific knowledge about certain aspects of a computer such as how to retrieve e-mail or how to use a certain program but that does not necessarily mean that the person possesses a general knowledge on the computer. Students may indicate they have taken a course that involves using the computer. Thus, they have the computer experience, but that does not mean they are knowledgeable about computers in general. Such persons may have learned a few steps or procedures in using a certain program required of them in the course but still lack the overall knowledge about the computer. Thus they may have some computer experience but will still be anxious at the thought of using computers for other tasks. Having a general knowledge about the computers may reduce one's anxiety level toward the computer while having some experience with the computer may not. To further complicate the problem, the findings on the relationship between computer experience and computer attitudes have been mixed. Henderson, Deane, Barrelle, and Mahar (1995) found a significant relationship between computer experience and computer attitudes on only two of their sample groups. Henderson et al suggested that

> such results may also suggest that the relationship between computer experience

> and computer anxiety, confidence and liking may not be a simple linear one. It may be that some form of threshold effect is present such that, a positive relationship only holds for those with lower levels of experience, and beyond a certain level of experience much weaker or negligible relationship exists. (p. 190).

It is important then to have a distinction between computer knowledge and computer experience. Both computer anxiety and computer liking/interest should be affected by computer knowledge. Computer knowledge can be defined as having the general skills to operate a computer or to perform a certain task using a computer. Studies in the past have shown that computer courses or having computer knowledge can decrease computer anxiety and increase computer liking (e.g., Harrison & Rainer, 1992). Others have found that computer knowledge is significantly related to computer attitudes such as computer anxiety and computer liking.

The present study will attempt to construct a reliable and valid measure of the computer knowledge construct. For the purpose of the study, computer knowledge is defined as a collection of specific skills related to certain aspects of the computer. Computer experience, on the other hand, is about the time spent, exposure to the computer, or the frequency of using the computer.

Method

Subjects

Two hundred and seventy-six subjects who were enrolled in General Psychology courses at the University of Arkansas during the spring of 1998 participated in the study to fulfill a course requirement. Subjects were run in group sizes ranging from 2 to 10 in a classroom-like setting set aside for group research.

Out of the 276 subjects, 110 (39.9%) were males, 165 (59.8%) were females, and one subject failed to provide the information. One hundred and seventy-seven (64.1%) of the subjects were freshmen, 54 (19.6%) were sophomores, and only 40 (14.5%) indicated that they were upperclassmen (juniors and seniors). The age of the subjects ranged from 18 to 39 years old (M=19.94, SD=3.10). There were 58 (21%) subjects who indicated that they were 18 years old while 122 (44.2%) subjects indicated that they were 19 years old. The rest of the subjects were 20 or older. Most of the subjects who participated in the study were Caucasians (222 subjects, 80.4%). There were only 26 (9.4%) African Americans, 9 (3.3%) Asians, 9 (3.3%) who indicated a race other than those mentioned, and 10 (3.6%) failed to provide the information.

While some universities have implemented the policy that freshmen starting school must have a computer, it is not yet a policy for the University of Arkansas. However, 216 (78.3%) of the 276 subjects indicated that they own a computer. When asked whether they plan to learn more about computers, 258 (93.5%) of the subjects said "yes."

The subjects' majors ranged from psychology to engineering. Because the university consists of several major colleges, the subjects' major was categorized according to the colleges, namely the arts and sciences college, engineering college, business college, and education college. There are several other colleges such as the architectural college and the law school. However, because there were only a handful of students from these colleges, a decision was made to include them in the arts and sciences sample. Thus, in the final grouping, there were 149 (54%) subjects from the arts and sciences college, 44 (15.9%) subjects from the business college, 25 (9.1%) subjects from the education college, 17 (6.2%) subjects from the engineering college, 31 (11.2%) subjects who were undecided, and 10 (3.6%) subjects who did not indicate their major.

Materials

The computer survey consisted of a total of 55 items (see Appendix A) and 15 demographic questions. Eighteen of the 55 items were selected to measure anxiety, 20 items to measure computer liking/interest, and 17 items to measure computer knowledge. It should be recognized at the outset that, although the resulting scales will be referred to hereafter as measures of computer anxiety, computer liking/interest, and computer knowledge, the scales more accurately should be considered measures of reported computer anxiety, reported computer liking/interest, and professed computer knowledge, respectively, because they are based on self-report items. The order of the 55 items from the 3 scales was randomly arranged. For each item, subjects were instructed to indicate the extent they agreed with the statement. They rated each item on a five point scale from 1 being strongly agree to 5 being strongly disagree. Among the 15 demographic questions were 3 items (questions 6, 7, and 8) designed to assess their future expectations of the computer affecting their lives.

For the purpose of the study, confirmatory factor analysis (CFA) was performed to develop the 3 subscales. The score for each of the subscales was then obtained for additional analyses.

Procedure

Upon arrival at the group research room, subjects were told they would be participating in a study called 'computer survey' and that the experiment would last approximately 30 minutes. Subjects were then asked to read and sign a consent form describing the experiment (see Appendix B). The computer survey together with the instructions were then presented to the subjects. Upon completion of study, subjects were encouraged to speak with the experimenter if they had further questions about the study.

Results

The responses to all 55 items on the initial computer survey were coded and recorded. To analyze the data using CFA, a correlation matrix based on all 55 items was obtained (see Appendix C). The organization of the correlation matrix is based on the standard input file format for LISREL where the first part of the file consists of correlation coefficients and the variable labels are found on the second part. The order of the variables in the correlation matrix is as follows: A1 to A18, K1 to K17, and L1 to L20. The following confirmatory factor analyses were based on the correlation matrix.

Computer Anxiety Scale

The preliminary computer anxiety scale (CAX) consisted of 18 items (Table 1) designed to reflect a general feeling of anxiety about the computer, where computer anxiety is defined as the feeling of dread, apprehension, or fear of the unknown. A confirmatory factor analysis (CFA) was then performed on the responses to this preliminary scale using LISREL (Figure 1). All factor loadings were significant. The goodness of fit statistics revealed that the fit was far from ideal, $\chi^2(135, \underline{N} = 276) = 654.73$, $\underline{p} \approx 0$; Incremental fit index (IFI) = 0.76; $\chi^2/df = 4.85$. An IFI that approaches 1 and a Chi-Square / df ratio of 2 or less indicates a "good" fit. For additional information, please refer to Joreskog and Sorbom (1994) and Bollen (1989).

The model could be refitted and improved. Modification indices indicated that if the error terms of items A8 and A9 were allowed to correlate, the fit would improve significantly. Item A8 asked subjects, "I worry that I will not be able to keep up with the

Table 1

Preliminary computer anxiety scale (18 items)

A1. I hesitate to use a computer for fear of making mistakes that I cannot correct.

A2. I am unsure of my ability to interpret a computer printout.

A3. I avoid using computers because they are unfamiliar and somewhat intimidating to me.

A4. I find the technical aspects of computers are difficult to understand.

A5. One of my worries is that I could erase vital files or data by hitting a wrong key.

A6. The thought of learning about computers worries me.

A7. Not everyone can learn to use a computer.

A8. I worry that I will not be able to keep up with the constant advances/upgrading of computer hardware.

A9. I worry that I will not be able to keep up with the constant advances/upgrading of computer software.

A10. The thought of using a computer to do my work makes me nervous.

A11. I feel tense whenever working on a computer.

A12. I get a sinking feeling when I think of trying to use a computer.

A13. I hesitate to sign up for a course that requires the use of a computer.

A14. I hesitate to call the technical support or get help when I have a problem with the computer for fear of appearing foolish or incompetent.

A15. The thought of installing computer hardware/components makes me nervous.

A16. I worry about accidently erasing files thus causing a program to be unusable.

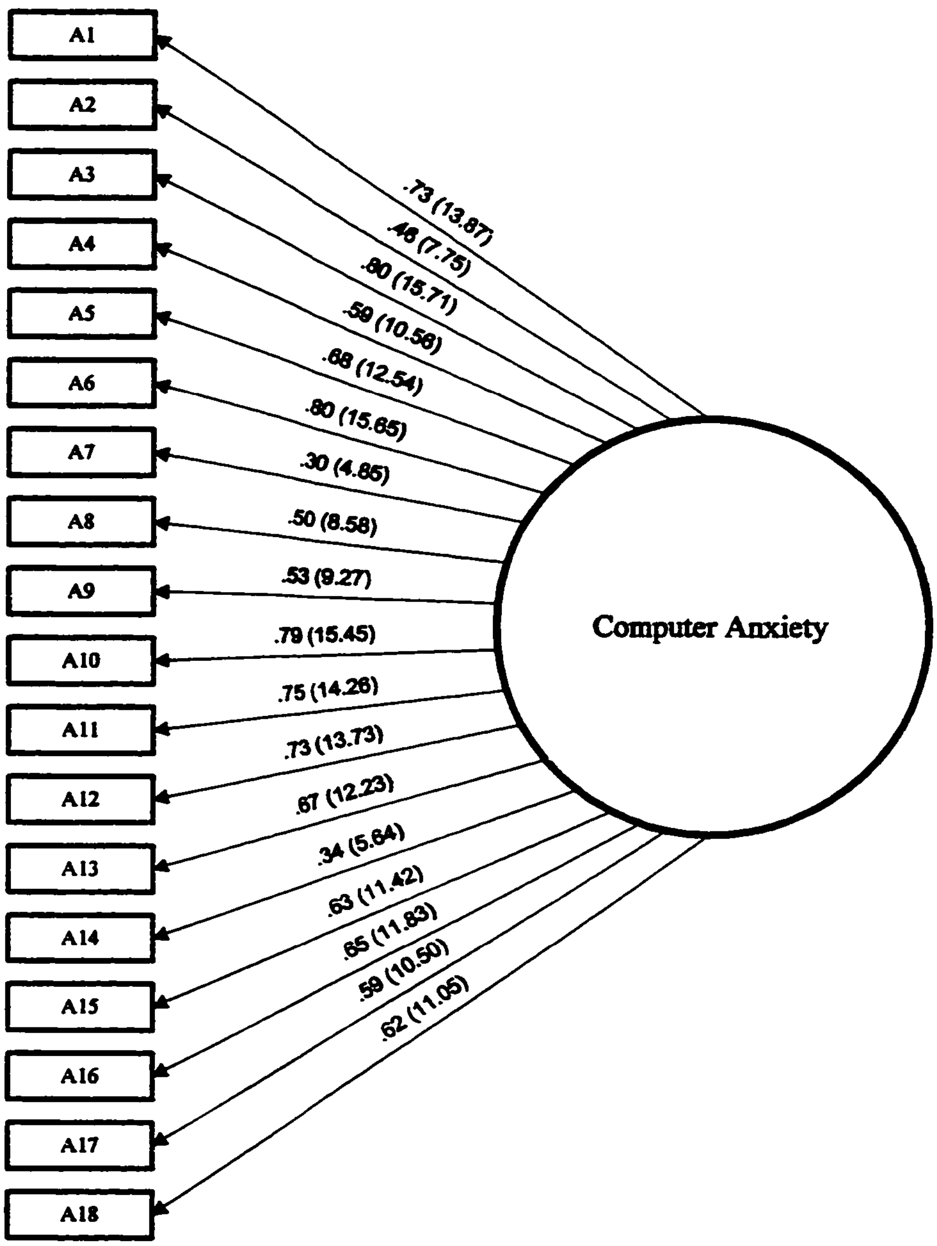
A17. I get a sinking feeling whenever I see an error message 'pop' up on the computer monitor screen.

A18. The thought of using the computer to surf the Internet worries me.

Note: Subjects rated each question on a 5 point scale, from 1 (strongly disagree) to 5 (strongly agree)

Figure 1

Factor loadings and t-values of the preliminary computer anxiety factor (18 items)



constant advances/upgrading of computer hardware," while item A9 was, "I worry that I will not be able to keep up with the constant advances/upgrading of computer software." Apparently subjects perceived both the questions to be redundant. A decision was made to drop item A9 to achieve the maximum improvement of fit of the model. The model was then reassessed. The goodness of fit statistics for the second model revealed a significant improvement in fit, $\Delta\chi^2(16) = 239.06$, $p \approx 0$. While the fit of the second model without item A9 was better, the goodness of fit statistics revealed that the model was not a good one, $\chi^2(119, N = 276) = 415.67$, $p \approx 0$; IFI = .87; $\chi^2/df = 3.49$.

In a similar fashion, using the maximum modification index as a guide and careful examination of item content, items A4, A5, A9, A10, A16, and A17 were eventually dropped from the model. The result was an improved scale (Figure 2) with $\chi^2(54, N = 276) = 80.46$, $p = .011$; IFI = .98; $\chi^2/df = 1.49$. The improved model consists of 12 items that measure general computer anxiety.

Computer Liking/Interest Scale (CLS)

The preliminary computer liking/interest scale consists of 20 items (Table 2) designed to measure the user's positive attitude toward the computer. Computer liking/interest means the user not only enjoys or likes to use the computer but also shows an interest in reading about and/or discussing computers. Again, CFA was performed on the preliminary CLS scale (Figure 3). All loadings were significant. Item L5 is reverse scored. The goodness of fit statistics, $\chi^2(170, N = 276) = 667.67$, $p \approx 0$; IFI = .83;

Figure 2

Factor loadings and t-values of the improved computer anxiety factor (12 items)

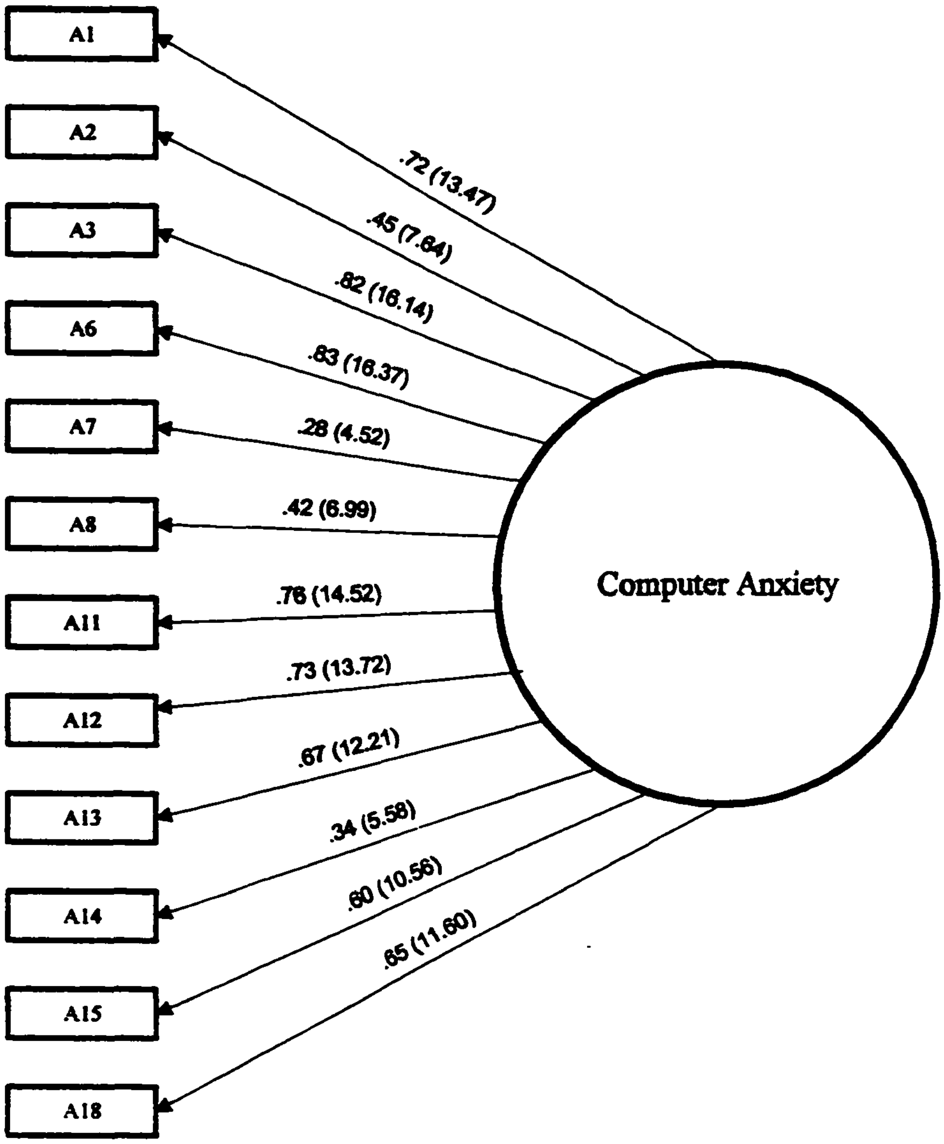


Table 2

Preliminary computer liking/interest scale (20 items)

L1. The challenge of learning about computers is exciting.

L2. If given the opportunity, I would like to learn and use computers.

L3. I look forward to using a computer on my job.

L4. I enjoy working on a computer.

L5. It is easy to get tired of using a computer.

L6. It is fun to figure out how computers work.

L7. Learning about how a computer program works is fun.

L8. Learning about how a computer component works is fun.

L9. I enjoy reading about how computers are used in our daily lives.

L10. I wish I had more time to use computers.

L11. I like computers because they can simplify complex problems.

L12. The benefits of computers outweigh their monetary costs.

L13. I think computers are fascinating.

L14. I enjoy reading about computers.

L15. I like to use a computer because it allows me to use word processing programs and such to do my work.

L16. I like to use a computer because I can play games on it.

L17. I like to use a computer because it gives me the ability for faster analysis of information.

L18. I like to use a computer because it can provide me with information that could lead to better decisions.

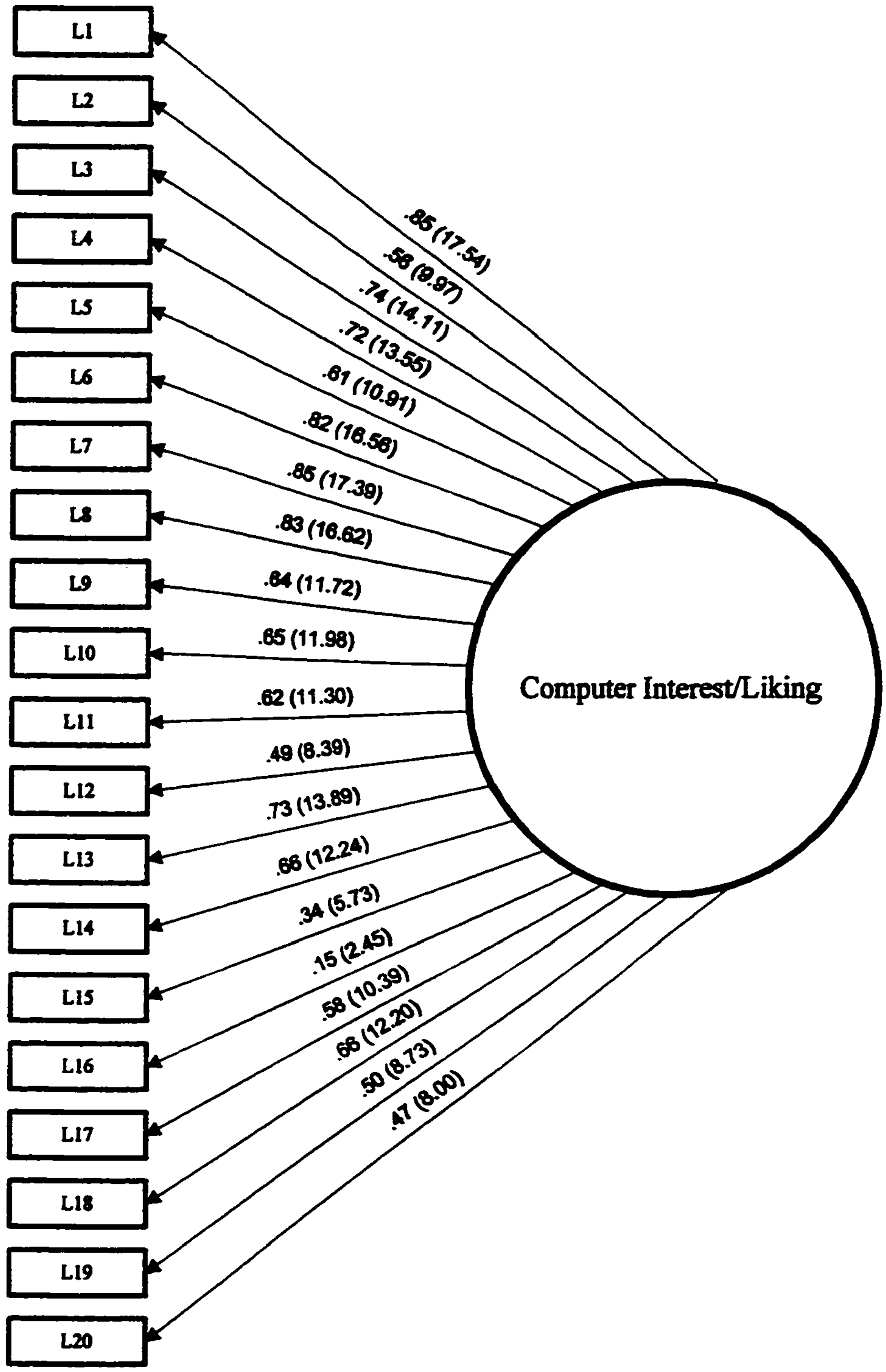
L19. I like computers because I can get on the Internet with it.

L20. I like computers because I can meet and interact with people.

Note: Subjects rated each question on a 5 point scale, from 1 (strongly disagree) to 5 (strongly agree)

Figure 3

Factor loadings and t-values of the preliminary computer liking/interest factor (20 items)



χ^2/df = 3.92 suggest that the model can be improved. Based on the maximum modification index, several items were ultimately dropped from the scale. The first item dropped was item L14. Apparently subjects perceived item L14. "I enjoy reading about computers" and L9, "I enjoy reading about how computers are used in our daily lives" as essentially the same question. Item L14 was dropped from the rest of the analyses. Eventually, items L1, L4, L6, L8, L9, L16, L17, and L18 were also dropped to arrive at the improved model shown in Figure 4. The goodness of fit statistics, $\chi^2(44, \underline{N} = 276) = 66.58$, $\underline{p} = .016$; IFI = .98; χ^2/df = 1.51 suggest a model that fits reasonably well.

Computer Knowledge Scale

Computer knowledge is defined as having the general skills to operate a computer or to perform a certain task using a computer. A preliminary computer knowledge scale (CKS) composed of 17 items (Table 3) was constructed in an attempt to measure the concept. The CKS was included in the analyses as part of the validation process for the computer anxiety and computer liking/interest scale. The 17 item scale was then assessed by performing a CFA using LISREL (Figure 5). All factor loadings were significant. The goodness of fit statistics suggest that the model was not a good fit, $\chi^2(119, N = 276) = 790.43$, $p \approx 0$; IFI = .69; χ^2/df = 6.64. The maximum modification fit index was used to improve fit. Large modification indices associated with correlated error terms suggested that subjects perceived the certain items as redundant. For example, item K4 "I know how to use Internet browsers such as Netscape or Microsoft

Figure 4

Factor loadings and t-values of the improved computer liking/interest factor (11 items)

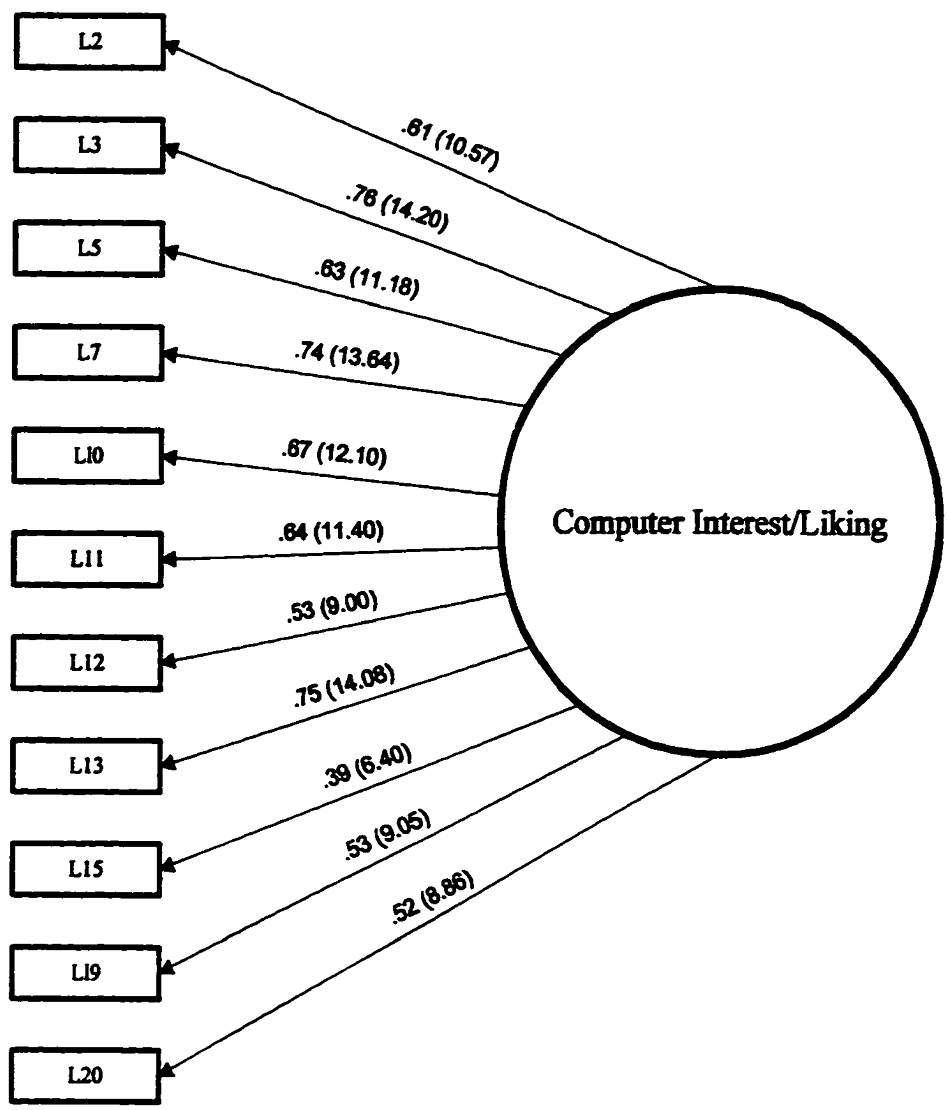


Table 3

Preliminary computer knowledge scale (17 items)

K1. I have no problem using a word processor on the computer to do my work.

K2. I have no problem calling up a file or data to view on the monitor screen.

K3. I can trouble shoot computer problems.

K4. I know how to use Internet browsers such as Netscape or Microsoft Explorer to get navigate around the internet.

K5. I can install a computer hardware component on a computer.

K6. I can install computer software programs such as an application program or a game.

K7. I have no problem writing simple programs for the computer.

K8. I have no problem using the computer to do my homework.

K9. I have no problem understanding the computer jargon/terminology.

K10. I know how to use the operating systems on the computers such as Windows 95 or Windows 3.1.

K11. I know how to retrieve my e-mail from the mainframe.

K12. I know how to print my work on a printer.

K13. I know how to use the user's manual or use online guide when help is needed.

K14. I know how to get rid of files when they no longer needed.

K15. I can explain to another person why a program will or will not run on a given computer.

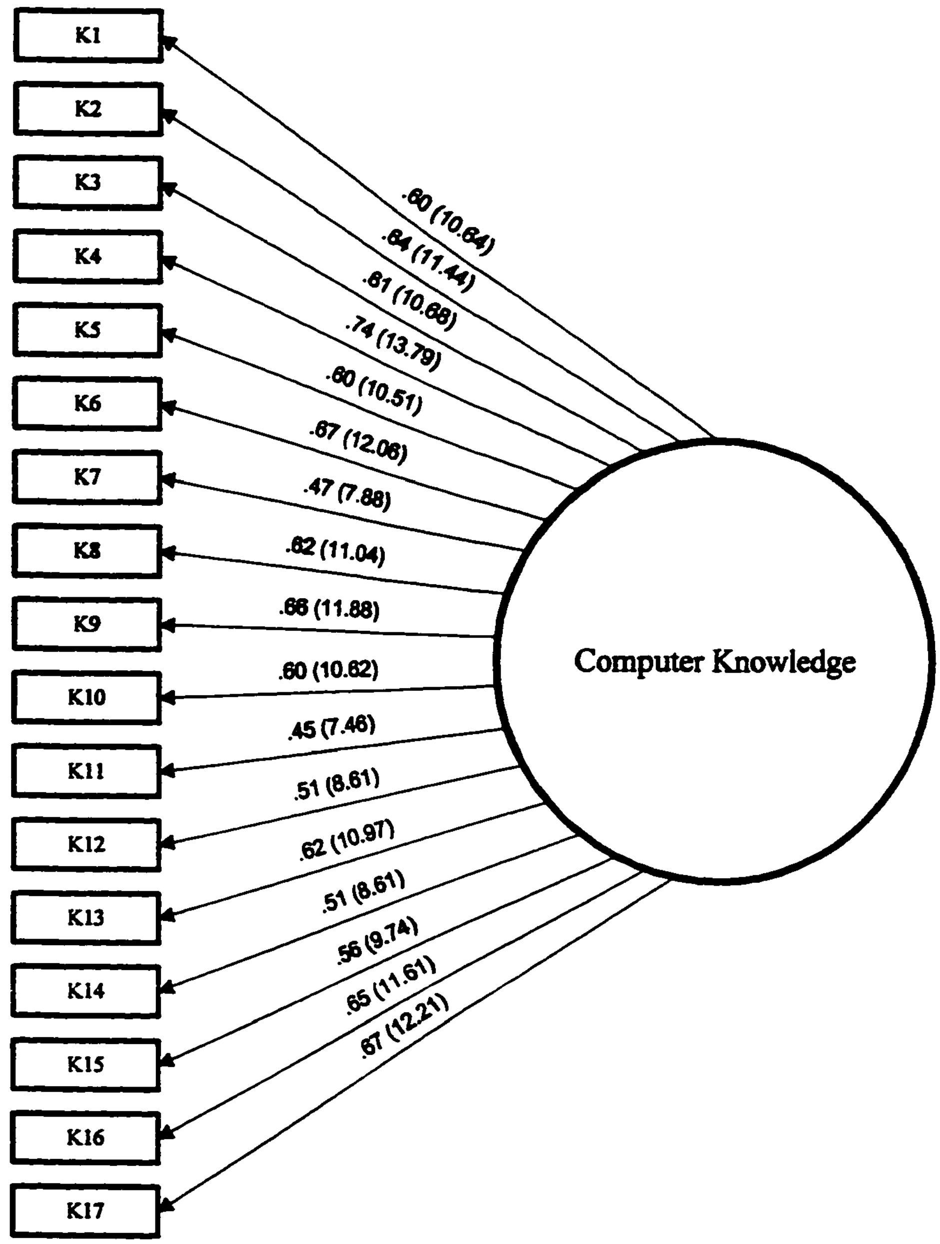
K16. I know how to logon to the internet.

K17. I know how to research for information on the internet.

<u>Note</u>: Subjects rated each question on a 5 point scale, from 1 (strongly disagree) to 5 (strongly agree)

Figure 5

Factor loadings and t-values of the preliminary computer knowledge factor (17 items)



Explorer to navigate around the internet" and item K17 "I know how to research for information on the internet" appear to be drawn from the same part of the domain of computer knowledge; thus, a decision was made to drop one of the items. In addition, item K5 "I can install a computer hardware component on a computer" and item K6 "I can install computer software programs such as an application program or a game" also appeared to reflect the same aspect of the domain. Item K5 was subsequently dropped from the scale. The improved model (Figure 6) which has a $\chi^2(35, \underline{N} = 276) = 116.35$, $\underline{p} \approx 0$; IFI = .91; χ^2/df = 3.32 is a reasonable model which consists of 10 items.

General Computer Survey (GCS)

The three scales that had been confirmed separately were now combined to produce a preliminary general computer survey (GCS). The CKS was also included in the next phase of the CFA as part of the validation process. The preliminary GCS consisted of 12 items from the improved CAX, 11 items from the improved CLS, and 10 items from the improved CKS (Table 4). A CFA was conducted on the 33 items. The loadings are presented on Figure 7. All loadings were significant. The goodness of fit statistics, $\chi^2(492, \underline{N} = 276) = 1046.44$, $\underline{p} \approx 0$; IFI = .86; χ^2/df = 3.79 suggest the model could be improved. Using the maximum modification index, the largest improvement in fit of the model could be achieved by correlating the error terms of item L19 "I like computers because I can get on the Internet with it" and K17 "I know how to research for information on the internet." Subjects seem to perceive both questions as inquiring about the knowledge of the internet; Thus, item L19 was dropped from the scale. One of

Figure 6

Factor loadings and t-values of the improved computer knowledge factor (10 items)

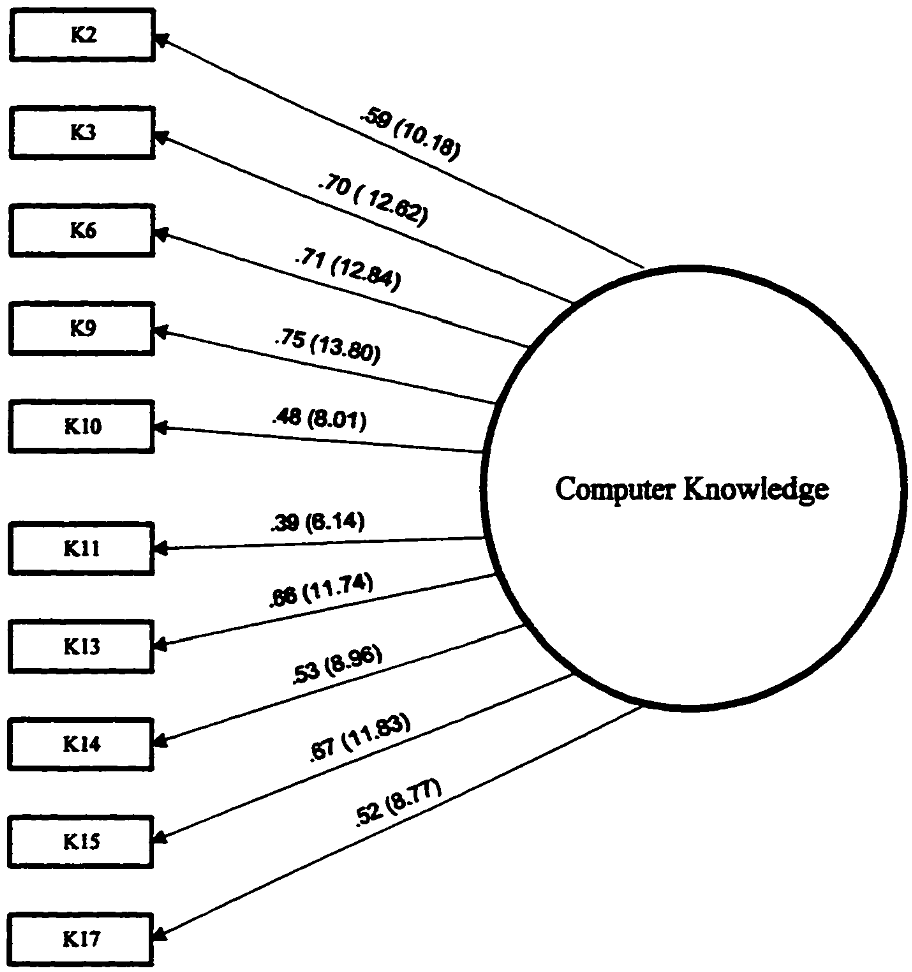


Table 4

<u>Preliminary General Computer Survey (33 items)</u>

Computer anxiety scale (12 items)

A1. I hesitate to use a computer for fear of making mistakes that I cannot correct.

A2. I am unsure of my ability to interpret a computer printout.

A3. I avoid using computers because they are unfamiliar and somewhat intimidating to me.

A6. The thought of learning about computers worries me.

A7. Not everyone can learn to use a computer.

A8. I worry that I will not be able to keep up with the constant advances/upgrading of computer hardware.

A11. I feel tense whenever working on a computer.

A12. I get a sinking feeling when I think of trying to use a computer.

A13. I hesitate to sign up for a course that requires the use of a computer.

A14. I hesitate to call the technical support or get help when I have a problem with the computer for fear of appearing foolish or incompetent.

A15. The thought of installing computer hardware/components makes me nervous.

A18. The thought of using the computer to surf the Internet worries me.

Computer Liking/Interest Scale (11 items)

L2. If given the opportunity, I would like to learn and use computers.

L3. I look forward to using a computer on my job.

L5. It is easy to get tired of using a computer.

L7. Learning about how a computer program works is fun.

L10. I wish I had more time to use computers.

L11. I like computers because they can simplify complex problems.

L12. The benefits of computers outweigh their monetary costs.

L13. I think computers are fascinating.

L15. I like to use a computer because it allows me to use word processing programs and such to do my work.

L19. I like computers because I can get on the Internet with it.

L20. I like computers because I can meet and interact with people.

Computer knowledge scale (10 items)

K2. I have no problem calling up a file or data to view on the monitor screen.

K3. I can trouble shoot computer problems.

K6. I can install computer software programs such as an application program or a game.

K9. I have no problem understanding the computer jargon/terminology.

K10. I know how to use the operating systems on the computer such as Windows 95 or Windows 3.1.

K11. I know how to retrieve my e-mail from the mainframe.

K13. I know how to use the user's manual or use online guide when help is needed.

K14. I know how to get rid of files when they no longer needed.

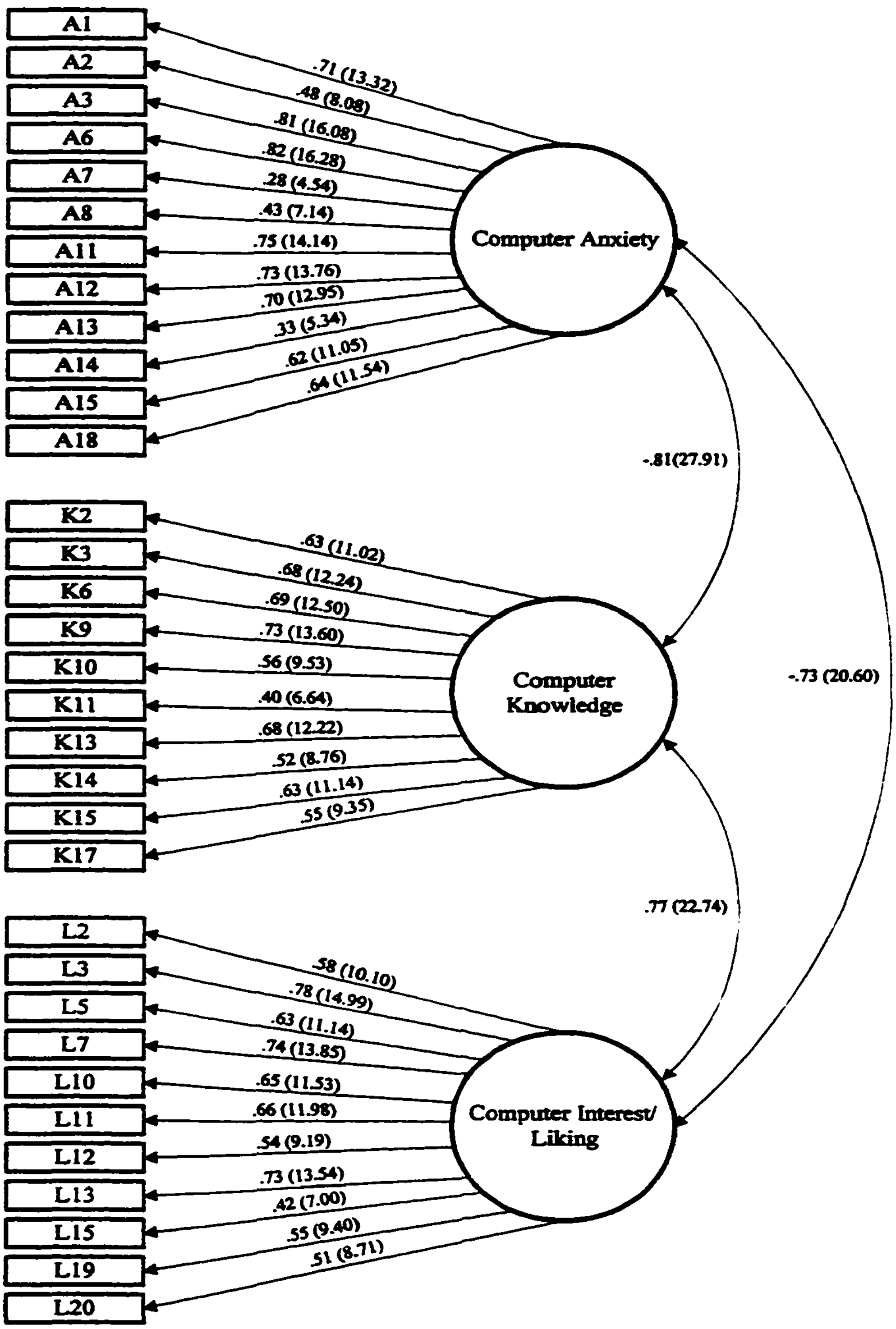
K15. I can explain to another person why a program will or will not run on a given computer.

K17. I know how to research for information on the internet.

<u>Note</u>: Subjects rated each question on a 5 point scale, from 1 (strongly disagree) to 5 (strongly agree)

Figure 7

Factor loadings and t-values of the preliminary general computer survey (33 items)



the advantages of CFA is it allows for the analysis the relationship of items across different factors as demonstrated above. Similarly, item A2 "I am unsure of my ability to interpret a computer printout" appeared to measure the user's computer knowledge better than it measured his or her computer anxiety.

By continuing to reassess and refit the model, the result was the final model (Figure 8) that presents a clear picture of the relationship between the factors as well as the items that measure each construct. The goodness of fit statistics, $\chi^2(249, \underline{N} = 276) = 343.65, \underline{p} = .000065$; IFI = .96; $\chi^2/df = 1.38$ indicates the final model fits the data reasonably well. Items for the final model are presented in Table 5. The intercorrelations among the factors (Table 6) indicates that the CAX and CLS correlate with each other and with CKS in the predicted manner: CAX is correlated negatively with CLS and CKS, while CLS and CKS have a positive correlation. All correlations were significant. The correlation coefficients among the factors, at first glance, may seem relatively high. The reason for the high correlation is because they have been corrected for attenuation. LISREL reports correlations among the factors, where the effects of the measurement errors have been eliminated. The intercorrelations among the scales are presented in Table 7: Computer anxiety and computer liking/interest scale had a correlation of -.56, computer anxiety and computer knowledge scale had a correlation of -.62, and computer liking/interest and computer knowledge scale had a correlation of .63. The reliability analysis, Cronbach Alpha, for each of the subscales was calculated (Table 8). Coefficient alpha for all 3 scales is greater than .80.

There were no significant gender differences in computer anxiety and computer

Figure 8

<u>Factor loadings and t-values of the final general computer survey (24 items)</u>

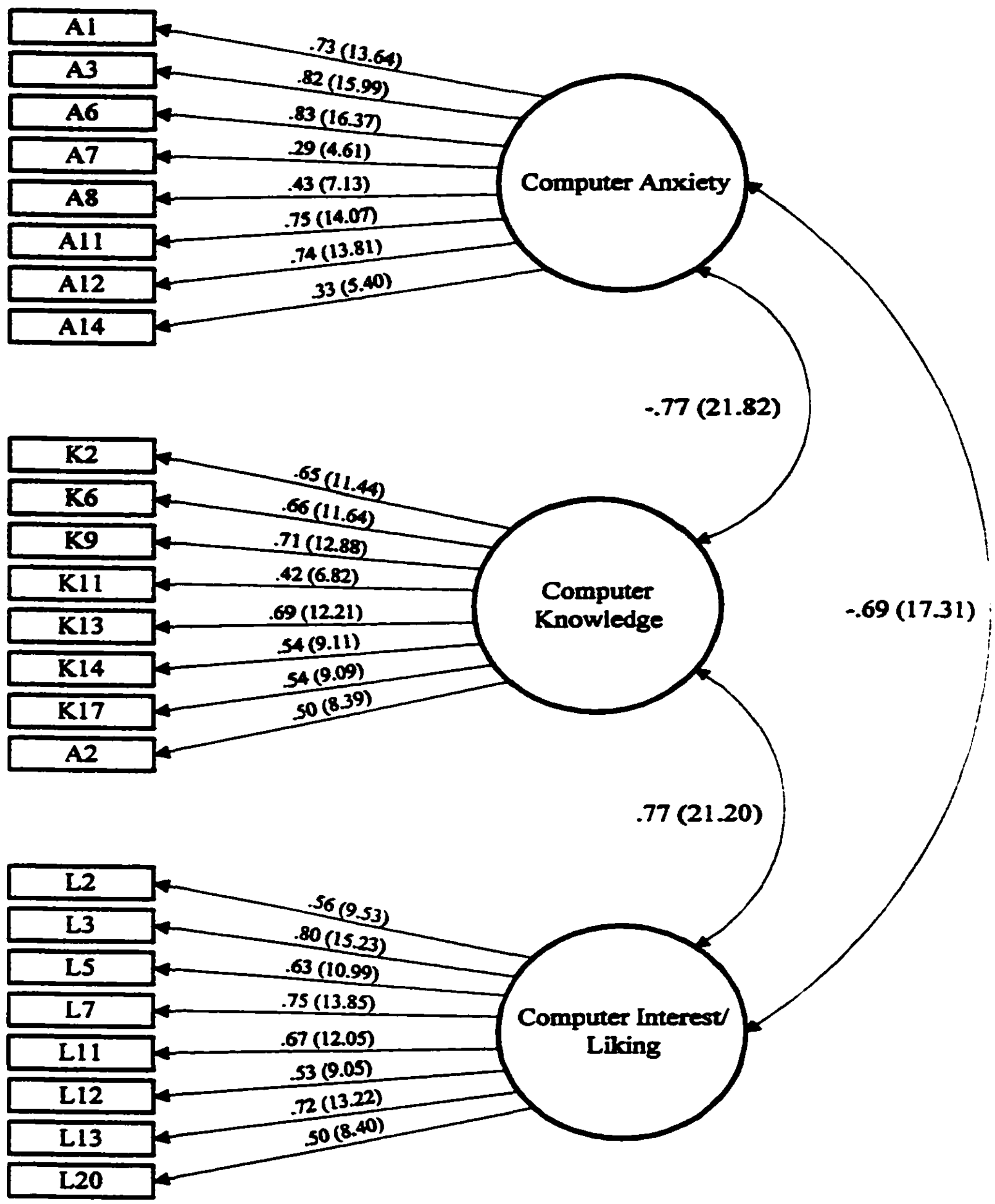


Table 5

<u>Final General Computer Survey (24 items)</u>

Computer anxiety scale (8 items)

A1. I hesitate to use a computer for fear of making mistakes that I cannot correct.

A3. I avoid using computers because they are unfamiliar and somewhat intimidating to me.

A6. The thought of learning about computers worries me.

A7. Not everyone can learn to use a computer.

A8. I worry that I will not be able to keep up with the constant advances/upgrading of computer hardware.

A11. I feel tense whenever working on a computer.

A12. I get a sinking feeling when I think of trying to use a computer.

A14. I hesitate to call the technical support or get help when I have a problem with the computer for fear of appearing foolish or incompetent.

Computer liking/interest scale (8 items)

L2. If given the opportunity, I would like to learn and use computers.

L3. I look forward to using a computer on my job.

L5. It is easy to get tired of using a computer.

L7. Learning about how a computer program works is fun.

L11. I like computers because they can simplify complex problems.

L12. The benefits of computers outweigh their monetary costs.

L13. I think computers are fascinating.

L20. I like computers because I can meet and interact with people.

Computer knowledge scale (8 items)

K2. I have no problem calling up a file or data to view on the monitor screen.

K6. I can install computer software programs such as an application program or a game.

K9. I have no problem understanding the computer jargon/terminology.

K11. I know how to retrieve my e-mail from the mainframe.

K13. I know how to use the user's manual or use online guide when help is needed.

K14. I know how to get rid of files when they no longer needed.

K17. I know how to research for information on the internet.

A2. I am unsure of my ability to interpret a computer printout.

<u>Note</u>: Subjects rated each question on a 5 point scale, from 1 (strongly disagree) to 5 (strongly agree)

Table 6

Intercorrelations Between Computer Anxiety, Computer Liking/Interest, and computer Knowledge Factors

Factor	1	2	3
1. Computer anxiety	–	-.69	-.77
2. Computer liking/interest		–	.77
3. Computer knowledge			–

Note: n = 276

Table 7

Intercorrelations Between Computer Anxiety, Computer Liking/Interest, and computer Knowledge Scales

Scale	1	2	3
1. Computer anxiety	–	-.56	-.62
2. Computer liking/interest		–	.63
3. Computer knowledge			–

Note: n = 276

Table 8

Coefficient Alpha and mean factor scores of the subscales of general computer scale

Subscale	Coefficient α	Mean factor score (SD)
Computer Anxiety	.81	2.24 (.64)
Computer Liking/Interest	.81	3.55 (.69)
Computer Knowledge	.85	3.63 (.69)

Note: n = 276

liking/interest. However, there was a significant difference on the computer knowledge between men ($M = 3.76$, SD = .74) and women ($M = 3.53$, SD = .64), $t(273) = 2.75$, $p < .01$. Women in general professed to have less computer knowledge but they are not more anxious or less interested in computers than men. However, women ($M = 4.48$) are more likely than men ($M = 4.30$) to believe that their work in the future will be affected by their knowledge of the computers, $t(273) = 2.05$, $p < .05$.

In addition to the gender differences, the newer students were more anxious than the older students, Spearman's $\rho(271) = -.13$, $p < .05$. The higher the status of their class standings (for example, juniors and seniors), the more computer knowledge they profess to possess, Spearman's $\rho(271) = .176$, $p < .01$.

Subjects in different majors also differ significantly in their computer knowledge, $F(4, 261) = 5.59$, $p < .01$. A follow-up analysis showed that arts and sciences students ($M = 3.50$) had significantly lower computer knowledge than engineering students ($M = 4.17$) and business students ($M = 3.86$), but not significantly different from the students from the educational students ($M = 3.57$). In addition, the engineering students had significantly more computer knowledge than the educational students. However, the students from different majors did not differ in their computer experience, $F(4, 261) = 1.69$, $p > .05$.

There was also a significant effect of the different majors on the liking/interest of computers, $F(4, 261) = 4.71$, $p < .01$. Follow-up analysis show that arts and sciences students ($M = 3.46$), who showed the least interest in computers, differ significantly from the engineering students ($M = 4.06$) and business students ($M = 3.78$). However, when rated on computer anxiety, there was no significant difference, $F(4, 261) = 2.27$, $p > .05$. When asked about their future expectations of computers having an effect on their work, there was also a significant effect of major, $F(4, 261) = 5.35$, $p < .01$, where arts and sciences students ($M = 4.29$) differ significantly from engineering students ($M = 4.88$) and business students ($M = 4.67$). Arts and sciences students were the group least likely to expect computers to affect their work in the future.

When asked to rate their computer experience, those who had more experience with the computer were more likely to be less anxious, ρ (275) = -.40, $p < .01$. In addition, computer experience also correlated with computer liking/interest and computer knowledge, ρ (275) = .48, $p < .01$ and ρ (275) = .51, $p < .01$ respectively.

Discussion

Validation of the constructs

A test or survey has to correlate with other important variables for it to be of any use to the researcher. On the other hand, "the content of a construct must be homogeneous for its correlates to be interpretable" (Nunnally & Berstein, 1994, p 312). According to these authors, "one of the dilemmas of construct validation is that the need for diverse correlates of a measure pushes investigators in one direction, and the need for homogeneity pulls them in another. Both are essential" (p. 312). Early researchers in the computer field were plagued with the problem of constructs that were not very well defined (Kernan & Howard, 1990). The present study minimized the problems faced by early studies, first, by careful definition of each of the constructs, then, by writing and selecting items from the domain of content, then, using confirmatory factor analysis to further refine item selection so that the resulting scales represent broad domains that are, nevertheless, unidimensional.

Researchers typically rely on coefficient α to demonstrate homogeneity of the content of a scale. However, there is a danger in relying solely on the coefficient α to demonstrate homogeneity because it is possible for a scale that is not unidimensional to have a high coefficient α. So even though the coefficient alphas in the present study were high, other evidence for homogeneity was necessary. The strongest evidence for homogeneity, besides high coefficient α, was demonstrated in the initial factoring which produced strong significant factor loadings for all items on the proposed scales, unlike findings from earlier studies (Marcoulides, 1989; Miller & Rainer, 1995). However, the present study did not avoid the problem of heterogeneity of content completely. The fits were poor; modification indices indicated improvement would occur by freeing correlated error terms. The suggestion is some items comprising the scales were factorially complex after all, loading not only on the factor defining the construct but also loading on a trivial factor (that is, a factor that has few items loading on it). Most often trivial factors are a result of some sort of methodological homogeneity, such as items having the same stems or items that refer to the same very specific content. The trivial factor problem was also evident in the earlier studies. For example, Marcoulides performed an exploratory factor analysis and found that a two-factor solution was more appropriate. The resulting trivial factor was a factor that was defined in extremely narrow terms. In other words, a trivial factor may consist of items drawn repeatedly from the same part of the domain. To remedy the problem of heterogeneity of content in the present study, one of each pair of items that had highly correlated error terms was removed from subsequent analyses. Thus, by dropping one item from each pair, the trivial factors were removed. The resulting scales, consequently, measured constructs both broad in domain and unidimensional.

In addition to removing the trivial factors from one scale at a time, the next step in the validation process was to combine the three scales in a single factor analysis. The goal was to demonstrate that items from the same scale load on the same factor and that there are no cross loadings of items among the different factors. If cross loading of items is allowed, then there is a problem of differentiation of constructs. That is, if the same items could be indicators of two constructs, it is not clear there are two separate constructs. The final model (Figure 8), in fact, showed that the items loaded on the proposed factor, there were no trivial factors, and there were no cross loadings.

Computer Anxiety, computer liking/interest, computer knowledge, and computer experience

While it is necessary to demonstrate that the breadth and unidimensionality of each scale, it is also necessary to demonstrate concurrent validity as part of the validation process. Both the computer anxiety and liking/interest are related to current knowledge state. Users are less anxious and like the computer more when they know more about the computers. The significant correlations between the CKS and CAX and CLS demonstrated concurrent validity. The CAX and CLS are correlated with CKS in the manner predicted. In other words, CKS is negatively correlated with CAX and positively correlated with CLS.

In addition, the more experience the users had with a computer the less anxious they are toward the computers. The users with more experience also showed more interest in computers. This is similar to the findings by Davidson and Ritchie (1994) who found that children who have more experience with computers in school were less anxious and more interested in computers. In addition, Bear, Richards, and Lancaster (1987), Meier and Lambert (1991), Harrison and Rainer (1992), and Henderson, Deane, Barrelle, and Mahar (1995) also found that users tend to have less anxiety and showed more interest in computers as they have more computer experience.

External correlates

An essential step in validation of a construct is to demonstrate that the construct correlates with other important variables. The main purpose of inclusion of such variables as gender and college majors in the present study was to demonstrate that the three constructs developed correlate with important external variables.

One interesting finding is there were no significant gender differences for computer anxiety and computer liking/interest. This is contrary to the findings by Collis and Williams (1987) and Todman and File (1994). These non-significant differences in computer anxiety and computer liking/interest may be due to the fact that both men and women did not differ in computer experience. As reported earlier, differences in computer attitude may be accounted for by differences in computer experience.

Women, nevertheless, indicated they have less computer knowledge than men (even though the magnitude of the gender difference was relatively small, $\omega^2 = .02$). One can only speculate about the reasons for the gender difference. One possibility is that men and women use computers for different reasons. It could be that women spend most of their time on the computer to perform a certain task such as doing their school work while men spend most of their computer time learning about how the computer works. Another reason for the difference in knowledge may be due to the fact that the computer field today is still very much geared toward men. Taylor and Moundfield's (1994) report that there are more men than women who are majoring in computers seems to suggest that this is true. On the other hand, there is a real possibility that the gender difference in professed computer knowledge may simply be that women underreport their actual computer knowledge. Further research will be needed to determine the causes of this difference.

While there are gender differences in computer knowledge, the study also revealed that there are differences in attitude and knowledge when comparing the users' major. Computer users from different majors have different attitudes toward the computer. The arts and sciences students which include mostly liberal arts majors were least interested in computers in comparison to the engineering and business students. Why the difference in attitude toward the computer? One possibility is that those students have very little interest in computers before college and thus opted to stay away from those majors that require one spend a lot of time on the computers. Another possibility is that the students, because of their major in arts and sciences, did not have the chance to learn more about the computers. This lack of opportunity to use computers in their classes may have contributed to their lack of interest in computers.

In addition, the arts and sciences students were less knowledgeable about the computers than others. While there is a significant correlation between computer interest/liking and computer knowledge, it is uncertain whether the lack of knowledge contributed to the lack of interest in computers or the causal relationship is actually in the opposite direction. The scope of the present study could not answer this question.

Arts and sciences students also indicated that they expect computers to have very little impact on their future. Their lack of knowledge may have contributed to the little computer interest and expectation in the future. Arts and sciences students have the most to lose as they will be the group who are least prepared for the workplace upon graduation. This is clearly a challenge to the educators and school administrators to remedy this situation. One interesting finding is that there was no significant difference of major in their computer experience. In other words, students from all majors spend equal amount of time on the computers. It may very well be that those students in the various engineering and business majors are inherently interested in computers which lead them to learn more about the computers, thus the difference in knowledge of the computers. For whatever reason, the arts and sciences students are not learning more about the computers while in college even though they spend a lot of time using them.

General computer survey

The survey was also developed in part to provide researchers and educators with a valid, reliable, updated, and useful tool to utilize in their studies or surveys. The present study demonstrated that it is possible to develop a computer attitude scale that measures both computer anxiety and computer liking/interest as well as professed computer knowledge. The three subscales when used together can provide a profile of the computer users.

The confirmatory factor analysis demonstrated that the GCS is factorially valid. The inter-correlations of the factors were significant but the coefficients were not large enough to show internal structural problem. The direction of the correlations also revealed concurrent validity. The CAX is negatively correlated with CLS and CKS. Also, CLS and CKS have a positive correlation coefficient. The external measures such as the user's measure and class standing demonstrated that the GCS is a sound measure, able to differentiate among the different users.

Although the computer survey can be used in a wide variety of settings, it may have a limitation in that may not be valid if used to measure the computer attitude and knowledge of advanced users. This instrument is meant to measure the computer attitude and computer knowledge of general users such as college students but not specific groups such as programmers who work in the computer industry.

Directions of future research

The computer survey can be a very useful measuring instrument for educators and businesses alike as it provide information on the user's computer attitude and computer knowledge. One possible area for future research is the usage patterns of computers in men and women. It may very well be that men and women use the computer for different reasons. If the difference in computer knowledge turns out to be because of the differences in usage pattern, the major implication is that the gender gap still exists. Another possibility is to investigate the differences in attitude of the students in different majors. Could it be that what prompted certain students to choose certain major is due in part to their lack of computer knowledge?

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Appendix A

General computer survey questionnaire and the additional questions

General computer anxiety scale

1. I hesitate to use a computer for fear of making mistakes that I cannot correct.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

2. I am unsure of my ability to interpret a computer printout.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

3. I avoid using computers because they are unfamiliar and somewhat intimidating to me.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

4. I find the technical aspects of computers are difficult to understand.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

5. One of my worries is that I could erase vital files or data by hitting a wrong key.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

6. The thought of learning about computers worries me.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

7. Not everyone can learn to use a computer.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

8. I worry that I will not be able to keep up with the constant advances/upgrading of computer hardware.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

9. I worry that I will not be able to keep up with the constant advances/upgrading of computer software.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

10. The thought of using a computer to do my work makes me nervous.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

11. I feel tense whenever working on a computer.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

12. I get a sinking feeling when I think of trying to use a computer.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

13. I hesitate to sign up for a course that requires the use of a computer.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

14. I hesitate to call the technical support or get help when I have a problem with the computer for fear of appearing foolish or incompetent.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

15. The thought of installing computer hardware/components makes me nervous.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

16. I worry about accidently erasing files thus causing a program to be unusable.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

17. I get a sinking feeling whenever I see an error message 'pop' up on the computer monitor screen.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

18. The thought of using the computer to surf the Internet worries me.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

Computer liking/interest

1. The challenge of learning about computers is exciting.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

2. If given the opportunity , I would like to learn and use computers.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

3. I look forward to using a computer on my job.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

4. I enjoy working on a computer.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

5. It is easy to get tired of using a computer.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

6. It is fun to figure out how computers work.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

7. Learning about how a computer program works is fun.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

8. Learning about how a computer component works is fun.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

9. I enjoy reading about how computers are used in our daily lives.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

10. I wish I had more time to use computers

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

11. I like computers because they can simplify complex problems.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

12. The benefits of computers outweigh their monetary costs.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

13. I think computers are fascinating.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

14. I enjoy reading about computers

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

15. I like to use a computer because it allows me to use word processing programs and such to do my work.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

16. I like to use a computer because I can play games on it.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

17. I like to use a computer because it gives me the ability for faster analysis of information.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

18. I like to use a computer because it can provide me with information that could lead to better decisions.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

19. I like computers because I can get on the Internet with it.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

20. I like computers because I can meet and interact with people.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

Computer knowledge

1. I have no problem using a word processor on the computer to do my work.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

2. I have no problem calling up a file or data to view on the monitor screen.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

3. I can trouble shoot computer problems.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

4. I know how to use Internet browsers such as Netscape or Microsoft Explorer to get navigate around the internet.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

5. I can install a computer hardware component on a computer.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

6. I can install computer software programs such as an application program or a game.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

7. I have no problem writing simple programs for the computer.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

8. I have no problem using the computer to do my homework.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

9. I have no problem understanding the computer jargon/terminology.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

10. I know how to use the operating systems on the computers such as Windows 95 or Windows 3.1.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

11. I know how to retrieve my e-mail from the mainframe.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

12. I know how to print my work on a printer.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

13. I know how to use the user's manual or use online guide when help is needed.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

14. I know how to get rid of files when they no longer needed.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

15. I can explain to another person why a program will or will not run on a given computer.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

16. I know how to logon to the internet.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

17. I know how to research for information on the internet.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

Computer experience

1. How often do you use a computer at school or at home?

1	2	3	4	5
Never	Very little	Average	Some	A lot

2. Do you plan to learn more about computers?

___Yes __No

3. How would you rate your experience with computers?

1	2	3	4	5
Novice				Expert

4. How much time each day do you typically spend using a computer?

5. What percentage of your time is spent on using the computers?

Future Expectation

1. In the future, I believe that knowing how to use computers will help me to be more productive at work.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

2. In the future, I believe that knowing how to use computers will improve my job performance at work.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

3. In the future, I believe that knowing how to use the computers will lead to higher quality work.

1	2	3	4	5
Strongly disagree	Disagree	Undecided	Agree	Strongly Agree

Additional Questions

1. Do you own a computer at home?

   __Yes __No

2. Gender

   __Male __Female

3. Classification:

   __Freshman __Sophomore __Junior __Senior __Graduate

4. Race:

   ____

5. Age:

   ____

6. Major:

   ____

7. GPA:

   ____

Appendix B

Informed consent form

Consent to participate in the experiment **Computer Survey**

Descriptions:

In this study we will be asking you to complete a survey designed to assess your computer knowledge and attitude. The survey should take no more than 30 minutes to complete.

YOU MUST BE AT LEAST 18 YEARS OLD TO PARTICIPATE

Risks and Benefits:

There are no known risks or side effects that we can foresee. All questions and procedures have been approved by the Department of Psychology Human Subject Committee and the University Institutional Review Board for the Protection of Human Subjects. The benefits include (1) helping psychologists learn more about psychological processes, (2) learning more about psychological processes, and (3) you will receive ½ credit for participating in this study.

Obligations

By agreeing to participate in this research, you are obligating yourself to give your full attention to this research and to follow the instructions carefully and to the best of your ability.

Voluntary Participation and Right to Withdraw:

Your participation in this study is completely voluntary. You are free to withdraw from this study at any time. If you withdraw, you will receive experimental credit for the time you have spent.

Confidentiality:

All information obtained during this experiment will be held in the strictest of confidence. Your name will appear only on this form. Your answers will be used in research, and may be shown to people outside the research team, but your answers will never be associated with your name.

I have read this statement and have no further questions. I am at least 18 years old and I agree to participate in the research under the conditions described.

Signature:______________________ Printed Name:______________________

Student ID:______________________ Instructor:______________________

Appendix C

Correlation matrix of the general computer survey

1.0000														
.3026	1.0000													
.6145	.3306	1.0000												
.4012	.4606	.4556	1.0000											
.6169	.2456	.4776	.4023	1.0000										
.6164	.3796	.6825	.4775	.4976	1.0000									
.2483	.1916	.1719	.1973	.2085	.2401	1.0000								
.3696	.1777	.3273	.4080	.3381	.3308	.1944	1.0000							
.3739	.2232	.3194	.4682	.3965	.3589	.2561	.8001	1.0000						
.5146	.3031	.7022	.3803	.4773	.6411	.2295	.3634	.4051	1.0000					
.5367	.3377	.6197	.3636	.4497	.6070	.1950	.3123	.3122	.6635	1.0000				
.5148	.3327	.5804	.3475	.4632	.6036	.2265	.2898	.3099	.6828	.6107	1.0000			
.4126	.3591	.5881	.4507	.4117	.5500	.1750	.2561	.3202	.5473	.5130	.4716	1.0000		
.2386	.1543	.2809	.1260	.2195	.3001	.1252	.2254	.1953	.2681	.2646	.2057	.2163	1.0000	
.4703	.4009	.4687	.4940	.4484	.4767	.0902	.3584	.3877						

.4256 .4731 .4069 .4651 .2073 1.0000

.5475 .2331 .4528 .4395 .7301 .4350 .1813 .4073 .4406

.4563 .4114 .3952 .3692 .2689 .4644 1.0000

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.5165 .5013 .5263 .4306 .2043 .2875 .3581 .2813 1.0000

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-.5110 -.4572 -.5263 -.4002 -.0978 -.2508 -.3148 -.2231 -.5425

1.0000

-.3722 -.2956 -.4333 -.3390 -.3575 -.4236 -.2038 -.2237 -.2706

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-.2138 -.2102 -.2114 -.2519 -.0221 -.0943 -.1450 -.1555 -.3219

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K1 K2 K3 K4 K5 K6 K7 K8 K9 K10 K11 K12 K13 K14 K15 K16 K17

L1 L2 L3 L4 L5 L6 L7 L8 L9 L10 L11 L12 L13 L14 L15 L16 L17 L18 L19 L20

A GENERAL COMPUTER SURVEY MEASURING THE USER'S COMPUTER ATTITUDE AND COMPUTER KNOWLEDGE

Abstract of dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy

By

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This abstract is approved by:

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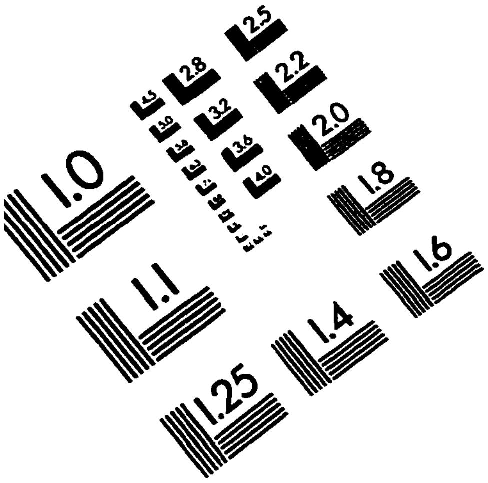
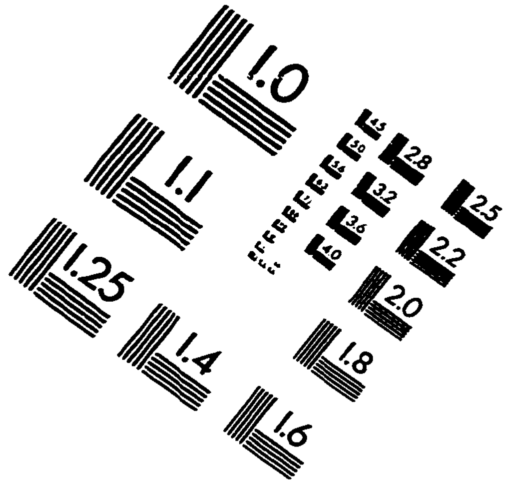
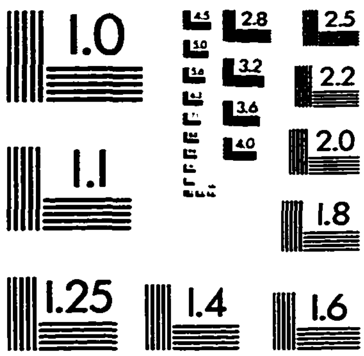
Dennis R. Bonge, Ph.D.

Both attitude toward computers and knowledge about computers are evolving rapidly, so instruments measuring these constructs should also change. The purpose of this research was to provide those who study computer users with valid scales that assess current computer attitude and knowledge. A general computer survey was administered to 276 college students. The survey included self-report items selected to reflect computer anxiety, liking/interest, and knowledge. Confirmatory factor analyses of these items were used to develop scales that are broad in domain but, nevertheless, unidimensional. Confirmatory factor analyses also were used to show items on the scales do not cross-load and that the scales correlate with each other in the expected manner. Additional evidence for construct validity was demonstrated by observing relationships of the scales with other important variables. Men and women differed significantly on professed computer knowledge. Arts and science students had less interest in computers and less knowledge about computers than did business and engineering students.

IMAGE EVALUATION TEST TARGET (QA-3)







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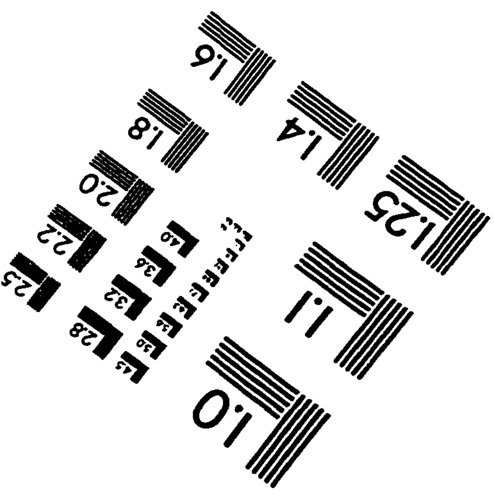

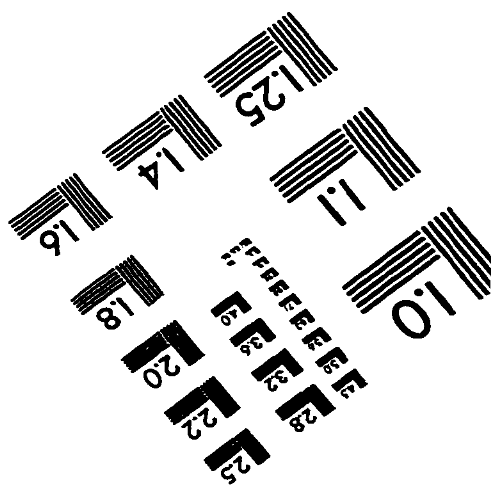

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