THE RELATIONS AMONG COMPUTER ANXIETY, COMPUTER EXPERIENCE, AND PERCEIVED CONFIDENCE IN SCAFFOLDING

By

JOHN H. GRIFFIN

Bachelor of Arts
University of Houston
Houston, Texas
1973

Master of Science
Oklahoma State University
Stillwater, Oklahoma
1988

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Thesis Approved:

Thesis Adviser

Dean of the Graduate College

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TABLE OF CONTENTS

Chapter	Page

LIST OF TABLES

Table Page

LIST OF FIGURES

Figure Page

CHAPTER I

INTRODUCTION

Computer anxiety has been found to be a significant problem in the use of computers in education, business, and industry (Raub, 1981; Weil & Rosen, 1997). Weil and Rosen (1997) reported that up to 50% of the population may have varying degrees of technology-related anxiety that can interfere with certain aspects of their lives at home, at work, or school. Similarly, in research on computer anxiety levels among agricultural extension employees, 44% of respondents rated themselves as "mildly anxious" to "very anxious" (Martin, 1998) with 20% rating themselves as "very anxious" (Martin, 1998).

The computer age is here, and the role of the computer has shifted from its being predominantly a tool for mathematics and programming that many students and educators could avoid, to being a tool that provides interactive communication functions that are rapidly becoming essential to the educational process. As more instructors go online, the technology of computers has become the defacto standard for students and instructors alike (Raub, 1981; Rosen & Maguire, 1990, Sherry, 2000). As the extent of computer use in education has increased, so has the nature of computer usage and expectations about computer literacy (Overbaugh & Reed, 1994-1995). As the computer and its place in society have changed, so also have perceptions of the computer as a personal threat.

In Rosen, Sears and Weil's (1987) investigation of the impact of negative reactions to technology, which they refer to as technophobia, they found that technophobes tended to avoid computer interactions when possible. Based on these results and Weil, Rosen and Wugalter's (1990) study of the etiology of technophobia, it is hypothesized that psychological reactions to technology will lead those who are computer anxious to avoid computer use (Rosen & Weil 1995).

The overly anxious person is in a heightened state of suspense, while anticipating further information to clarify his or her situation. He or she is highly observant and alert, often excessively so, over-reacting to external stimuli. The student may feel helpless and threatened even though he or she cannot articulate and communicate exactly why (Davis, 1987). Some very common mis-beliefs about computers contribute to computer anxious behavior, including the beliefs that 1) computers are somehow magical, and beyond the person's understanding and control, 2) everyone else but me uses them (successfully), and 3) computers are taking over control of people and/or society. These associations of computers with life being out of control in the face of rapid technological changes can create feelings of powerlessness and negative attitudes (McInerney, Marsh & McInerney, 1999; Meier, 1985; Weil & Rosen, 1997).

Vygotsky (1978) pointed out the social nature of bringing up children, and the role of adults in giving them guidance. We know today that knowledge is not simply accumulated, but that new information is integrated into existing knowledge in order to create complete and useful models of the world. We use these models to guide us. In the area of support, novice learners are gradually integrated into the world of the more expert user. Ryder (1994) as well as others point out the need for greater computer user support, and the potential of getting that support from the community of online users. Sherry and Wilson (1996) argue for creating these performance supporting environments, but a search of the literature found no empirical research that dealt with the nature of computer anxiety in these potential environments. Specifically, the possible differences in support preferences between high and low computer anxious students has not been adequately addressed. This research seeks to fill in that gap.

Statement of the Problem

Computer anxiety has been found to be a significant problem in the use of computers in education, business, and industry (Raub, 1981; Weil & Rosen, 1997). While there has been sufficient research on the effects of computer anxiety and related attitudes on the use of computers for teaching and learning, there has been much less interest in research on how computer anxiety relates to student preferences for, and their confidence in the support they receive, which will be referred to in this research as *perceived confidence in scaffolding.*

Of primary interest in this research is whether computer anxious students and their non-anxious counterparts will select different options for support when learning to use technology, or whether the more anxious students choose more limited options for help-seeking than do their non-anxious counterparts. In other words, do computer anxious students select different types of mediation of support, such as paper-based help, over machine-based help at different rates than do the non-anxious? And, if computer-anxious students select different alternatives for help than do their non computer-anxious counterparts, do their confidence levels change as a result of receiving their preferred help?

Purpose of the Study

The purpose of this study is to investigate how students' computer anxiety relates to their choices of computer support, and their perceived confidence in scaffolding support, that is their confidence when using a given support mediation (support delivered by human, machine, or paper) within given task-specific settings. To achieve that goal this study examined student support needs in terms of mediation (human, machine, or paper) through which support is given on some typical types of computer tasks.

Rationale

The rationale behind this research is that anxious and non-anxious students come to the computer-based learning environment with different perceived prior experience, different goals, and support needs, and that they may also differ in their perceptions about what type of support they need in order to succeed in given tasks (Mitra, 1998; Potosky & Bobko, 1998). Students' perceptions of their support needs may well be related to their computer anxiety, and ultimately their confidence, depending on the individual level of arousal. Students may vary greatly both in their combinations of types of specific computer anxiety (anxieties about possible damage to the machine, or loss of self-respect, etc.), and in the intensity of their anxiety (arousal levels) which relates to the levels of confidence they have while using the computer as a learning tool (Bull, 1999; Weil & Rosen, 1997).

In the instructional arena, many factors effect student computer use or non-use. Students may see their computer-based learning experience either as threatening, as being an attractive alternative to the traditional classroom options, or as entertaining and fun (Csikszentmihalyi, 1996). In addition, many possible avoidance patterns explain students' failure to use computer-related technology for communication and learning, and each student can conceivably have different preferences and affective states (anxieties) related to what they consider to be the most useful and efficient technology for getting help. Likewise, students can vary in their experiences, both by types (software, hardware, and Internet) and amount of experience, in other words, both the breadth of experience and the depth of experiences (Mitra, 1998; Potosky & Bobko, 1998).

This research provides insight into these individual differences in support needs. Understanding individual differences will help the instructor or instructional designer to better meet student needs. By exploring the perceptions of both computer anxious and non-computer anxious students, this study will provide a better understanding of their individual support needs, and limitations, where the setting is not the traditional learning platform. In non-traditional modes of learning via technology, students face many of their technical problems in isolation from those who could help them.

Theoretical Framework for this Investigation

Regardless of whether one defines failure as drop-out rates or greater number of course incompletes (I), technology dependent courses, and distance learning courses in particular are notorious for their high attrition rates. Computer-based distance learning in particular is plagued by persistently higher attrition rates that are largely due to the "dizzying array of challenges" (Phipps, 2000, p. 7) presented to students in terms of new skills and support they will need in order to successfully complete their course work. These factors tend to create a complex and highly threatening learning environment, the worst possible learning environment for the least able students, who may find these new and complex environments overstimulating.

A report to the Institute of Higher Education Policy (Phipps, 2000) prepared for the National Education Association and American Federation of Teachers points out that while support is a critical issue in distance learning, very little research has been done within a theoretical framework to explain differences in individual affective states and support needs, or address individual differences across differing technology applications in this learning environment (Phipps, 2000). This research seeks to reduce that gap.

This research borrows from Vygotsky's (1978) work on scaffolding and examines the complex nature of the students' affective states in a given technological environment, and the students' support needs as these relate to their confidence. Specifically this research focuses on computer anxiety across several types of computer-related tasks in order to assess students' confidence in independently improving their skills on those same tasks, what help they believe they need in order to perform better (with scaffolding), and whether the help they specify actually improves their confidence in their ability to eventually perform the same task independently.

Assumptions and Limitations

1) The subjects were unpaid and answered honestly within their abilities.

2) Selection of students is non-experimental and primarily based on using classes, hence randomness is not assumed, and cause-effect conclusions cannot be drawn. In addition, due to the nature of anxiety being recursive, causality cannot necessarily be inferred from the results, significant or otherwise, because alternative explanations cannot be excluded.

3) In addition, the limited nature of the self-report instruments measure anxiety does not include physiological measures, such as heart rate, for example.

4) One of the primary limitations of this research is the nature of self-report assessments. The reality of getting help may actually be different when students are observed in a stressful learning laboratory in which their performance is related to the successful completion of a course.

5) Another limitation is with the population used for this study. Similar research with a greater age-span, and/or non-traditional populations may also show differences in support needs based on age or education levels.

Scope of the Study

The subjects of this research consist of undergraduate, mid-western university students, and thus the results of this study are not readily generalizable to other university or college students, nor to high school students or older adults, especially those of other regions or cultures, which may somewhat limit the scope of this study. In addition, the scope may be limited to students who are more academically inclined to use computers, who may be more or less computer literate, or less computer anxious, and may be motivated by different instrumental needs, than would be the non-academic computer users.

Research Questions

This research is concerned with the relations among the students' computer anxiety levels, and their respective choice of mediation for scaffolding (human, machine, or paper), and whether there is a change in their confidence as a result of scaffolding, that is, getting the support they need. This research topic can be broken down into the following research questions:

Research question 1: Do students of high and low computer anxiety levels differ in their preferences for types of scaffolding (see CASA instrument Appendix B)?

Research question 2: Is there a difference in the student's independent confidence depending on their computer anxiety levels (B of Appendix B)?

Research question 3: When scaffolding mediation options (section C) and assisted confidence (section D) are combined into *perceived confidence in scaffolding,* is there a difference in *perceived confidence in scaffolding* depending on the students computer anxiety levels?

Research question 4: Is there a difference in the student's assisted confidence depending on their computer anxiety levels (section D of Appendix B)?

Research question 5: Is there a difference in the independent confidence before assistance and assisted confidence levels after assistance?

Definitions of Terms

The following terms and definitions are used for this research.

Asynchronous communication/interaction: Communication or interaction that is not in real time, such that there is a delay between one person's actions and another person's response. This is typical of e-mail in contrast to instant messaging or chat room communications in which messages are virtually instantaneous.

Computer Anxiety: The complex emotional reactions that are evoked in individuals who interpret computers as threatening (Raub, 1981, p. 9) and "an uneasiness due to anticipated negative results of using the computer" (Raub, 1981, p. 8) that leads to computer avoidance.

Computer-Mediated Communication (CMC): Transmission and reception of messages using computers as input, storage, output, and routing devices. CAC includes information retrieval, electronic mail, bulletin boards, and computer conferencing (Paulsen, 1995).

Computer Self-efficacy: The conviction that one can successfully execute the behaviors required to produce the desired outcomes, specifically in the computer-based environment. This is similar to, but not the same as confidence.

Learner-as-learner describes the learner when the student is learning in the content learning mode (Guzdial, n.d.).

Learner-as-user: describes the learner when the student is learning in the not content learning mode, but is learning peripherally related skills that enable or enhance content learning. An example of this occurs when the student is learning to use email in order to communicate about the content, or to clarify dates and deadlines (Guzdial, n.d.).

Mediation of Support or Scaffolding: Refers to the particular mediation used to deliver information, which in this research can be either human, machine (or computer-based), or paper-based, each of which also involves different types and qualities of interaction.

Perceived confidence in scaffolding: For purposes of this study, perceived confidence in scaffolding is the student's confidence in their ability to complete a given task with a given support option. In this study, it is operationalized as the students' assisted confidence associated with the corresponding task and type of support by mediation.

Scaffolding: A teaching-learning strategy in which one person, regardless of mediation, with more extensive knowledge or expertise, provides a temporary supporting structure to another, less knowledgeable, person in order to make it possible for the novice learner to accomplish a task that he or she would not ordinarily be able to perform independently. Scaffolding can be thought of as both a supporting and controlling mechanism that helps a student learn. Strategically speaking, scaffolding is constantly changing to match the student's changing level of need. It is a dynamic, moving, and controlling mechanism which increases the student's chances of giving a correct response while simultaneously limiting the probability of error. The scaffolding structure is deconstructed or removed from one "place" to be rebuilt in another place, so as to be constantly ahead of the student's immediate needs, while also allowing the learner to attempt the task alone as his or her abilities mature (Vygotsky, 1978). Scaffolding is not limited to the human as a mediator, but may also include any mediating tool, device, or program that can store information necessary for accomplishing a given task. Regardless of mediation, feedback is essential for scaffolding to occur.

Technology: Technology is practical implemented knowledge (Ferre, 1988. p. 138). Technology as used here accepts the colloquial use of the word with connotations of advanced technology as opposed to simple technology (pencil and paper).

Votes: Votes are the students' expressed desire for method of support.

Votes for Scaffolding: These are defined as the votes for a particular mediation method for support (human, machine, or paper) for a specific task, or task-factor.

Zone of Proximal Development (ZPD): A term used by Vygotsky (1978) to refer to the difference between two regions, one called the *actual developmental level* where a person is developmentally unable to accomplish a task alone and the other, the *completed developmental level*, where the person can accomplish the same task with support provided by another person, object, or program. Those who are below the Zone of Proximal Development are not developmentally ready and therefore require additional prerequisites before scaffolding can be of any use to them.

CHAPTER II

LITERATURE REVIEW

The Setting

The computer has become an essential tool in education, not only for traditional uses such as a *computational* tool in mathematics, or statistics, and as a word processor, but it has become an integrated communications tool for the virtual learning environment (VLE) which forms the basis of distance learning or distributed learning programs. Information Technology (IT) has expanded geographic access, providing instructional opportunities for students in remote areas of the country as well as allowing us to reach those with disabling conditions which preclude access to traditional classrooms. This increases the potential for greater equality of access for all to the same learning resources.

Significance of the Inhibitory Effects of Computer Use in Education

Computer anxiety (CA) has been shown to have inhibitory effects on students using computers. Weil & Rosen (1997) reported that up to 50% of the population may have varying degrees of technology-related anxiety that can interfere with certain aspects of their lives at home, at work or school. As the extent of computer use in education has increased, so has the nature of computer usage and expectations for computer literacy (Overbaugh and Reed, 1994-1995). In recent years the role of the computer has shifted from being predominantly a tool for mathematics and programming that many students and educators could avoid, to become a tool that provides interactive communication functions that are rapidly becoming essential in the education arena (Raub, 1981; Rosen & Maguire, 1990; Sherry, 2000). As the computer and its place in society have changed, so have perceptions of the computer as a personal threat.

Computer-based communication technologies serve as a gateway to allow access to new information and enables interaction with others. Furthermore, computers can provide potential for building new virtual learning environments and creating complex relationships in new student-centered learning environments. In such environments, there is greater potential for interaction between students and content, between students and students, and between students and instructors. Computer-based communication tools such as CMC and Listservs, for example, enable interaction between students and other persons who may serve as outside experts. Students are even interacting with intelligent learning systems in which software is designed to replicate intelligent human behaviors. These online relationships are quickly becoming an essential and integral part of online learning that uses the constructivist paradigms in which individuals create their own meanings, learn together, and co-create communities of discourse in which they can become instrumental to each other in their own learning (Bull, 1999; James, 1997).

Electronically mediated learning environments use dynamic, interactive presentation tools and many communication features that place the student in a new and unique social context where both quantity and quality of interaction are critical to the quality of learning (Bradley & Russell, 1997). This increased connectivity provided by information and communication technology (ICT) has also created greater isolation among some users, who may feel alone and most vulnerable to their computers precisely at a time when they need help the most (Weil & Rosen, 1997). How, for example, can the students who are most in need of computer help get all the basic technical support and course content-related help they need when they already feel isolated and intimidated by their computer? If they lack both a prior history of successful computer use, and the self-knowledge that they can succeed with their computer (low computer self-efficacy), they are all the more vulnerable to negative emotional and cognitive states of mind that may predispose them to further failure (Eastin & LaRose, 2000).

New computer-based communication and learning tools can be intimidating, especially for a novice computer user, but the constant barrage of new releases of communication tools, to say nothing of constant updates of software versions, adds to the demand placed on both the novice and the advanced user. Having to deal with these changes, and the steep learning curves involved, before even beginning the online course, can make students wonder about the safety or wisdom of taking an online course. Guzdial (n.d.) makes the distinction between the *learner-as-learner* in which the learner is learning course content materials, and the *learners-as-users*, where the student is learning non-content features of the software he or she needs in order to function in the computer-based learning environment.

Ambiguity

When students are new to a given content area there are higher levels of ambiguity and students may well be under somewhat higher levels of stress (learner-as-learner), but if the same students are also new to the requisite technology (learner-as-user), the increased stimulation due to greater ambiguity is more likely to cause them to experience excessive arousal that keeps them from functioning properly, and may even cause them to withdraw from the course (Cambre & Cook, 1985; Meier, 1985). A student may be confronted with the typical anxieties associated with their concerns about their ability to learn content (Raub, 1981), or appraisals of their performance, but the computer anxious student in particular may panic when forced to contend with a possibly overwhelming barrage of new computer terminology which may be more than the student can take (Ropp, 1999).

The overly anxious person is in a state of suspense, while anticipating further information to clarify his situation. This person is highly observant and alert, often excessively so, over-reacting to external stimuli. He may feel helpless and threatened even though he cannot articulate and communicate why (Davis, 1987).

Understanding the student's computer anxiety and how it affects online communication and learning behaviors within the shared virtual community is essential for reducing stress and negative expectations, and for getting the entry level student into a pattern of successful functioning with high expectations of success as soon as possible (Mithaug, 1993).

Terms like *technophobia*, *computerphobia*, and *infoglut* convey a sense of the nature and magnitude of the problems of computer anxiety which can interfere with the flow of learning (Rosen & Maguire, 1990). While a certain level of anxiety may facilitate learning by stimulating students, keeping them alert and preparing them for further learning, excessive anxiety is a very real problem (Cambre & Cook, 1985) because of the inhibiting, even debilitating effects it can have on students. Virtual Learning Environments (VLE) add an extra layer of sophistication and complication to the more traditional learning skills which would normally be basic reading and writing, critical thinking, etc. Where reading and writing skills once served as the minimal gateway skills, technologically advanced computer-based literacy skills are now important gateway tools. Without these skills students may be severely restricted in interacting in the modern electronic mediated classroom (Campbell, 1997).

For some student computer users, getting the help they need is a playful challenge (Webster & Martocchio, 1992), but for others, using the computer is an exercise in terror (Rosen & Maguire, 1990; Weil & Rosen, 1997). Understanding the problems involved, and providing support systems for students as they are needed, may prevent the downward spiral of excess anxiety, unnecessarily lowered confidence, and computer avoidance.

Interactive Communication for Construction of Knowledge

The proliferation of information and communication technologies (ICT) has provided a fertile environment for new theories and methods of instruction that depend on these incredibly rich communication media. Constructivist theories fit hand-in-glove with the new information technologies (Sherry, 1998; Sherry, 2000). Information is so very easily gained and shared, and therein lies a new dilemma in that there is an excess of online information and a perceived need to access it as quickly as possible; these conditions can lead to emotional problems for some (Weil & Rosen, 1997).

In addition, the information and communication technologies that can mediate learning are becoming increasingly more interactive (Ruberg, Moore & Taylor, 1996). Virtual Learning Environments are especially appropriate and useful for the constructivist methods of teaching and learning. Computer-Mediated-Communication (CMC) forms an essential component of such instructional methods, especially those forms of CMC (e-groups, listservers, etc.) that take advantage of the technology to allow students to spend more time working together, sharing ideas, as well as gaining collaborative and cooperative experiences by exchanging information, evaluating it, and coming up with creative solutions to problems (Campbell, 1997; Sherry, 1998; Sherry, 2000; Soloway et al., 1996).

While these virtually unlimited opportunities for freedom of interaction can greatly facilitate social construction of meaning and contribute to creative online learning, they also come with an emotional price tag for some. Increased interaction between individuals and course content also requires learning both the computer-based technology and the socially appropriate behaviors that go along with creating relationships in these electronically mediated environments. While gathering and evaluating information itself is important, interpersonal feedback is essential for understanding course content as well as gaining more accurate self perceptions and developing self knowledge that ultimately enables self-regulation, and hence growth (Miltiadou, 1999; Sherry, 1998). Feedback in these settings is important for scaffolding to succeed.

Active engagement is a critical component for the construction of knowledge, and high levels of interaction fit in well with hi-tech learning, which can provide an environment that increases the student's sense of self-control and emotional excitement (arousal) that typically leads to increased motivation for learning. However, use of these positive features can be seriously impeded if the user is either unable or unwilling to take advantage of them (Miltiadou, 1999).

Computer-Mediated Communications

Some students willingly use information and communications technology for instructional purposes, while others seem reluctant, or antagonistic to its use. Reluctant users may say that they prefer more traditional methods of instruction that allow them to see the instructor's face without technology getting in their way. They have a trust in face-to-face modes of communication and feel a need to use all their senses to relate to others. However, other students who may be very reluctant to speak up in face-to-face situations can become very active in electronic chat rooms, or when using email (Savicki et al., 1999). It seems quite probable that those who choose to communicate differently may also choose to both study and to seek support in different ways (Scull, 1999).

Computer-mediated Communication (CMC) has also changed the balance of power and control in the classroom. Some traditional face-to-face lectures are very similar to the broadcast mode of communication in that they leave little opportunity for student feedback to the instructor and little opportunity for peer relationships to grow. Communications in online learning changes the learning environment, altering the balance of power and control in ways that allow greater amounts and types of student interaction. With CMC, compared to lecture modes, students more often initiate communications on their own, and generally communicate more between themselves and with their instructors. The convenience of online peer reviews or collaborative work has made it possible for motivated students to quite easily improve the quality of their learning (Brown & Vician, n.d.; Gay, Sturgill & Martin, 1999; Ruberg, Moore & Taylor, 1996).

Gay, Sturgill & Martin (1999) reported on their research with a new piece of software from Cornell University which was designed to allow students to make online margin notes or share annotations to their documents. They felt that students were less inhibited because they were able to share knowledge, or lack of knowledge, with less embarrassment and work together on improving their work, and because they could see they all were struggling to deal with similar issues.

Althaus (1997) created computer-mediated discussion groups (CMD) for students in his traditional class, finding that place independence, time independence, and absence of time restrictions favored those reflective thinkers who would not otherwise have had opportunities to participate in lecture classes. He found that those with prior email experience made more use of computer-mediated group discussions, and of those who participated in discussion groups, 92% said their online discussions helped them learn more. In addition, those who participated in both face-to-face discussion and computer-mediated group discussions scored higher on the first written assignments and their final exam grades. They also attended class more often and were more active in the face-to-face classroom. Another advantage was the benefit offered to the hearing impaired.

Althaus (1997) found that those with prior email experience made more use of computer-mediated group discussions, and learned more, but that women did not use the online groups more than men, nor did usage vary as a result of age. He found that among the online students, more time and attention was given to the written message than they would have otherwise given to the teacher-dominated spoken lectures. In addition, those with more computer experience made greater use of the online discussion group. While it is possible that the online group contributed to the higher level of performance, Althaus also acknowledged the possibility of self-selection in that the more motivated and hard working students may have been attracted to the online group.

Although it would seem that those who are apprehensive about personal communications would appreciate the opportunities for reflective thinking that E-mail offers, it is not clear that this is the case. Carlson and Wright (1993) using both the CAS (Loyd and Gressard, 1984) and the Personal Report of Communication Apprehension (PRCA-24) (McCroskey, 1976) found a correlation of $r = 0.22$ between the two, indicating that those who are anxious in the communication setting may also be more anxious about using the computer. Research by Scott and Rockewell (1997) found a correlation of $r = 0.137$ between communication apprehension and computer anxiety, and a correlation of $r = 0.047$ between writing apprehension and computer anxiety. Looking at the question of *likelihood to use* each of 16 new technologies, they found that, of 13 items that were significant, anxiety did not totally predict future use on all technologies. However, the most striking result was that anxieties and *likelihood to use* were most strongly linked to telephone-based technologies (associated with oral communication apprehension), more so strongly than to the simple computer technologies, and that computer programming in particular was not at the top of the list, but word processing was! They found that experience was a better predictor of *likelihood to use* than was anxiety.

Anxiety and Inhibition

Computer Anxiety Defined

Some very common mis-beliefs about computers contribute to computer anxious behavior. These include the beliefs that 1) computers are somehow magical, and beyond the person's understanding and control, 2) everyone else but me uses them (successfully), and 3) that computers are taking over control of people and/or society. These associations of computers with life being out of control in the face of rapid technological changes can create feelings of powerlessness and negative attitudes (Weil & Rosen, 1997; McInerney, Marsh & McInerney, 1999; Meier, 1985). In fact, Raub (1981) has defined computer anxiety as the "complex emotional reactions that are evoked in individuals who interpret computers as personally threatening" (p. 9) and beyond their control. Epstein (1972) describes anxiety as the result of the threat of

> loss or damage to a value held important to the individual. The greater the importance and significance, the greater is the potential for distress. This anxiety may be precipitated by three primary conditions: 1) overstimulation, 2) cognitive incongruity, and 3) response unavailability. (p. 195)

Arousal

The Yerkes-Dodson (1908) arousal-performance curve suggests that those who are on the low side of the (inverted U) arousal-performance curve are under-aroused and will behave differently from those who are on the middle area, or the opposite end of the arousal-performance curve. Each person is unique in their arousal needs and their reactions to their current state of arousal. Generally, the lower levels of arousal (associated with sleepiness and inattention) result in lower levels of attention and performance, while moderate levels result in high levels of attention and peak performance. But, when the level of arousal increases to the point of over-arousal, represented by the far extreme side of the curve, excessively high levels of activation that are associated with excessive anxiety and a plethora of negative effects take their toll on the individual.

According to Franken (1988), it is conditions of overstimulation, cognitive incongruity, and response unavailability that create heightened arousal such that the *perceived* absence of realistic escape mechanisms exacerbates the problem, perhaps increasing the perceived threat far out of proportion to any possible real threat. The perceived, probability of occurrence, the perceived probable impact, and the lack of self-efficacy in terms of controllability may also figure into the magnitude of the perceived threat and resulting anxiety. In other words the person's feelings of danger and entrapment in the presence of the computer depend in part on such internal factors as personal self-efficacy, confidence, sense of control, and perceived expectations of success (Meier, 1985).

Anxiety consists of specific unpleasurable characteristics, with both a somatic, physiological side and a psychological side. It is associated with:

> 1) a physically and mentally painful sense of powerlessness to do anything about a personal matter; 2) a presentiment of an impending and almost inevitable danger; 3) a tense and physically exhausting alertness as if facing an emergency; 4) an apprehensive self-absorption which interferes with an effective and advantageous solution of reality-problems; and 5) and an irresolvable doubt concerning the nature of the threatening evil, the probability of the actual threat, the best objective means of reducing the evil, and one's capacity for effectively using those means when the emergency arises (Campbell, 1989).

All these characteristics come together in what one might call the pessimistic computer avoider, or ineffective user, who may well spend more time avoiding and fretting about using the computer than would otherwise be required to master it and take advantage of its benefits! These definitions of computer anxiety include various combinations of negative cognitions and emotions along with varying degrees and types of physical symptoms (Raub, 1981).

Prevalence and Impact of Computer Anxiety

Anxiety, and its inhibiting effects, have been the subject of research in many areas, ranging from physically demanding domains such as sports, to the cognitively demanding skills needed in the classroom. According to research by Rosen and Maguire (1990), up to 50% of the population may suffer from varying degrees of computer anxiety. Overly anxious persons, in particular, spend valuable mental and emotional resources on monitoring the environment rather than focusing on learning new and complex materials (Bandura, 1986; Spielberger, 1972). Computer anxiety, like any other anxiety (Marcoulides, 1988), also interferes with learning in a number of ways. At an excessive level, anxiety can be debilitating and recursive, feeding on itself (excessive worries) by attacking the student cognitively, emotionally, and even physically; it can interfere with pre-processing and post-processing of information, and impede recall of information. High levels of anxiety can cause failures to perform, in which bodily sensations and cognitions remind the students of a past failure, causing further distraction and negative self-evaluations that result in avoidance of the anxiety-provoking object which caused the negative cycle in the first place. Thus, anxiety reduces mental efficiency by creating negative emotions and excessive arousal which can further lead to a sense of panic and result in physical distress (Bull, n.d.; Miltiadou, 1999; Scull, 1999). For some, these negative emotions and worries create a reduced sense of self-efficacy with lowered expectations, followed by (as in self-fulfilling prophesy) lowered performance which serves as a confirmation that the student was justified in being anxious in the first place (Bandura, 1986). Simonson et al. (1987) described behaviors that are indicative of computer anxiety: "1) avoidance of computers and general areas where computers are located, 2) excessive caution with computers, 3) negative remarks about computers, and 4) attempts to cut short the necessary use of computers (Simonson, et al. 1987 p. 238)." Clearly computer anxiety, like other anxieties, can be related to a host of negative affective and instructional outcomes.

Rosen and Maguire (1990), in their meta-analytic study, show that computer anxious students perform more poorly, make more errors, take more time to accomplish tasks, and feel less confident. Anxiety is recursive and feeds on itself. Bloom (1985) gives us an example of how this recursive cycle can lead to failure: 1) Distrust of personal abilities and 2) low self confidence, 3) along with a high level of anxiety and physical symptoms of stress which distract attention 4) result in ineffective learning, which leads to a distrust of personal abilities–and the cycle continues (Bloom, 1985). Rosen and Weil (1990) found that students who failed to seek treatment for their anxiety and negative attitudes towards computers were twice as likely to drop out and/or receive lower grades (Rosen & Weil, 1990) and Anderson (1996) reported similar results.

Users with lower computer anxiety are generally expected to have greater self-confidence and awareness of how to use the computer to their advantage in coping with problems (Ropp, 1999). Depending on task level and resulting demands, a low-to-moderate level of anxiety may enhance some students' performance by increasing their arousal level and spurring them on to achieve peak performance, especially where there is sufficient experience and confidence. But as anxiety levels increase beyond a point that the student can tolerate, attention is distracted, and their focus can narrow and shift inappropriately, resulting in lowered performance. As computer anxiety increases beyond a tolerable level, computer users may not even be aware of a decreased level of performance, and may be less likely to make sensible decisions about when, where, and how to use the computer for communication and learning (Ropp, 1999). This decrease in performance has been found in many areas including both communications (McCroskey, 1976; McCroskey & Andersen, 1976) and computer use (Raub, 1981; Rosen & Maguire, 1990).

Zhang and Espinosa (1998) found what they referred to as *comfort/anxiety* to correlate with 1) confidence levels for beginning (entry level) computing skills ($r = 0.65$), 2) confidence levels with advanced computing skills ($r = 0.58$), and 3) confidence levels with telecomputing skills ($r = 0.41$). Using regression techniques, they found that comfort/anxiety was significantly predictive of computer self-efficacy. Those who were comfortable with and non-anxious about computer use were more computer self-efficacious. Raub (1981) found that novel situations elicited feelings of insecurity and hence anxiety, but these feelings could also be reduced or eliminated both by gaining more knowledge and by regaining a sense of control and confidence through experience and training.

Computer Anxiety and Attitudes

Bishop-Clark and Donahue (1999) examined computer attitudes in their study of three different types of computer classes. After the classes were over they conducted a focus study and found that incremental, hands-on success throughout the program was a big factor in increasing positive attitudes. Those students who experienced success were both more positive and more confident about continued computer use.

Based on their work, Zhang and Espinosa (1998) point out that successful completion of any computer-dependant classroom assignment is beneficial to creating a cycle of improved attitudes in the areas of lowered anxiety, increased comfort, and perceived usefulness of the computer. They note that instructors should be aware of the differences between current (i.e. experienced) students and incoming students who have little or no computer literacy, and perhaps less-than-positive experiences to motivate them to become more computer literate. Meier (1985) found computer avoidance to be related to perceived loss of control, fear of negative evaluations, and lack of familiarity with the computer language. Rosen, Sears, and Weil (1987) found the student's academic major to be related to experience and computer anxiety. Those who had experience in the hard sciences and in dealing with machines were more likely to expect to use computers as part of their field of expertise. But in the soft sciences such as the social sciences, students may think of the computer as a mechanical number-crunching tool that is peripheral to their true area of interest, or possibly as a distraction from their desired goals. Such beliefs may cause negative attitudes and feelings of entrapment when these students are forced to use computers. A few negative experiences may quickly lead to a downward trend of computer-related anxiety and solidify future negative reactions, resulting in avoidance of the threatening object. Some researchers believe that the younger generations are exposed to computers earlier and therefore may be less computer anxious; however, this claim is also tenuous since exposure to mathematics, public speaking, and testing situations also fail to consistently reduce anxiety, especially where there is lack of positive experiences for various reasons (Guzdial, n.d.).

Human Computer Interface and Man-Machine Interaction

The Human-Computer Interface (HCI) includes the mechanical and representational mechanisms through which humans exercise control of their technology. When the interface is simple and efficient, it becomes transparent and allows for immediate and effortless control; it is at its best when it is invisible to the user and the user can achieve a high level of flow without the machine itself ever being a distraction. The interface design is said to be invisible when the user is unaware of its presence and can perform a task without having to expend unnecessary energy communicating with the computer, or having to intentionally communicate through it in order to reach a goal. Ideally, the human-to-machine, or human-through-machine functions are so easily automated in the users mental structures that their use becomes as automated and cognitively effortless as is walking itself. Its been said that the best and most intelligent interface meets the human's needs and expectations rather than demanding that the human learn to meet the computer's needs and expectations. This idealistic expectation is far from implementation, however, and even the best interface design today still requires human flexibility (Lohr, 2000).

To the extent that the interface mimics human behavior, or at least appears to do so, it takes on human characteristics, even acquiring personality traits associated culture and gender (Marcus & Gould, 2000). Efforts to create avatars, which are iconic representations of individuals, include the studies of creating an artificial or virtual presence online. As interface elements are used to represent self and others, the computer or representational elements can take on cultural or gender-specific characteristics which may well influence approach-avoidance behaviors related to getting help with the computer. Some of these efforts center around creating positive affective feelings that are conducive to increasing human interaction. How one sees the computer, and its ways of doing things, contributes to the way one relates to the computer (Cooper & Stone, 1996). Essentially, users are reacting to how someone else constructed the machine and designed its interface personality. In reality, they are interacting with the artifacts of the creator of the machine, operating through the machine to communicate with the person who created it, or with another user, in much the same way they interact with the writer of a letter, or a book – interacting as best they can through the medium, as they perceive it, to achieve an exchange of information or reach shared goals (Huang, 1999; Lohr, 2000). Hence, the creator's assumptions become the user's environment.

Once someone learns to use the telephone and understands its limitations, for example, the machine itself becomes rather incidental and unobtrusive to its user. The ideal invisible interface allows the user to act upon it, and through it, intuitively without the interface itself becoming an impediment to the flow of ideas or information. Unlike the telephone, however, the computer will most likely always require new learning, or mental retooling, as the interface changes with advances in technology or changes in marketing strategies. Often, the interface does not appear transparent to the user, or does not function below the level of awareness, which typically requires that the user shift into linear sequential modes of thinking and adopt machine-like ways and non-intuitive metaphors rather than the computer thinking in human ways (Hueser, 1998; Lohr, 2000).

Not only does the computer interface frequently cause confusion among the uninitiated novice learners, it also creates a steep learning curve for them. But, beyond this learning curve, the use of the computer itself also creates new social and operational expectations which contribute to the users' feelings that they must move at ever faster rates in order to keep up (Lohr, 2000; Rosen 1997).

In a similar vein, Crouch and Montecino (1997) refer to asynchronous anxiety as the result of the incessant and instantaneous nature of email, in which users are anxious and not really sure whether their email went through to the intended recipient, went to an entire email group, or went anywhere at all. Given the personification of the computer and our human interactions with it, it only makes sense to suspect that levels of computer anxiety are affected by student personality variables (cognitive style, gender, need for control) and system configuration and type of software and support options available. These variables differentially affect the users' sense of ease of use (usability), and ability to control their mediated environment, and perhaps even lead to gender-based biases related to the software, message type, or message sender.

Soreanu (1998) points out the need for an interface design to be adaptive to the user's level of expertise. Computer users may be like children in the sense that they move through levels or stages of development from novice users, who are largely ignorant of the computer's potential and what to expect of it, to becoming competent or even expert users as they automate their basic skills, develop greater awareness of the program options, and come to recognize that there are many more potential uses.

Novice users lack basic understanding and the technical vocabulary needed to request help from others or to maximize their use of online help tools. As system complexity increases, and as the computer interface provides more excessive options, the probability that the novice will get lost in unnecessary and incomprehensible options also increases. The novice user, in particular, may be overwhelmed (over aroused) in a sea of options that create high levels of ambiguity, and become even more aroused as a result of feeling lost.

Computer-based tools, which include computer hardware and software, and their various combinations give us the Internet, which in itself has become a rather open-ended and chaotic extension of our realities that can easily lead to high levels of uncertainty and anxiety. In Vytgotskian terms we might say that these electronic tools, constructed for knowledge mediation and communication, also require more time and effort to master, extending the novice student's apprenticeship time (Vygotsky, 1978).

Gender

Gender is another important influence in the area of communications, behavior in the online world, and computer anxiety. It has been associated inconsistently with computer anxiety (Brosnan, 1999; Rosen & Maguire, 1990). Though inconsistent, results related to gender issues are inconsistent they have served to highlight several personality variables related to computer use. Some note, for example, that gender experience and expectations play a role in how people interpret or project gender onto their computer, or that each gender approaches computer-based communication with different perspectives and uses (Herring, 2000; Hueser, 1998; Rosen, 1997). Sussman and Taylor (2000) for example, reported gender differences in language used in email (CMC) construction.

Rohner (1981) developed a Computer Anxiety Inventory (CAIN) which he used with college students and found no gender differences in his study of computer anxiety. Jay (1985), however, in his study found significant main effects for both gender and amount of experience.

Weil and Rosen (1995), in their study of twenty-three countries, examined computer anxiety, computer thoughts (cognitions), as well as computer/technology-related experience, shortage of equipment, and gender, or any combination of these three. Their findings show vast differences across nations and cultures in computer use and attitudes. They found that, overall, female students had less experience than males, and on the whole, were also more anxious about using computers. In only one country, Indonesia, did females had more computer experience than males.

Harrison, Rainer, and Kelly (1992) found that being male reduced anxiety and enhanced computer performance. Brosnan (1999), in his extensive review of the literature, finds contradictory evidence for the existence of significant gender-based differences. But he does believe that where they do exist, it is in terms of psychological gender rather than biological gender and subsequent gender-based socialization and experience. Parker (1997) found no gender difference in levels of computer anxiety, and Massoud (1991) examined computer attitudes and computer knowledge of adult students in Adult Basic Education courses, finding that males had a more positive attitude to computers than did females.

A very typical pattern in all these findings seems to be for males to have more positive attitudes to computers, and have less computer anxiety about them than do females, but it is also possible that males are socialized in such a way that they less able to recognize or express their anxieties. It also seems that negative computer attitudes, even if they do increase male computer anxiety do not interfere with male computer performance as much they do for females. Some have suggested that males are more likely to have been socialized to ignore their anxieties and persist in the face of their anxieties anyway. Some researchers point out that females' self-perceptions may be different depending on their setting of interaction; that is, males and females appear to react differently depending on whether they are in same-sex (same sex, self-comparisons) or mixed groups, where females compare themselves to males while using the computer.

Cooper and Stone (1996) explored the way children respond when given the freedom to choose the gender for screen images of online tutors. Their interest was in whether girls would select female faces for their tutors and boys would select male faces for theirs, and what results this might have on other factors. They found that in mixed-gender groups, girls appear to have shortchanged themselves, under-reporting their types of computer use, number of hours using computer-related technology, and perceived knowledge of using computers. However gender differences were less evident in the same-sex groupings of children. The implication is that social factors are at play in creating contexts in which gender, and associated self-evaluations, have an effect on anxiety and the student's resulting performance.

Some conclude that the learned gender-based thinking of girls is predicated on the historical fact that computers were originally part of the male world of machines which were highly mechanical, largely hardwired, and required engineering and programming skills simply to make them function. Hence, those who were at one time less accustomed to the idea of independently using and controlling machines may feel less efficacious using computing machines, and thereby be more likely to feel vulnerable and more anxious about the results or outcomes. Whereas computers were once used primarily in highly technical areas such as mathematics and engineering, their current use includes teaching and learning, with interfaces and communication software that are more user-friendly and appeals to a wider range of users.

Gender-based Communication Differences

Tannen (1991) was one of the first to point out that males and females live in different worlds, as it were, and that when they communicate, it is essentially cross-cultural conversation. In a similar vein, Hanson (1992) argues that girls and boys have been socialized in different ways and will have different life experiences. Girls, for example, often miss out on the same kinds of physical play that little boys may enjoy and grow to expect, and in doing so may be at a disadvantage when it comes to learning to visualize three dimensional objects and verbalize related concepts that are relevant to successful discourse in mathematics, which requires those skills. Likewise, the same imbalance in socialization may place boys at a disadvantage when it comes to developing social graces and learning to communicate and work cooperatively with others. Boys may fail to learn the language of relationships that girls learn.

Herring (1992, 2000) notes that the idealistic claims that many have made about the Internet serving to democratize society have not materialized because gender and social patterns of disparity have simply been moved over into cyberspace. Her ethnographic research shows that in computer-mediated-communication (CMC) men post more messages in general, and also post most of the excessively long messages.

In asynchronous CMC, it is primarily men who begin and close discussions, assert their opinions as fact, and in general communicate without concern for saving face of others, communicating in an adversarial manner designed to win discussions. In contrast to this, women are more likely to post shorter messages, qualify their assertions, generate more face-saving communications and in general be more concerned about the rapport and relationships among the interactants (Herring 2000). Herring believes that gender is a significant factor in online leadership, noting that there is some evidence that women react better in female-led group discussions, or even with male leadership in mixed gender discussions when the discussion is moderated (controlled), even if by a male, because they feel safer in the controlled and more civilized discussions in which the more vociferous cannot run over those who are more quiet (Herring, 2000).

Males held the floor more often than females in online debates, with both males and females responding more often to male postings. User comments in Herring's (1992) research shows that the male communication patterns are so distinctive that when males have tried to pass themselves off as females in online discussions their communication behaviors often gives them away. Women also react more aversively in online discussions (Herring, 1993). When verbal hostilities break out the males are often proud of their participation, more often taking the Darwinian stance that they are simply clarifying the issues of debate by removing or weeding out faulty logic from the discourse. In the face of this behavior, females feel intimidated and angry, often choosing to leave these mixed-gender discussions and move into female only discussion groups (Herring, 1993).

A longitudinal study by the Higher Education Research Institute (Phipps, 2000) found that both males and females are using computers more than ever, and at about the same numbers, but that the confidence of female computer users is lower than that of their male counterparts. This disparity, may be partially explained in light of their finding that there is also greater disparity between the numbers of males and females entering the computer programming careers (Phipps, 2000).

Experience, Exposure, Familiarity, and Age

In a meta-analysis of computer anxiety and its correlates, Chua (1999) consistently found support for the relationship between computer anxiety and prior computer experience, even though the term experience does not seem to be used in a consistent manner in the literature (Potosky & Bobko, 1998). Chen (1986) found that as experience increases so does interest and confidence, while anxiety goes down. But this is not always as straightforward as it seems. In some particular populations and settings, computer anxiety actually goes up after encountering certain computer experiences or computer-dependant courses (Dyck & Smither, 1996; Rosen, 1997).

Computer experience is measured in many different ways, some measures being more subjective and others more objective (Smith et al., 1999). Computer experience can also be confounded with other variables such as age, academic level, and gender, when these are not clearly delineated and measured adequately. Age, for example, may not be a significant variable when it only reflects years of computer experience and does not appear to be related to any age-related debilitating factors. This may be especially true when the age range of the subjects is rather limited, as with college students.

Studies concerning the relationship of prior computer experience to attitudes and anxiety have also been less than clear in their results. The setting of the research and how the computer is being used also contribute to this ambiguity in that some studies have measured anxiety in a computer programming course, for example, that is a hard science course. In contrast, others have measured experience where the computer is used as an adjunct tool in a soft course, for example, such as word processing or writing. Centrality of the computer use in the course may be a factor, especially if the presence of the computer is perceived as being intrusive. Computer use in a computer-dependant course may be different from computer use in a humanities course if the value of its use is not successfully demonstrated.

Age can also be confounded with length of computer use. When Lim (1996) compared those under 25 years of age to those over 25, he found greater levels of computer confidence, computer liking, achievement, and intent to use computers for the older group. Ownership of a computer, which can also be related to increased experience, has also predicted greater levels of computer confidence, computer liking, achievement, computer usefulness, ease of use, and intent to use computers (Lim, 1996). Lim (1996) also found that, among older students and graduate students, those who quite possibly have accumulated a greater number of positive experiences with computers, gave computers higher ease-of-use ratings than did younger and undergraduate students.

Quality of Experiences

Weil and Rosen (1995) assessed quantity and type of computer-based technology use with their Demographic Data and Technology Experience Questionnaire which consisted of questions about whether a person had or had not used computers, written a computer program, used a computerized library card catalog, used computerized library literature search, used word processing, played computerized arcade games, used a programmable video-cassette recorder, used a programmable microwave oven, or used automatic banking machines. Their instrument captured multiple forms of technology experience.

Necessary and Parish (1996) had this to say about computer ownership and voluntary use, which also relates to positive or negative experience:

> While age $F(1,127) = 0.04$, $p > 0.05$ and gender $F(1,127) = 3.64$, $p > 0.05$ were not found to have any significant effect the main effects of voluntary use $F(1,127) = 8.52$, $p<0.005$ and ownership $F(1,127) = 9.48$, $p < 0.005$ were highly significant. The results indicated that those who had voluntarily used a computer, and/or owned one were significantly more likely to demonstrate lower computer anxiety scores, and higher computer confidence and computer liking scores, when compared to their counterparts. (Necessary & Parish 1996).

Anderson (1996), found that perceived knowledge, rather than actual prior experience is a predictor of computer anxiety. Anderson felt that researchers must take a closer look at the qualitative outcomes of experience; they must examine the value of the experience to the users and whether it actually increased the users' self-efficacy, or perhaps ask the users questions about their affective states in conjunction with their learning experience. This means that the perception that all is going well in the course of the learning process may be just as, important, or more important than, the reality of the situation itself.

The fit between prior experience or exposure and the person's self-concepts such as not good at mathematics may carry over onto their beliefs about computer use. Caputi et al. (1999), in their review of the construct of computer experience say that other factors mediate the relationship between computer attitudes and computer anxiety, and they distinguish between what they refer to as objective computer experience (OCE - quantitative measures) and subjective computer experience (SCE - emotional-affective relationships). They point out that indirect sources of information about computers can also have an impact on a person's subjective experience and are manifested as the perceived usefulness or liking of the computer.

Some believe that experience/exposure to computers reduces computer anxiety (Jones & Wall, 1985), but studies of this relationship have also been inconclusive. While some programs have been designed to successfully reduce computer related anxiety (Rosen 1997), research has also shown that, on the whole, exposure to computers, or computer training on computers, can in some cases at least, actually heighten computer anxiety, especially when the experience is not properly designed to avoid causing anxiety (Rosen, 1987).

In a longitudinal study Rosen et al. (1987) examined the relationship between experience and computer anxiety, finding that a student's computer experience did not necessarily reduce computer anxiety. In fact, in one of their 10-week computer classes, a student's computer anxiety remained unchanged, while attitudes and physical discomfort actually got worse. Another study by Rosen et al. (1987) in an aircraft corporation, found that for 30% of those sampled, their computer anxiety actually increased during a 4-day training workshop. It seems, based on a broader look at the literature, that computer experience, at least for some persons, in a mis-matched situation, can be so stressful that it fails to increase self confidence, self-efficacy, etc. and, especially when not designed properly, the exposure can cause greater anxiety among users. Training may also serve to increase expectations of success and subsequent anxiety if the training is not also perceived by that student as being successful.

Rovai (1969) used the CAS in what he referred to as a quasi-experimental method to examine how a mandatory computer literacy course could be used to reduce computer anxiety. He conducted three observations over a 13 week period with 75 subjects, finding a significant reduction in computer anxiety and an increase in computer confidence. However, computer liking and computer usefulness did not change. Rovai described the relationship between computer anxiety and the three observations as 94.75% linear and 5.25% quadratic, and that the relationship between confidence and the three observations was strongly linear with a non-significant quadratic trend.

Loyd and Gressard (1986) found that among those with more experience, males were generally more confident and that those with greater experience also believed computers to be more useful. Gardner, (1997), using the Loyd and Gressard CAS instrument, found that among community college faculty, more experience was associated with more positive attitudes (including lower computer anxiety), indicating that attitudes are predictive of computer-related technology use in the classroom. Toppin (1998), who also used the CASA (computer anxiety measure) of the CAS instrument, found that when computer confidence was the dependent variable, computer experience and academic major (business vs undecided) were significant factors.

Quality of experience seems to be the critical factor in the etiology of computer anxiety. For those who have high levels of quality support when they encounter problems, feelings of arousal are more likely to turn into excitement and hope rather than anxiety. The use of a quality of current and prior experience component of assessment may help to gain valuable insight into the experience factor and its relationship to computer anxiety and support preferences. To sum up the apparent contradiction seen here, it makes sense to say that quality of experience or, perhaps even experience-to-person fit may be a better perspective than examining simply gender or culture as a factor in the etiology of anxiety (Bradley & Russell, 1997; Smith et al., 1999).

Need for Support

Regardless of how success or failure rates are defined, distance learning is notorious for its high drop-out rates, and computer-based distance learning in particular is plagued by persistently high dropout rates that are due in part to the dizzying array of challenges (Phipps, 2000 p. 7) that it presents to the students in terms of new skills and support that they need.

A report of the Institute of the Higher Education Policy, prepared for the National Education Association and American Federation of Teachers points out that support is a critical issue in distance learning where drop-out rates are about double or triple that of traditional classroom settings (32% vs 4% and 36% vs 5% in some cases) (Merisotis, & Phipps, 1999; Phipps, 2000). Very little research exists to explain individual differences in affective states as they relate to the support structure of the online course.

The online course demands a high level of user skills and the student is constantly faced with having to search for information about how to accomplish simple tasks such as updating and modifying software. In the worst case scenario, even completing simple tasks can be daunting for the students whose attitude is that computers are peripheral to their academic interests, who mistrust them, and who are anxious about being able to complete assignments on time and with satisfactory grades. These students, in particular, may seem to demand quick and easy answers in situations where patience and persistence are needed in order to learn basic skills for survival, essentially a combination of high expectations with high arousal and little experience to work from. Those with greater experience or patience will more likely find solutions independently, using whatever sources they can find. Dealing with this problem will require individualized structures to provide the isolated students with the help they need in a timely fashion, using the support tools they are willing and able to use. Tools for support may not directly contribute to a student's emotional well-being, but where possible, they should be designed to reduce negative emotions related to frustration and feelings of anxiety.

Scaffolding

Much of Vygotsky's (1978) worked dealt with understanding childrens' development in terms of the socio-cultural influences in their knowledge acquisition, and the mediation of knowledge from adults or experts to children. His research showed that knowledge first exists external to the individual, being stored in, or embedded in structures that humans create to serve as their tools, whether in the form of a hammer, a calculator, or linguistic tools such as words and concepts. Knowledge is also view as being embedded in socio-cultural tools such as language, rules, and art forms that give structure to the individual's externally shared environment. Those who are knowledgeable and perceptive, and understand the novice's needs, can mediate that knowledge and help the novice to understand and improve behaviors by modeling socially approved behaviors, or perhaps giving step-by-step demonstrations, or by translating hidden meanings into simpler words and concepts that the novice can understand. This is an active process of appropriating externally shared and stored knowledge from the environment and internalizing it, making it our own. This process is often facilitated by a knowledgeable person who serves as a coach. The coach must diagnose a problem or deficiency and evaluate the needs of the learner and then may make appropriate adjustments to the environment or give corrective feedback to the learner.

Vygotsky (1978) pointed out that two persons of the same apparent abilities or skill levels may differ in their ability to use various forms of knowledge and support structures (differential readiness), which is reminiscent of Cronbach and Snow's (1977) perspectives on Aptitude-Treatment-Interaction (ATI), also known as Attribute Treatment Interaction (Sieber et al., 1977). Scaffolding is the supporting process in which a person of greater knowledge or experience assesses a novice's problem in comprehension or completion of a task and provides an appropriate clue or suggestion, or uses similar strategies to help the novice complete the task successfully. The expert provides some form of diagnosis and corrective feedback that enables the novice to succeed. After successful completion of a task and confirmation that the task can be completed independently, the support is faded out.

Scaffolding essentially allows the individual to accomplish tasks that they would not otherwise be able to accomplish on their own. Vygotsky, in dealing with children's developmental issues, found that scaffolding must be appropriate to the person's developmental stage. While lack of support may make learning more difficult, premature or inappropriate support may also be useless because it will fail to make any sense to the child (or novice), which explains why diagnosis and good communication skills are important for scaffolding to work. Ideally the support system is in place to allow someone to observe a problem, diagnose it, and provide a useful clue, hint, or questions that will lead the student to a solution. As the child grows and develops, he or she masters one environment as well as he or she can, gains more understanding of her cur rent situation, and soon faces an essentially new environment that serves to create new opportunities and challenges.

As the competence levels of student computer users move beyond simple skill levels, users are also better able to see the potential for improvement or usefulness, as well as gain greater potential to work faster and smarter in new interest areas. This of course assumes the individual has the requisite positive attitudes, adequate levels of experiences, and the confidence that they can succeed if given the right tools and support.

Individual Needs

In any group of students there are those who are not ready to grasp a given skill or concept because they lack certain basic prerequisite knowledge or experiences. Others may be at a point in their learning where they are almost, but not quite, able to perform a task without assistance. They simply need some scaffolding in the form of demonstrations, hints, or clues as to the next step. They may, for example, only need answers to a few strategic questions in order to help them re-organize their thoughts, or help them notice previously undetected patterns that are significant for understanding a new concept. We say that the latter group can benefit from scaffolding, which is the appropriate help provided by a knowledgeable person, in a live setting or in the form of a tutorial, that enables a person to achieve a learning task that they would not have otherwise been able to complete on their own (Vygotsky, 1978).

Online students usually need at least two major kinds of information: Computer technical support (for the learner-as-user) and course content-related information (for the learner-as-learner). For those with excessive computer anxiety, non-essential concerns and negative reactions may consume excessive time and energy, and getting the computer problems out of the way (and off their minds) could clear the road for the students to get back on track, to focus on the course and its content, rather than on the technology involved. Smooth sailing at this point of entry into the course may well prevent the intrusion into the learning process of recursive negative thought patterns (Guzdial, n.d.).

Timeliness, or getting the help one needs when it is most appropriate, is an important step in reducing the loss of positive attitudes and energy at a critical time in the beginning of the learning curve. But how does each person seek out help and get it? The computer anxious and non-anxious students do not appear to be alike in terms of the quality and quantity of help they need in order to perform well. Ropp (1999), in her research with computer coping strategies, found that computer anxious students used fewer coping strategies and fewer variations in strategies than did the less anxious students. Her work would also seem to coincide with research from other fields, showing that anxious students have a narrowed focus of attention and use less productive strategies in dealing with the world around them. If this pattern holds for getting computer support, it would also imply that computer anxious students may well communicate differently (more poorly?) in their help-seeking behaviors, or seek help from less efficacious methods. It is quite possible that students who are most computer anxious, will communicate differently as they gain more experience. There is certainly reason to believe that the more anxious students will interact in less productive, or even counterproductive, communication patterns than do non-anxious students (Allen and Bourhis, 1996; Proctor et al., 1994; Schumacher & Wheeless, 1997), but there is little empirical information about possible differential help-seeking behaviors in these new teaching and learning environments.

Just as in traditional teaching/learning settings, there is typically, for each student, a unique level of, or combinations of, intellectual and emotional development, a task-specific situation that provides her with enough information and structure to match needs and abilities while simultaneously providing just enough ambiguity to maintain motivation. Either a lack of background skills and experience, or excessively high expectations can translate into excessive ambiguity, progressive worry and anxiety, and ultimately avoidance of the threatening computer task. Isolation, which can be a very real problem in certain online settings, can exacerbate the students' feelings of helplessness and entrapment when they cannot communicate in meaningful ways with those who could possibly help them. Typical student anxieties, compounded by computer user anxiety, and especially if combined with negative attitudes, can serve to limit the students' cumulative exposure as a result of computer avoidance, or can lead to selective experiences with computer-based technology. Obviously these same factors can also restrict student access to the computer-based communication channels they need, but may in fact abhor, especially when they have negative emotions and anxiety about future encounters with lowered expectations of getting useful information (helplessness). The irony here is that the tool with the most potential to provide help can actually be the tool least likely to be considered by the computer anxious student (Ropp, 1999, Sherry, 1998).

Environmental Structure, Independence, and Support

Paulsen (1995) described four online pedagogical techniques in terms of the environmental affordances and restrictions they create. Each level also varies as to the independence (or lack of structure) provided and degree of autonomy that it allows and demands of the user. Each level also varies in the degree of isolation of the student from the instructor or other students. A person's *isolation* and independence must fit with their own demands for freedom and independence, but the students must also be able to deal with the associated levels of ambiguity and stress that are involved in the environment. The four technologically mediated environments allow for different types and amounts of student interaction with the learning resources (other students, instructors, or materials) and are classified as 1) one-alone techniques, 2) one-to-one techniques, 3) one-to-many techniques, and 4) many-to-many techniques. These levels vary as to the amount of independence, autonomy, and structure that they offer to the student who uses them. Along with each of these environments come varying demands on the student for communication and social skills in order to perform in the course and get adequate support from others (Paulsen, 1995).

Based on Bandura's (1986) work, those who feel in control and self-efficacious about their situations, are more likely to take advantage of their online options and be more confident in their abilities to find the help they need (Henry & Stone, 1997). By way of contrast, those without this sense of control are usually more anxious about their condition. Less structure and higher ambiguity may be exciting for some students but cause other students to become over-aroused and anxious. Typically, these students will be less likely to perceive opportunities but come to believe that their learning environment is unsafe, and it thus will also be less likely to search for help, which they really do not believe is available to them.

Working in the isolation of home, for example, would seem to require a greater sense of self-confidence in their ability to master new computer-related skills, to get new help as needed, and perhaps emotionally to cope with the sense of isolation in this one-alone condition. The one-to-many techniques could also be the preferred mode of some who may feel safer with the more structured, traditional teacher-controlled and institution-driven agenda. On the other hand, these students may be quite goal oriented and lose patience with the group processes demanded in the many-to-many conferencing paradigm. Likewise, the student with high levels of social anxiety may also prefer an emotionally safer mode that allows them to continue to play the role of the so-called wall flower. The reflective thinker, sometimes referred to as a lurker in online parlance, may share some of the same preferences for isolation, but for different reasons. It seems quite probable that these learning environments also influence the student's perceptions of threat and resulting levels of arousal when they seek support, and need to examined in light of these differences (Cronbach and Snow, 1977).

Student Perceptions in Self-Reports Assessments

Any study which uses self-report measures of student anxiety, confidence, and perceived preferences for support must of necessity admit the possibility of error or limitations in student responses. In a literature review of self-report assessment of students, Assor and Connell (1992) point out the need to be sensitive to student self-perceptions and their needs to perhaps ignore negative components of a situation when not doing so would be detrimental to their self image. Students, like anyone else, may inadvertently alter their perceptions of reality to protect their self-image.

Dangwal & Mitra (1999) found discrepancies between students' self perceptions of their own learning styles and the way other persons assessed the students' learning styles. In another study, Kruger and Dunning (1999) found that unskilled students have overly favorable views of their own abilities. This lack of self-awareness occurred most often among those with the greatest deficits in relevant skills, and they found that improving relevant skills reduced the students' over-estimation of their abilities. They claim that overestimation due to incompetence leads one to a dual burden. The person who is incompetent may not only fail at a given strategy, but also lack the ability to recognize their own deficiencies in skills.

Tapin, et al. (2001) examined academic help-seeking strategies of high and low achievers in a distance learning setting. In a series of questions that reflected instrumental and executive types of strategies, they found that the high achievers more often asked for instrumental help which is process oriented and places more responsibility on the student than on the help than does executive help. In their findings, instrumental strategies are more efficacious than executive level help. Except for questions clearly related to course work, the majority of their students sought help from family, friends, or other students.

Summary

It is clear, that when they come up against difficult situations, computer anxious students will probably behave differently from their non-anxious counterparts, and that those (regardless of anxiety levels) with a greater repertoire of experience will have more options for support to choose from. Greater levels of computer experience are likely to give the student a greater appreciation of the potential uses of whichever specific technology they prefer and learn to understand; this alone may help reduce their anxiety about the technology itself and possibly give them greater confidence in perfecting and enhancing their related skills.

The student's pattern of behavior in times of trouble may vary just as much in intensity as they do by type of anxiety, that is whether the anxiety is about the computer itself, the self-evaluations they make about themselves in the social, or communication settings they find themselves in, or all of these.

Greater expertise should give greater confidence in the face of frustrating situations, but will it? Is there some unique, or idiosyncratic combination of types and degrees of computer anxieties and technical experience that will reveal patterns in selections of support options, and will some combinations give greater confidence to the users than others?

Students' beliefs about the efficaciousness of various types of mediation of help may well vary depending on how much confidence they place in either interactive technology, printed materials, or other people to give them adequate information; or in their own ability to use technology to extricate themselves from problematic situations.

Support information or intelligence can be designed to provided a multitude of ways to get help, mediated by humans or machines, but the question remains as to how students will choose to get their help, and when they get the help they choose, whether it will give them a boost in confidence.

CHAPTER III

METHODOLOGY

The purpose of this study is to examine the relations among computer anxiety and student preferences for scaffolding in computer-mediated learning environments. Presented in this chapter is the outline of the research methodology, including the research questions, research subjects, instrumentation, procedures for collecting data and finally the method of analysis.

Research Questions

This study addressed the following research questions:

Research question 1: Do students with different computer anxiety levels differ in their preferences for types of scaffolding (as measured in section C of Appendix B)?

Research question 2: Is there a difference in the student's independent confidence depending on their computer anxiety levels (section B of Appendix B)?

Research question 3: When scaffolding mediation options (section C) and assisted confidence (section D) are combined into *perceived confidence in scaffolding,* is there a difference in *perceived confidence in scaffolding* depending on the students' computer anxiety levels?

Research question 4: Is there a difference in the student's assisted confidence depending on their computer anxiety levels (section D of Appendix B)?

Research question 5: Is there a difference in the independent confidence before assistance and assisted confidence levels after assistance?

Assessment Tools

Computer Attitude Scale - Anxiety (CASA)

Computer anxiety was measured with the Computer Attitude Scale - Anxiety (CASA) a subscale of the Computer Attitude Scale (CAS) developed by Loyd and Gressard (1984a). This instrument was chosen because of its proven track record in reliability and (Loyd, & Gressard, 1984a; Loyd, & Loyd, 1985) and validity (Chua, Chen, & Wong, 1999; Gressard & Loyd, 1986; Loyd, & Gressard, 1984a; Loyd, & Gressard, 1984b; Woodard 1991).

The CASA instrument included ten items and each is rated on a four-point likert-like scale (Strongly Agree = 4, Slightly Agree = 3, Slightly Disagree = 2, Strongly Disagree = 1), with half of the items being reverse coded. The reliability coefficient (Alpha) for internal reliability is 0.90. Loyd and Gressard (1985) found that the correlation between low computer anxiety and high confidence was 0.92. This correlation indicates that lack of confidence in using the computer is also correlated with anxiety about using the computer and should serve as a check on the initial levels of independent confidence.

Development of the Assessment Package

Scaffolding Assessment

The student scaffolding assessment tool used here, *Computer Scaffolding Instrument* (Appendix D) was created by a research team (Bull & Overton, 2000; personal communication) and modified by the researcher, using feedback from various faculty and graduate students in the College of Education. This tool assessed the students' computer experience, independent confidence, perceived need for support, and assisted confidence. In the summer and fall of 2001 the Scaffolding assessment package was pilot tested with technical experts, a technical writing instructor, and English instructor, and students of various majors and levels. Formative feedback was gathered from instructors and outside professionals, as well as from students and non-students alike, of various interests, including professions in the distance learning area. Students and teachers completed the package and provided think-aloud feedback as they proceeded through each section. These comments and suggestions led to improvement in the layout and readability of the end product.

Perceived Confidence in scaffolding

Based on a review of the literature, other instruments, and discussions with other professionals, a two page assessment tool was designed to ascertain the 1) students' perception of their level of experience, 2) students' independent confidence that they can independently improve their performance at each task, 3) the one type of help (a vote) that the students feel/believe that they need most in order to improve their level of performance, and 4) their assisted confidence that they could successfully complete the tasks with the help they had chosen in the prior section.

Task List and Experience Response – Section A

Since quantity and diversity of experience are both important, the amount of experience queried (in section A) across each of the tasks derived from the literature on computer self-efficacy (Karsten & Roth, 1998), and computer experience (Potosky & Bobko, 1998), with scores representing both amount and diversity of experience (greater range of skills) at the relevant tasks that will be used in a hypothetical online learning course. The list includes twenty-one computer-related tasks related to 1) using software alone, 2) using software and hardware, and 3) using software for tasks related to the Internet. These are:

1. Use word processing software such as Microsoft Word, Word Perfect, etc.
2. Subscribe to, and participate in a Listserv
3. Manipulate data, e.g., Excel, Access, Lotus 1,2,3, etc.
4. Use presentation software, e.g., Power Point, Photo Delux, Illustrator, or similar
5. Use design programs, e.g., Netscape Composer, Lotus Domino, Page Mill, Front Page, etc to create a web page
6. Use Email programs
7. Talk to others in an online chat room

8. Talk to others using an Internet telephone
9. Install and use a web cam on your computer
10. Download files from the Internet
11. Use drawing programs to create your own artwork
12. Browse and search the Internet for academic articles
13. Add a printer and the printer related software
14. Create folders, save, rename, and copy files on your computer
15. Download and install software to use streaming audio or video
16. Use threaded discussion data bases for academic group discussions
17. Use one of the instant messaging services
18. Install software on your computer
19. Use FTP to upload a file
20. Install a modem and its software
21. Use Boolean logic with an online search engine to find information on the web

Independent Confidence Response – Section B

Section B assesses the students confidence in improving skill level when they are asked to respond to the statements in Section B as follows:

> For your online course work you need to learn to perform better in each area below. Consider each task and mark how much confidence you have that you can improve your performance at each task independently, on your OWN:

Student response options included: a. None; b. Very little; c. A small amount; d. A moderate amount; e. A lot; and f. Absolute.

Categories for Mediation of Support – Section C

Section C ascertained the students' preferred type of help, which amounted to their preferred mediation for help. The nine options for help are listed below, along with the categories of mediation for each. Students responded to this section as shown below:

C. For each item below circle the ONE type of help you need most in order to **improve your level** of performance:

I prefer help from:

a. a friend

b. a tutor or nearby expert

c. a teacher

d. drop-down help windows

e. instructions/FAQ's from Internet/online

f. an intelligent program

g. an instruction manual

h. a manual such as *Windows for Dummies*

i. a comprehensive textbook/program or course

These nine response options were subsequently collapsed (Shavelson, 1988) into three categories for types of mediation of support: human support (HS - options 1 through 3), machine support (MS - options 4 through 6), and paper support (PS - options

7 through 9). These options are thought to reflect the differences in interactivity and complexity in types of support options that are commonly used in the electronic classroom. These response options are categorized below, by type of mediation used:

Human Support mediation (HS)

1) Friend (FD)

2) Tutor (TU)

3) Teacher (TE)

Machine Support mediation (MS)

4) Drop Down (menus) (DD)

5) Search Internet (SI)

6) Interactive Intelligent (II)

Paper Support mediation (PS)

7) Instruction Manual (IM)

8) After-market (AM)

9) Textbook (TB)

Assisted Confidence Response – Section D

Section D assessed the students' after-scaffolding confidence in conjunction with their scaffolding type of mediation chosen in section C; it is the scaffolding-dependent response that reflects the students' final perceptions of their confidence in their abilities to use the scaffolding (support) option in Section C in order to improve their skills.

D. Given that you have the type of help specified in column **C**, how much confidence do you have that you could successfully complete the activity:

Students responded to the items in section D with the following options: a. None; b. Very little; c. A small amount; d. A moderate amount; e. A lot; and f. Absolute. These responses corresponded to ranged from a = 1 to f = 6. It was thought that after having been given the access to preferred scaffolding option, student confidence levels might increase, especially among those most anxious.

The different tasks would elicit different levels of independent confidence (while working alone), as measured in section B of the instrument, and that different tasks could also elicit different perceptions about needs for support when it came to increasing ones level of competence. It was also thought that the student's level of computer anxiety might influence the students choice of support by mediation. If this were true it, could also show up in confidence levels being different depending on the particular type of task under consideration. So, while section D measures the *final* confidence for all tasks, *perceived confidence in scaffolding* would be the result of the student's perceived optimal support and final confidence while working on that task. The assumption was that the perceived confidence in scaffolding means would differ for high and low computer anxiety students

The students' perceived level of (prior) experience, as measured by responses in Experience Section A, was expected to influence their initial independent level of confidence in independently learning new skills, as measured in Section B. Both of these (along with levels of computer anxiety) were expected to be related to student preferences for type of mediation of support (scaffolding as measured by Section C). It was thought that after having selected their preferred support option that the student's could express an increased level of confidence (as measured in section D), and be reflected in assisted confidence in using learning to perform the tasks with access to scaffolding (in Section D). Finally, responses in Sections C and D were used to represent the *perceived confidence in scaffolding* concept.

Procedures for Collecting Data

A purposive sampling method was used to assess Oklahoma State University students from various classes to reach a wide range of majors from undergraduate degree programs. Since information may be most useful from those with lower levels of computer experience and minimal exposure to online types of mediated learning, an attempt was made to use students in lower level courses.

Participants included a total of 612 students, with equal numbers of males and females, collected from 25 sections of classes in the College of Arts and Sciences (Psychology, English, Technical Writing), College of Education (Child and Adolescent Development, World of Work), and the College of Business Administration (MSIS). The complete package, consisting of the demographic sheet, Computer Anxiety Scale, and the Computer Scaffolding Instrument, was administered during class time between October 11, and 18, 2001, and took about fifteen minutes to complete. The oral consent statement (Appendix A) was read. Upon consent, the complete package was passed out to the students, which consisted of a demographics sheet (Appendix B), the Computer Attitude

Scale - Anxiety (CASA) from Loyd and Gressard (1985) (shown in Appendix C) and the Computer Scaffolding Instrument.

The point was made to the students that they were not under any obligation to participate, but if they did so, the nature of this research was such that their responses could not be properly analyzed unless they completed the entire package. To the best of the researcher's knowledge, only one person knowingly declined to participate. Completing the entire package required concentration and some students seemed to become bored or fatigued, and failed to complete all the parts. Some missed major sections, or an entire page. Others failed to fill out the computer anxiety instrument, so in all about thirty packages were discarded as unuseable.

Research Participants/Subjects

Procedures for Analysis

For administration of the survey an oral script approved by the Institutional Review Board was read to explain to students their rights. The were informed that the purpose of the study is to gain a better understanding of their support needs for online learning courses in which they may be expected to work largely from home. This explanation was used to create the initial mind set, and provide the setting to help clearly establish the context from which the students should make their responses. The CASA and the scaffolding package were assembled in an alternating order, and the order of the task items was also alternated (reversed order) and handed out in a *Latin Squares* method in order to reduce the effect of conditioning, fatigue, etc. on responses.

Certain of the demographic questions served as confirmation for the research results. It was thought, for example, that the questions of age and level within the university may reflect the level of the student's computer experience and confidence with computers.

The data were entered into SPSS for analysis and checked for errors of encoding and missing data. All of the returned packages that had any data missing were discarded. Exploratory tests were run to examine the shape of the data distribution, and examine any irregularities; these tests also aided in finding data input errors. Summary data were analyzed for each component. As was expected, the computer anxiety distribution curve was almost an inverted U shape on the high anxiety end of the scale range (13 in this case), but leveled out on the low computer anxiety end, indicating a population of students with very low anxiety levels. This information was relevant in determining what tests could be run on the data-set. Reliability tests were run for the computer anxiety scale, and on each section of the assessment package, along with correlations between all the parts (computer anxiety, computer experience, independent computer confidence, and the resulting computer confidence).

The scores from the CASA instrument were then used to divide the students into two groups with a median split of the population, creating high and low computer anxiety groups (CAGs). As is often done in anxiety studies (Cronbach and Snow, 1977; Sieber, et al. 1977), the scores from the CASA instrument were used to divide the total population of 612 students into two approximately equal size groups, based on a median split on the range of scores, with 315 (with scores of 13 to 35) students in the high computer anxiety group (HCA), and 297 (with scores of 36 to 40) in the low computer anxiety group (LCA). The CASA instrument was created to be used along with a set of instruments in which higher scores represent more positive attitudes, and that standard has been kept, such that the higher the CASA score, the lower is the student's computer anxiety (more positive their attitude).

The students' *choices for support*, which consisted of one of nine possible support options for each of the 21 tasks, are referred to here as their *vote(s)*, and represent their perceived need for support, and is essentially their task-specific votes for support. Since there were 21 tasks for each student to evaluate, the number of possible votes of support, by a given option, could vary from zero for a specific support option (no votes for machine support, for example). They could, also have up to 21 votes, for example, for the use of human support regardless of task. These counts of votes were used in the comparisons of the two different computer anxiety groups as they voted for each task.

Even though it was not expected that students would all vote for the same method of support, the SPSS non-parametric goodness of fit test, with a Pearson Chi Squares test of significance analysis was performed to test for a significant difference in the patterns, or distributions of preferred votes for support on each of the 21 different tasks, and compared for the entire student population as well as for high (HCA) and low (LCA) computer anxiety groups. In order to adequately and clearly discuss the results by contectualized tasks, the 21 tasks were factor analyzed, which reduced the number of tasks to three typical tasks : 1) Presentation and Production, 2) Communication, and 3) Technical tasks.

Votes by Mediation of Support

Of interest here was the mediation through which support was to be provided, not simply preferences for support options themselves. Because there were 189 possible combinations of 21 tasks (later three task-factors) by 9 support options (or three types of mediation), it was also necessary to collapse (combine) the nine support options into their respective forms of mediation preferred for the task-specific support. These are then referred to here as *votes for scaffolding* and later as *perceived confidence in scaffolding* when detailing the students differences in confidence in these specific task-support settings. For use in Chi Square, non-parametric analysis, the original nine forms of support were collapsed into three new levels of *mediation of support:* 1) human, 2) machine, and 3) paper-based support methods (Shavelson, 1988). This allowed the researcher to reduce excessive information while also expressing the nature of support in terms of the mediation involved. For purposes of clarity, the original nine possible types of support, are referred to as *options of support* until they are reduced (collapsed) to three options based on *mediation of support*, referred to as human, machine, or paper mediations of support. Examined in this way they tell us something about the mediation, rather than the task per se.

Task-Factors

A factor analysis, with oblique Harris-Kaiser rotation (Gorsuch,1983), was run on the 21 scaffolding support options to reduce the number of tasks, clarify the concepts involved and simplify the final interpretation. The original tasks were reduced to three conceptually relevant task-factors (equivalent concepts) that are called: 1) the Technical Factor, 2) the Communication Factor, and 3) the Production & Presentation Factor Gorsuch, 1983). The factors are shown below and a table of the factor loadings is also given in Appendix F.

The six tasks that went into the Technical task-factor (Tech):

Task 9. Install and use a web cam on your computer

Task 13. Add a printer and the printer related software

Task 15. Download and install software to use streaming audio or video

Task 18. Install software on your computer

Task 19. Use FTP to upload a file

Task 20. Install a modem and its software

The five task that went into the Production and Presentation task-factor (P&P):

Task 1. Use word processing software such as Microsoft Word, Word Perfect, etc.

Task 2. Subscribe to, and participate in a Listserv

Task 3. Manipulate data, e.g., Excel, Access, Lotus 1,2,3, etc.

Task 4. Use presentation software, e.g., Power Point, Photo Delux, Illustrator, or similar

Task 5. Use design programs, e.g., Netscape Composer, Lotus Domino, Page Mill, Front Page, etc. to create a web page

Six tasks that went into the Communication and Communication Tools factor:

Task 6. Use Email programs

Task 7. Talk to others in an online chat room

Task 8. Talk to others using an Internet telephone

Task 10. Download files from the Internet

Task 12. Browse and search the Internet for academic articles

Task 17. Use one of the instant messaging services

Four tasks were ambiguous and failed to load cleanly on any one factor but partially loading on two or more factors:

Task 11. Use drawing programs to create your own artwork

Task 14. Create folders, save, rename, and copy files on your computer

Task 16. Use threaded discussion data bases for academic group discussions

Task 21. Use Boolean logic with an online search engine to find information on the web

The number of votes, by mediation of support, for each of the newly conceptualized tasks, is computed yielding these categories, each of which was then compared individually by computer anxiety groups:

Technical factor–human support (TFHS)

Technical factor–machine support (TFMS)

Technical factor–paper support (TFPS)

Communication factor–human support (CFHS)

Communication factor–machine support (CFMS)

Communication factor–paper support (CFPS)

Production and presentation factor–human support (P&PHS)

Production and presentation factor–machine support (P&PMS)

Production and presentation factor–paper support (P&PPS)

Non-parametric, Chi Squares analysis was run individually on each of the scores for each of these new variables. These nine *task–factors by mediation of support* combinations were analyzed individually by their counts, similar to the overall simple tally of votes discussed above, in order to answer research question 1 about differences in choices for each of the nine types of task-factor-by-support options. These numbers were used to compute the crosstabulations used in research question 1. Then to answer the question about *perceived confidence in scaffolding* (research question 3), the associated assisted confidence was used in place of counts in order to calculate the confidence placed in each possible task–factor and its respective support mediation as shown above. Values for the computation of the Chi-squares were derived from the count feature in SPSS and the results were compared by computer anxiety groups. Each of the nine task-factor-by-support combinations was compared by computer anxiety groups to test for differences between the two populations, rather than testing for differences between the combinations themselves. See the diagram below for a more visual representation of the manipulations made:

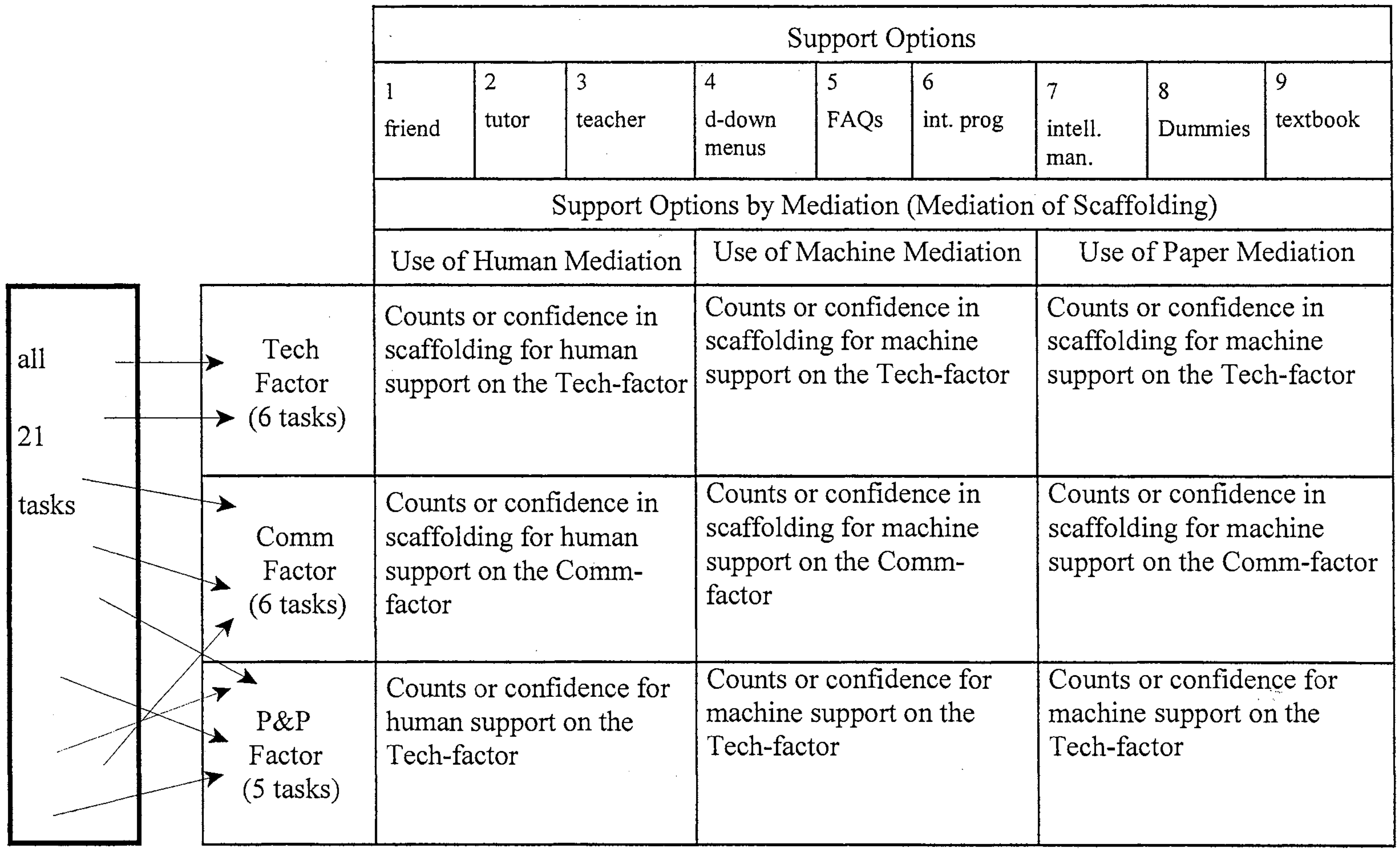

Figure 1. Derivation of task-factor support constructs for comparison by Computer Anxiety Groups.

Perceived Confidence in Scaffolding

Perceived confidence in scaffolding, as the term is used in this research, refers to the amount of student confidence in each of the nine specific task-by-support possibilities. In order to analyze the student's perceived confidence in scaffolding, the mean scores for assisted confidence were used to calculate the respective confidence-in-scaffolding scores, on all the tasks that went into each respective task-factor. These are task-by-support specific confidence measures. These *perceived confidence in scaffolding* scores were computed for each of the task-factors for each appropriate support mediation; then these variables were compared by the computer anxiety groups using a t-test to test for differences between high and low computer anxious students.

Independent and Assisted Confidence

The independent confidence and the assisted confidence were also computed and then compared for each computer anxiety group. But, the difference between the overall independent and assisted confidence, referred to as *gain in confidence*, was also compared, first overall, then compared by the high and low computer anxiety groupings.

CHAPTER IV

RESULTS

Data used in this research were collected from 612 undergraduate students in a mid-western university and analyzed using SPSS. The overall results are reported and then, since the research questions primarily focus on the differences in varying levels of computer anxiety, the emphasis will shift to report the results that are related to the differences between higher and lower computer anxiety groups (HCA – LCA). The demographic information is presented first, followed by the research questions.

Demographic Results

Participants were 612 students, with equal numbers of males and females, from 25 sections of classes in the Colleges of Arts and Sciences, Business, and Education. Ninety-six percent of the students were under the age of 25, and 91% were single. The term partnered was included as an option for the gay/lesbian community in the Marital choices. The question about marital status was included based on the thinking that married students may have their own support system. One of the students asked about the term partnered and commented that she had checked the partnered option, when in fact she was living with a male student.

By college of enrollment, the largest single group of students (55%), came from the College of Business Administration, the remaining 45% from many departments in other colleges. Almost 22% of the students were freshmen, 40% sophomores, 18% Juniors, and another 20% seniors. By computer platform, 91% were primarily IBM/compatible users, where the remaining 7% were MacIntosh users.

Ethnic and national background was 84% (513) Caucasian, with 7% (42) Native American, and 4.3% (26) African American, with miscellaneous others. The Other option was mostly marked by the few international students composing this sample.

Since the interest here is in students learning via non-traditional delivery methods, they were asked about alternative methods of delivery, and 59% had not taken courses with other methods, compared to 41% who had taken one or more courses with alternative methods.

Reliabilities

Cronbach's Alpha reliability of the CASA instrument as used in this study was found to be .91. Alpha reliability for the computer experience section was .92 with a standardized item reliability of 0.91. The mean score overall, for computer experience was 66.03, and a standard deviation of 16.20. Alpha reliability for the independent computer confidence section was found to be .95, with a mean score of 84.57, and a standard deviations of 26.68. Alpha reliability for the assisted confidence section was .97, with a mean score mean of 100.02, and a SD of 20.48. Table 1 below lists more specifics of each component of the assessment package.

Table 1

Summary Table for Demographic Variables of Interest

	Alpha	Mean	SD	N
Computer anxiety	0.92	33.75	5.97	612
Computer experience	0.92	66.03	16.2	569
Independent computer confidence	0.95	84.57	26.68	558
Resulting computer confidence	0.97	100.02	20.48	582

The statistics for the main variables of interest in this study are summarized in Table 2 below:

Table 2

Descriptive Statistics for Demographic Variables of Interest by Computer Anxiety Grouping

	Computer anxiety group	N	Mean	Std. deviation	Std. Error mean
Total experience	HCA	292	59.63	14.29	0.84
	LCA	277	72.78	15.35	0.92
Total independent confidence	HCA	283	75.46	22.14	1.32
	LCA	275	93.95	21.49	1.30
Total assisted confidence	HCA	293	92.75	20.88	1.22
	LCA	289	107.39	17.21	1.01
Amount of change in confidence	HCA	265	16.604	22.12	1.36
	LCA	268	12.914	18.969	1.16

Age

Students varied little in age range, with 95.6% of them under 25 years of age (in age group 1 and age group 2) and 97.7% of students were thirty years of age or under (the first three age-groups).

Table 3

Population of Age Groups by Sex

Age groups	Male	Female	Total
Less than 20	130	166	296
20 - less than 25	161	128	290
25 - less than 30	8	5	13
30 - less than 35	3	1	4
35 - less than 40	–	1	1
40 - less than 45	2	2	4
45 or older	2	3	5
Totals	306	306	612

An initial examination revealed that there were too few students in the last four age groups (age 35 and up), so the older age groups were simply collapsed into one category since many statistical procedures cannot best analyze extremely small group sizes, or empty cells. For statistical purposes, those over 25 years of age were collapsed into group 3, ages 25 and up. Table 4 below, shows the composition of the three new age-groupings after collapsing all of the older students into one group of 27 students.

Table 4

Population of Three Age Groups by Sex

Age groups	Male	%	Female	%	Total	Total %
Less than 20	130	42.5	166	54.2	296	48.4
20 - less than 25	161	52.6	128	41.8	290	47.2
Older than 25	15	4.9	12	3.9	27	4.4
Totals	306	100	306	99.9*	612	100

* Total does not equal 100% due to rounding

The three new age groups were used as three factors and computer anxiety, prior computer experience, and independent and assisted confidence were analyzed as dependent variables. This method does not however imply an endorsement of the idea that the factors are themselves causative in nature. The Analysis of Variance table, Table 5 below, shows which of the major variables of interest are significant at some level within the age groups.

Table 5

Analysis of Variance for Demographic Variables of Interest by Each Age Group

Variable		Sum of Squares	df	Mean Square	F	Sig.
Total computer anxiety	Between groups	301.53	2	150.77	4.28	.014
	Within groups	21,467.70	609	35.25		
	Total	21,769.24	611			
Experience	Between groups	2,145.34	2	1,072.67	4.13	.017
	Within groups	146,955.15	566	259.64		
	Total	149,100.49	568			
Independent confidence	Between groups	444.91	2	222.46	0.40	.673
	Within groups	311,889.57	555	561.96		
	Total	312,334.49	557			
Assisted confidence	Between groups	1,760.21	2	880.11	2.12	.123
	Within groups	242,005.54	579	417.97		
	Total	243,765.75	581			
Gain in confidence	Between groups	241.99	2	120.10	0.28	0.754
	Within groups	226,824.32	530	428.00		
	Total	227,066.31	532			

Table 5 above shows that the student's age is related to both computer anxiety and prior experience, but not to the three confidence variables. Table 6 provides means and statistics for computer anxiety, prior computer experience, independent confidence and assisted confidence by each of the age groups.

Table 6

Means and Statistics for Demographic Variables of Interest by Age Groups

Age groups	Statistics	Total computer anxiety*	Experience*	Independent confidence	Assisted confidence
Less than 20	Mean	34.48	67.55	85.40	101.71
	N	296	273	267	275
	Std. deviation	5.69	16.16	23.2	19.61
20 - 25	Mean	33.07	65.19	83.63	98.23
	N	289	269	264	282
	Std. deviation	6.12	16.23	23.98	21.25
Older than 25	Mean	33.19	59.04	85.63	101.64
	N	27	27	27	25
	Std. deviation	6.60	14.27	25.88	20.16
Total	Mean	33.75	66.03	84.57	100.02
	N	612	569	558	582
	Std. deviation	5.97	16.20	23.68	20.48

* Indicates the variables with significant main effect

Mean computer anxiety scores differed significantly among the three age groups, $F(2,609) = 4.277$ $p = .014$, with a Tukey post hoc analysis indicating that the youngest students were significantly less computer anxious (had a higher value) than the two older groups. Interestingly, there was also a corresponding reversal in trends in the sex composition of the student's age-group, with the younger group (20 years and under) containing proportionately more females than did group two which had more males. In addition, the post hoc analysis showed that the oldest students felt they had the least amount of computer experience.

An Analysis of Variance (ANOVA) for computer anxiety, when measured across the three age groups, indicated that the youngest students are significantly less computer anxious than the other two older age-groups. Table 7 indicates that, in terms of computer anxiety, the only significant difference between the age-group levels is between the youngest group and the two oldest groups (p = .012).

Table 7 shows that significant differences in mean scores for computer anxiety, for the three age groups, only exist between the youngest age group and the two older groups

Table 7

Multiple Comparisons of Means of Computer Anxiety for Each Age Group

(I) Three age groups	(J) Three age groups	Mean difference (I-J)	Std. Error	Sig.
Less than 20 *	20 - less than 25	1.41	0.48	0.012
Less than 20	Older than 25	1.29	1.17	0.694
20 - 25	Older than 25	-0.12	1.18	1.000

* Indicates significantly different subgroups

Neither means for independent confidence levels, nor assisted confidence levels of the three age groups varied significantly. But the means for level of prior computer experience did vary across the three age groups, F (2,566) = 4.131, p = .018, with the post hoc analysis showing that the older age-group students had significantly more experience than did the two younger age-groups, with a significant difference existing between the oldest age group, with the least amount of experience and the youngest group with the most computer experience (p = .018).

College Level

By college level, the majority of the respondents were lower level, with over 60% of students coming from the first two years in college.

Table 8

Composition of Students by Year in College

Year in college	Males	Females	Total	Percentages
Freshman	59	73	132	21.56
Sophomore	115	130	245	40.03
Junior	70	43	113	18.46
Senior	61	60	121	19.77
Total	306	306	612	99.82*

Total does not equal 100% due to rounding

Table 9 below shows the means for each of the college levels for each of the major variables of interest in this study.

Table 9
Means for Demographic Variables of Interest by College Level

College level		Computer anxiety	Experience	Independent confidence	Assisted confidence
Freshman	Mean	34.37	63.81	80.41	100.19
	N	132	122	118	122
	Std. deviation	5.83	17.44	26.61	22.29
Sophomore	Mean	34.26	68.66	86.57	99.51
	N	245	226	224	234
	Std. deviation	5.68	15.10	20.84	20.52
Junior	Mean	33.36	66.76	86.46	101.33
	N	113	109	108	108
	Std. deviation	5.87	16.26	24.16	18.55
Senior	Mean	32.43	62.42	83.10	99.65
	N	122	112	108	118
	Std. deviation	6.57	16.10	24.96	20.35
Total	Mean	33.75	66.03	84.57	100.02
	N	612	569	558	582
	Std. deviation	5.97	16.20	23.68	20.48

Table 10 summarizes the significant differences that exist in the college levels for each of the major variables of interest. There were significant differences in group means for Computer Anxiety, Computer Experience, and in the Gains in Confidence, but not in Independent confidence or Assisted confidence.

Table 10

Pairwise Comparisons of Significant Variables Only

Dependent variable	(I) College levels	(J) College levels	Mean difference (I-J)	Std. error	Sig.
Computer anxiety	Freshman	Senior	1.907	0.788	.016
	Sophomore	Senior	1.836	0.691	.008
Experience	Freshman	Sophomore	-4.832	1.885	.011
	Sophomore	Senior	6.257	1.921	.001
	Junior	Senior	4.531	2.232	.043

a Adjustment for multiple comparisons: Tukey's Least Significant Difference (equivalent to no adjustments).

College of Enrollment

The college of enrollment was not a significant factor in the students' computer anxiety groupings (no significant differences between HCA-LCA groups). But overall, with computer anxiety as the dependent variable, college of enrollment was a significant factor at $F(6,603) = 2.99$, $p = .007$, indicating the computer anxiety levels differed across the colleges. College of enrollment was a significant factor in the student's increased gains in confidence at $F(6,524) = 2.74$, $p = .012$; greater levels of Experience $F(6,560) = 4.97$, $p = .000$; Independent confidence $F(6,549) = 4.05$, $p = .001$; and Assisted confidence $F(6,573) = 4.38$, $p = .000$. See Table 11.

Table 11

College of Enrollment

Colleges	Male	Female	Total
College of Agricultural and Environmental Sciences	27	21	48
College of Arts and Sciences	43	79	123
College of Business Administration	185	153	338
College of Education	21	12	33
College of Veterinary Medicine	–	–	–
College of Human Environmental Sciences	3	32	35
College of Engineering Architecture and Technology	26	4	30
University Academic Services (write in)	1	3	4
Undecided (write-in)	–	1	1
Totals	306	305	611

Means of students computer anxiety are given below for each of the colleges:

Table 12

Means for Computer Anxiety by Colleges

College	Mean	Std. dev.	Std. error	N
College of Agricultural and Environmental Sciences	32.21	6.706	0.854	48
College of Arts and Sciences	33.66	5.805	0.536	122
College of Business Administration	34.19	5.726	0.322	338
College of Education	31.76	7.483	1.030	33
College of Human Environmental Sciences	31.74	6.275	1.000	35
College of Engineering Architecture and Technology	36.17	4.379	1.080	30
University Academic Services (write in)	33.25	7.890	2.959	4
Totals	33.75	5.975	0.242	610

Sex

Even though there were equal numbers of males and females overall, there were significantly more female students in the most computer anxious group (HCA), with 183 females compared to only 132 males, and hence fewer in the least anxious group (LCA), with only 123 females and 174 males χ^2 (1, N = 612) = 17.015, p = .01). Table 13, below shows that there were significant sex-related differences in all the major variables of interest by computer anxiety.

Table 13

Test of Significant Differences in Computer Anxiety for all Major Variables of Interest by Sex of Student

Variable	t-test for equality of means t	df	Sig. (2-tailed)	Mean difference	Std. error difference
Computer anxiety	4.172	610	.000*	1.99	0.48
Experience	5.851	567	.000*	7.73	1.32
Independent confidence	4.571	556	.000*	9.01	1.97
Assisted confidence	2.402	580	.017*	4.06	1.69
Change in confidence	-3.059	531	.002*	-5.44	1.78

Means scores for each of the major variables differed significantly by sex and are shown in Table 14 below by sex of the student.

Table 14

Mean Scores for Demographic Variables of Interest Delineated by Sex of Student

Variable	Sex	N	Mean	Std. deviation	Std. error mean
Total computer anxiety	Male	306	34.75	5.51	0.32
	Female	306	32.76	6.24	0.36
Total experience	Male	278	69.98	17.06	1.02
	Female	291	62.25	14.39	0.84
Total independent confidence	Male	268	89.26	23.79	1.45
	Female	290	80.24	22.77	1.34
Total assisted confidence	Male	290	102.06	20.31	1.19
	Female	292	98	20.49	1.20
Amount of change in confidence	Male	257	11.93	20.4	1.27
	Female	276	17.37	20.59	1.24

Table 14 above shows that males had lower computer anxiety, more perceived prior Experience, greater Independent and Assisted confidence, but the females had a greater increase in confidence, referred to here as Gain.

A t-test, $t(610) = 4.172$, $p = .000$ (two-tailed), indicated overall that males were less computer anxious (with a mean of 34.75) than females (with a mean of 32.76). Overall, there was also a significant difference between independent confidence and assisted confidence, $t(532) = 16.481$, $p = .000$ (two-tailed), indicating a change or gain in confidence. While, there were also sex-related differences in both independent and assisted confidence, the sex of the student made a significant difference in their independent confidence, $t(556) = 4.57$, $p = .000$ (two-tailed) where the mean independent confidence score for males was 89.26 compared to a lower confidence for females of 80.24. While there was also a similar sex-dependent difference in resulting computer confidence scores was somewhat less t (580) = 2.402, p = .017 (two-tailed) with a mean confidence score for males of 102.06 and females of 98.00.

In addition, there was also a significant sex-dependent difference in the changes between independent and assisted confidence (gain in confidence). That is, there was an *overall* mean difference of 14.75 between the independent and assisted confidence scores; where the male mean Gain was 11.93, but the female mean gain was 17.37, showing a greater increase or benefit from assistance. These results lead one to believe that there may be a greater improvement in confidence for the female students as a result of being offered support, which implies that females in particular, or those with lowered confidence in general, may benefit the most from the availability of support.

Alternative Delivery Methods of Instruction

The question about alternative methods of instructional delivery included this question:

> Have you ever taken: 1) correspondence study course 2) Independent study 3) satellite or Television course, or 4) computer based/delivered.

Those who did not mark anything were coded as none (0), while those who entered any of the optional methods were coded as one or more (1). A majority of students, (58.8%) had not taken courses by alternative delivery methods, while 41% had taken one or more courses by these alternative delivery methods. Those who took courses by alternative delivery methods had significantly lower computer anxiety, t (610) = 2.36, p = .019 (two-tailed), and scored higher on both computer experience, t (567) = 3.11, p = .002 (two-tailed); and independent confidence, t (556) = 2.39, p = .017 (two-tailed). However there were no significant differences in the levels of Assisted confidence.

Table 15 shows the results of recoding (collapsing) as used in further analysis.

Table 15

Alternative Delivery Methods

Number	Male	Female	Totals
None	169	192	58% (360)
1 or more	130	113	35.3% (216)
Total	306	306	100% (612)

In Table 16 below, the t-test of the means for each of the major variables of interest showed that having taken a course by alternative delivery methods is associated with lower computer anxiety, more experience, and higher levels of independent confidence.

Table 16

t-test for Difference in Means of Demographic Variables of Interest by Alternative Delivery Methods

	t-test for equality of means		
Major variables of interest	t	df	Sig. (2-tailed)
Total computer anxiety *	-2.359	610	0.019
Total experience *	-3.108	567	0.002
Total independent confidence *	-2.393	556	0.017
Total assisted confidence	-1.463	580	0.144
Amount of change in confidence	1.360	531	0.174

Formal Computer-related Courses Taken

The question regarding *Computer-related Courses Taken* included the option: Have you taken formal computer courses in college/university? If yes, please indicate below:

1) Programming, 2) Word Processing, and 3) Other: (please describe below).

The responses ranged widely from the expected responses such as word processing and programming, to CAD and HTML courses. Some respondents simply wrote in too many to list. Because of the large number of diverse responses that were written in, each option checked or written in was summed and the totals were entered into the data set. Their totals were also recoded, as above into none (zero), or some (1) to be used for analysis.

A total of 59.8% of students had never taken any other formal computer courses, and 40% had taken one or more formal courses, and 34.5% of the students had marked that they had taken only one other course, leaving only about 6% of the students who had taken more than one other formal course (Table 16). Those who had taken more than a few computer related courses were too few to really consider as groups, but still, computer anxiety appeared to drop between none and three courses. These group sizes were too small so they were converted to two groups of None or One or more as shown in Table 17.

Table 17

Computer-related Courses Taken

Related courses taken	Male	Female	Total	
None marked	167	199	59.8%	(366)
One related course	111	100	34.5%	(211)
Two related courses	23	5	4.6%	(28)
Three related courses	4	1	0.8%	(5)
Four related courses	1	–	0.2%	(1)
Five or more related courses	–	1	0.2%	(1)
Totals	306	306	100%	(612)

The chi square test indicated that males had taken more formal computer related courses, χ^2 (5, N = 612) = 18.743, p = .002, than had female students. Those who had taken formal computer courses also scored higher on both Computer Experience t (567) =

2.65, p = .008 (two-tailed) (see Table 18) and Independent confidence at t (556) = 2.97, p = .003 (two-tailed), (see Table 18).

Table 18

Computer-related Courses Taken -Revised

Related courses taken	Male	Female	Total	
None marked	167	199	59.8%	(366)
One or more related course	139	109	40.5%	(248)
Totals	306	306	100%	(612)

Whether or not a student had taken a computer-related course seems to be related to their experience and confidence but not so much to their computer anxiety.

Table 19

t-tests for Differences in Demographic Variables of Interest by Computer-related Course

	t-test for equality of means		Sig. (2-tailed)
Variables	t	df	
Total computer anxiety	-1.345	610	0.179
Total experience *	-2.654	567	0.008
Total independent confidence *	-2.974	556	0.003
Total assisted confidence	-1.459	580	0.145
Change in confidence *	2.486	531	0.013

* Indicates significant difference

The means for each group are given below:

Table 20

Means for the Demographic Variables of Interest by Computer-related Courses

No. of computer related courses		Computer anxiety	Experience*	Independent confidence*	Assisted confidence
None	Mean	33.49	64.57	82.2	99.01
	N	366	343	340	348
	Std. deviation	6.01	15.66	23.29	21.08
One or More	Mean	34.15	68.24	88.27	101.53
	N	246	226	218	234
	Std. deviation	5.89	16.78	23.87	19.5
Total	Mean	33.75	66.03	84.57	100.02
	N	612	569	558	582
	Std. deviation	5.97	16.2	23.68	20.48

The Computer Attitude Scale - Anxiety (CASA) and Reliability

Computer anxiety, as measured by Loyd and Gressard's Computer Attitude Scale - Anxiety (CASA) instrument, showed very little overall computer anxiety among the Oklahoma State University students. The overall mean score computer anxiety of 33.75 was roughly comparable to that of other studies. Oklahoma State University students appear to be a little less anxious about using computers. Among the 50 most anxious students, those with score of 23 or less, 35 were females and only 15 were males.

Alpha reliability of the CASA instrument as used in this study was found to be .89 which compares well with the findings of the creators of the instrument (Loyd, and Gressard, 1984; Loyd, and Loyd, 1985; Gressard, and Loyd, 1985).

Computer Anxiety

Loyd and Loyd (1985) reported a mean score of 32.1 based on a pool of 114 teachers. In another study, by Gressard and Loyd (1985), 196 teachers in a computer course, with a pre and post measure of computer anxiety had means of 29.83 and 33.36 respectively. Mean computer anxiety score for this sample was 33.75 with a median of 35 which may be a little less anxious than the average population due to greater computer experience in high school and college.

Overall, there was a significant difference between the male and female computer anxiety, at $F(1,612) = 17.409$ $p = .000$.Computer Anxiety in this study was found to be 33.75, with a standard deviation of 5.97, indicating a slightly lower level of computer anxiety among males (a mean score of 34.75) and a little higher computer anxiety among females (a mean score of 32.76), .

Anxiety, Arousal, and Splitting Students

Cronbach and Snow (1977) discussed the use of Aptitude Treatment Interaction (ATI) in situations where the population is expected to perform differentially on a given factor, and Sieber, et. al (1977) used ATI in a similar fashion for their work on anxiety in instruction. In line with their research on anxiety, the Yerkes-Dodson (1908) arousal-performance curve, an inverted U curve, suggests that there are approximately three combinations of arousal and performance conditions. First, those who are on the lower side of the arousal curve are under-aroused and can be thought of as less mentally and physically primed, and less ready for performance; they are non-attentive, etc. In the middle of this theoretical continuum, at the peak of the curve, is the second group, those who are at medium levels of arousal and their minds and bodies are fully alert, functional and more likely to be motivated. The psychological state of flow (Csikszentmihalyi, 1996) can occur in this state. To the extreme on the continuum, is the third group, those who are most aroused, and usually described as being excited, agitated, and perhaps in a state of panic. The third group consists of those who are over-aroused, and may be easily overstimulated, if they aren't already. Those who are on the opposite ends of the arousal-performance curve behave differently. This is the ideal setting for the analysis of the two extremes of population.

As is often done in anxiety studies (Cronbach and Snow, 1977; Sieber, et al. 1977), the scores from the CASA instrument were used to divide the total population of 612 students into two approximately equal size groups, based on a median split on the range of scores with 315 (with scores of 13 to 35) students in the high computer anxiety group (HCA), and 297 (with scores of 36 to 40) in the low computer anxiety group (LCA). The CASA instrument was created to be used along with a set of instruments in which higher scores represent more positive attitudes, and that standard has been kept, such that the higher the CASA score, the lower is the student's computer anxiety (more positive their attitude).

The CASA instrument indicated that the vast majority of the students were not in fact, computer anxious. This was somewhat of a problem for the researcher, in that there were so few computer anxious students to create balanced groups for analysis. In fact 539 students, or 88 percent of the students were above the midpoint of the scale (a mean score of 25).

Computer anxiety scores varied by college level F (5,611) = 2.233 p = .050, college of enrollment, F (7,610) = 2.561, p = .013, whether or not the students had taken courses by alternative delivery methods (Non-traditional) F (4,612) = 2.066, p = .084).

Creating Computer Anxiety Groupings (CAG)

SPSS was used to median split of the student population into two approximately equal groups based on their computer anxiety (CASA) scores: Group1 - Highest Computer Anxious (HCA) and Group 2 - Least Computer Anxious (LCA). Because the scale was originally created to measure positive attitudes, scores of computer anxiety are inversely related to actual computer anxiety.

Table 21

Composition of Computer Anxiety Groups

Groups	Range of scores	N	Means
High computer anxiety	13 - 35	315	29.19
Low computer anxiety	36 - 40	297	38.59
Overall	10 - 40	612	33.75

Research Questions

Research Question 1

Do students of high and low computer anxiety levels differ in their preferences for types of scaffolding (see CASA instrument Appendix B)?

Since the researcher is interested in the question of context-specific information, the question of different preferences for scaffolding was examined in terms of the given tasks that students may engage in. This was done by a parsing process explained in chapter 3, which also reduced the data output to a manageable levels and focuses on the votes of support for each of the three forms of mediation, specifically for the derived task-factors of Technical, Communication, and Production and Presentation tasks.

Student preferences for support were parsed out, that is calculated, for each task-factor by each of the possible methods of mediation of support, human, machine, and paper as outlined in Chapter 3. The descriptive statistics for the resulting task-by-support scores, on each possible combination are shown by in Table 22 below for each computer anxiety group.

Table 22

Descriptive Statistics for Scaffolding by Task-Factors for Each Computer Anxiety Group

Task-factor by Support	HCA Group					LCA Group				
	N	Sum	%tags	Mean	Std. Dev.	N	Sum	%tags	Mean	Std. Dev.
TF[a] – HS[d]	303	1407	**74.7**	4.644	1.794	235	1059	**59.7**	4.506	1.815
TF – Ms[e]	74	156	**8.3**	2.108	1.288	107	311	**17.5**	2.907	1.876
TF – Ps[f]	110	321	**17.0**	2.918	1.551	128	404	**22.8**	3.156	1.714
CF[b] – HS[c]	310	1633	**87.0**	5.268	1.281	259	1296	**73.1**	5.004	1.472
CF – MS	82	171	**9.1**	2.085	1.307	115	334	**18.8**	2.904	1.947
CF – PS	44	74	**3.9**	1.682	1.289	65	143	**8.1**	2.200	1.716
P&PF[c] – HS	299	1248	**79.5**	4.174	1.244	263	1035	**70.0**	3.935	1.36
P&PF – MS	76	135	**8.6**	1.776	1.066	101	235	**15.9**	2.327	1.511
P&PF – PS	86	186	**11.9**	2.163	1.235	92	208	**14.1**	2.26	1.436

[a] Technical Factor
[b] Communication Factor
[c] Production and Presentation Factor
[d] Human Support
[e] Machine Support
[f] Paper Support

In Table 22 above, note that *N* equals the number of students who voted, whereas Sum and Percentages represent the actual number of votes cast for a given method of support for each of the three task-factors. Note that the percentages differ most radically between the HCA group and the LCA groups on the issue of machine support on all three types of tasks, which represent types of tasks.

The Chi-square test of independence was used to test for any significant differences between the two populations of students in the two different computer anxiety groups. Table 23 below shows that computer anxious students in particular have different preferences for support, and that they especially avoid machine-based support, regardless of the particular task involved.

Table 23

Chi-squares Tests of Significance for all (Task Factors by Mediation of Support) Scaffolding Possibilities

Scaffolding possibilities	χ^2	significance	df
Technical Factor with HUMAN Support	3.024	.696	5
Technical Factor with MACHINE Support	18.735	.002	5
Technical Factor with PAPER Support	9.713	.084	5
Communication Factor with HUMAN Support	6.323	.276	5
Communication Factor with MACHINE Support	16.14	.007	5
Communication Factor with PAPER Support	6.266	.281	5
P&P Factor with HUMAN Support	6.064	.194	4
P&P Factor with MACHINE Support	9.475	.050	4
P&P Factor with PAPER Support	4.211	.378	4

Table 24 below shows that for the Technical factor, 74.7% of the High Computer Anxiety group (HCA) voted for some form of human support, but only 59.7% of the Low Computer Anxiety group (LCA) did so. Numbers for the paper support options were about equal for the HCA and LCA groups, but the machine support differed by a factor of almost 2-to1.

Table 24

Comparison of Differences in Technical Task-Factor as a Function of Computer Anxiety Group

Task-factor by support	HCA Counts	%	LCA Counts	%
Technical factor with human support	1407	74.7	1059	59.7
Technical factor with machine support	156	8.3	311	17.5
Technical factor with paper support	321	17.0	404	22.8
Totals	1884	100	1774	100

Table 25 below shows that for the Communication factor, 87% of the HCA group voted for some form of human support, but only 73.1% of the LCA group did so. Numbers for both the machine and paper support options differed by a factor of about 2-to-1 between the HCA and LCA groups.

Table 25

Comparison of Differences in Communication Task-Factor as a Function of Computer Anxiety group

Task-factor by support	HCA Counts	%	LCA Counts	%
Communication factor with human support	1633	87.0	1296	73.1
Communication factor with machine support	171	9.1	334	18.8
Communication factor with paper support	74	3.9	143	8.1
Totals	1878	100	1773	100

Table 26 below shows that for the Production and Presentation factor, 79.5% of the HCA group voted for some form of human support, but only 70% of the LCA group did so. Numbers for both the machine support option differed by a factor of about 2-to-1 between the HCA and LCA groups, while the differences in paper support was not quite so extreme.

Table 26

Differences in Production and Presentation Task-Factors as a Function of Computer Anxiety

Task-factor by support	HCA Counts	%	LCA Counts	%
P&P factor with human support	1248	79.5	1035	70.0
P&P factor with machine support	135	8.6	235	15.9
P&P factor with paper support	186	11.9	208	14.1
Totals	1569	100	1478	100

Research Question 2

Is there a difference in the student's independent confidence depending on their computer anxiety levels (B of Appendix B)? A t-test t (556) = -10.006 (two-tailed) on independent confidence with computer anxiety groupings shows that the computer anxiety groups have a significant difference in their levels of independent confidence. Table 26 below gives the mean scores for independent computer confidence for each of the computer anxiety groups indicating that low computer anxious students (LCA) are also more confident. The overall mean for independent confidence is 84.57 (SD = 23.68 N = 558).

Table 27

Independent Confidence by Computer Anxiety Groups

	Computer anxiety groups	N	Mean	Std. deviation	Std. error mean
Independent	HCA	283	75.46	22.14	1.32
Confidence	LCA	275	93.95	21.49	1.30

Research Question 3

When scaffolding mediation options (section C) and assisted confidence (section D) are combined into *perceived confidence in scaffolding,* is there a difference in *perceived confidence in scaffolding* depending on the students computer anxiety levels?

This question is essentially an extension of the processes used in Research Question one and two, except that the confidence is now compared by high and low computer anxiety students. Votes for scaffolding, essentially a voting process that was used in research question one. Each of the 21 tasks is associated with the respective students selected support options, and an associated assisted confidence (one of nine support options plus their assisted confidence which can be reduced to three support options by mediation). These confidence values were computed in the respective task-factor by support options to give *perceived confidence in scaffolding* for each combination of task-factor by mediation, which was then compared for the HCA and LCA groups.

The task-factor by support mediation options are shown below, and a table of the factor loadings is given in Appendix F. All of the perceived confidence in scaffolding for each of the factors is significant at the .05 level or better.

Table 28

Test for Differences in Perceived Confidence in Scaffolding for Task-Factors

Perceived confidence in scaffolding task-factors	t-test for equality of means t	df	Sig. (2-tailed)
Technical factor with human support	-8.05	533.6	.000
Technical factor with machine support	-5.54	132.31	.000
Technical factor with paper support	-4.19	236	.000
Communication factor with human support	-7.46	563.6	.000
Communication factor with machine support	-4.6	156.86	.000
Communication factor with paper support	-1.76	107	.082
Production and presentation with human support	-6.459	558.64	.000
Production and presentation with machine support	-4.07	144.33	.000
Production and presentation with paper support	-1.56	175	0.12

Individual means for comparison purposes are given in Table 26 below:

Table 29

Confidence in Task-Factors for High and Low Computer Anxiety Groups

Confidence in scaffolding by task-factors	Computer anxiety group	Number of subjects who voted for this support option	Number of votes	Mean	Std. deviation	Std. error mean
Technical factor with human support	HCA	303	1407	4.2329	1.243	0.071
	LCA	235	1059	5.0219	1.031	0.067
Technical factor with machine support	HCA	74	156	4.0212	1.337	0.155
	LCA	107	311	5.0497	1.053	0.102
Technical factor with paper support	HCA	110	321	4.4900	1.186	0.11
	LCA	128	404	5.0839	1.002	0.089
Communication factor with human support	HCA	310	1633	4.7391	1.079	0.061
	LCA	259	1296	5.3380	0.833	0.052
Communication factor with machine support	HCA	82	171	4.4732	1.208	0.133
	LCA	115	334	5.2291	1.030	0.096
Communication factor with paper support	HCA	44	74	4.5254	1.079	0.163
	LCA	65	143	4.9236	1.214	0.152
Production and presentation factor with human support	HCA	299	1248	4.3420	1.062	0.061
	LCA	262	1035	4.8920	0.955	0.059
Production and presentation factor with machine support	HCA	75	135	4.3747	1.182	0.137
	LCA	99	235	5.0653	1.003	0.101
Production and presentation factor with paper support	HCA	85	186	4.3110	1.136	0.123
	LCA	92	208	4.6031	1.331	0.139

Research Question 4

Is there a difference in the student's assisted confidence depending on their computer anxiety levels (section D of Appendix B)?

After selecting their preferred option for support, students in the lower computer anxiety group had significantly more assisted confidence than did those in the higher computer anxiety group score on assisted confidence t (580) = -9.241, p = .000 (two-tailed). Table 27 shows statistics for these two groups in terms of their assisted confidence.

Table 30

Means for Assisted Confidence by Computer Anxiety Groups

Computer Anxiety Group	Subjects	Mean	Std. deviation	Std. error mean
HCA	293	92.75	20.88	1.22
LCA	289	107.39	17.21	1.01
Total	582	100.02	20.48	.85

Research Question 5

Is there a difference in the independent confidence and assisted confidence levels? A paired samples t-test revealed that there is a significant overall difference between independent and resulting mean scores of confidence t (532) = -16.481, p = .000 (two-tailed). The overall difference, a positive change in confidence scores, was from

84.57 (for independent confidence) to 100.02 (for the assisted confidence) which was a overall positive difference of 15.45.

As shown in Table 28, the different computer anxiety groups also had different levels of gain in confidence.

Table 31

Comparison of Confidence Means by Computer Anxiety Groups

	HCA			LCA			Overall		
	Mean	N	SD	Mean	N	SD	Mean	N	SD
Independent confidence	75.46	283	22.14	93.95	275	21.49	84.57	558	23.7
Assisted confidence	92.75	293	20.88	107.39	289	17.21	100.02	582	20.5

Differences between the two measures of confidence, both significant of the .05 level or greater, referred to as gain, are given in Table 29.

Table 32

Gain – Changes in Confidence

Computer Anxiety Groups	Independent Confidence	Assisted Confidence	Gain
High computer anxiety	75.463	92.747	17.281
Low computer anxiety	93.949	107.394	13.445

Summary

This research shows that computer anxiety varies across the student population, and is related, to varying degrees, to such factors as the student's college of enrollment, and whether or not the students has prior computer experience, or computer-related course work.

Based on the significant disparity in gender composition, and the differences in computer anxiety of students based on college enrollment, there may be also be a self-selection process in which those who are computer anxious select programs that minimize computer contact in various forms (either computer technology as a mediational tool or hard-core computer programming course). Those who have taken courses by non-traditional methods, or who have taken more formal computer courses can also be expected to be less computer anxious, perhaps as a result of their having had more computer-related experience, or possibly as a result of their experience working independently and learning that they can overcome technical problems.

This research also shows that student's computer anxiety, experience, and confidence correlate moderately. The results of this study indicate that getting computer support (should) tends to mitigate lack of computer experience, especially for those who are most anxious and/or are inexperienced. The independent disparity in confidence levels seems to actually decrease when students are offered their choice of perceived needs in computer support.

The vast majority of students said they desire personal support over other forms machine-based and paper-based support, but perceived scaffolding needs also vary across students depending on their computer anxiety and experience levels. The less anxious, or more experienced, and more confident students appear to prefer more sophisticated means for getting their support, such as computer-based or paper-based methods. There are of course a number of questions about, and explanations for this. One is that the more experienced students are less anxious *because* they are more experienced and believe they can get the help they need, when they need it. In addition, greater experience on the computer may make them feel more confident about overcoming a greater range of obstacles, knowing that they also have more options to suit their particular needs and ability levels. These options may include a greater circle of computer literate friends, a repertoire of troubleshooting skills that will enable them to solve problems, or successful experience finding special tutorials online as the need arise (just-in-time learning). To what degree do novice computer using students feel for example that they cannot understand the more sophisticated forms of support.

The disproportionate increase in female confidence as a result of support indicate again that those in greatest need may benefit the most from being given support.

Table 12 shows that males had lower computer anxiety, more perceived prior experience, greater independent and assisted confidence, but the females showed there greater increase in confidence.

A paradox appears in that when looking at age groups and college level it appears that experience, either in greater age or more years in college setting, reflects lower computer anxiety and greater self-perceived experience, but not necessarily greater confidence. It may be that younger students are simply over overconfident due to their lack of experience with the computer reality. Another possibility is that much of the college level academic experience is increasingly stressful as one progresses up the academic ladder, the stakes of failure become more visible or apparent to the student, especially those who begin to think about going on to graduate school and need higher grades.

After all, getting help from a computer or a book requires a certain level of competence at forming a good question, or knowing enough of the computer language that is essential for finding the correct words in an index or table of contents – in other words getting help often requires more than a minimal level of computer language because of the complex lingo of the computer world.

While it might seem that those with more experience levels might get more confidence from being offered support of their choice, this research could be used to argue that those who are most anxious, have the least experience, or are the least confident may feel most optimistic about the benefits of getting the support they desire.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Discussion

This research has been driven by the belief that students have many different reasons to be anxious about using the computer as part of a computer-mediated learning environment, and perhaps even more reasons to be anxious about the support they receive when working on different types of tasks. These feelings can be exacerbated when the students are taking courses in an environment where they cannot readily receive the help they need from others. Learner support in an online class for example, is often mediated by the computer itself, the object of fear for many students.

The avoidance of the computer as a means of support may well be a critical mistake, especially for the already at-risk student. If, as Brosnan (1999) and Rosen and Weil (1997) suggest, some students are anxious for good reason; they may be aware that they need help with learning a range of complex skills which include more than just using the computer as the mediating tool itself, but they may feel that they lack adequate social skills for socializing on the computer, or in the online class, or in seeking emotional support from others, whom they may not know or trust.

Hogan (1997) pointed out that scaffolding is an important tool for the social construction of learning, and depends heavily on sophisticated forms of communication and modeling, but communication tools and modeling online, in highly mediated learning environments, makes the entire process potentially more problematic. As the computer-mediated learning environment grows and evolves, there will also be a need for greater understanding of the nature of these interrelationships.

McLoughlin and Marshall (2000) note that too little attention is given to understanding of the nature of student support for novice learners in the online world. According to them, novice online learning students face:

> a new environment and the expectation that they will have independent learning skills and the capacity to engage in activities that require self direction and self-management of learning....Learners first need learning how to learn skills to be effective online learners, the new needed skills will have to be explicitly supported and taught (Introduction).

Summary of Findings

Research question 1: Do students of high and low computer anxiety levels differ in their preferences for types of scaffolding (see CASA instrument Appendix B)? The results of this research indicate that those of higher and lower computer anxiety do make different choices in their selection of support. While overall, the majority of students (80%) chose personal forms of support, the more computer anxious students in particular avoided help from computer mediated sources, especially when dealing with technical tasks.

Research Question 2: Is there a difference in the student's independent confidence based on their computer anxiety levels (B of Appendix B)? The computer anxious students had significantly less independent confidence than did their non-anxious counterparts.

Research Question 3: When scaffolding mediation options (section C) and assisted confidence (section D) are combined into *perceived confidence in scaffolding,* is there a difference in *perceived confidence in scaffolding* depending on the students computer anxiety levels? Regardless of task, the (only significant) greatest disparity in confidence between the computer anxious and non-anxious groups, when receiving support, was in the area of receiving computer mediated support. This disparity was the greatest with the technical tasks-factor, less so with communication types of tasks, and least with the presentation and production types of tasks.

Research question 4: Is there a difference in the student's assisted confidence with scaffolding, depending on their computer anxiety levels (section D of Appendix B)? Yes there was a difference in confidence levels between the high and low computer anxious students.

Research Question 5: Is there a difference in the independent confidence and assisted confidence levels? An overall, paired samples t-test, revealed a significant overall difference between assisted and independent resulting mean scores of confidence $t(532) = -16.481$, $p = .000$. The overall difference, a positive change in confidence scores, was from 84.57 (for independent confidence) to 100.02 (for the assisted confidence) which was an overall positive difference of 15.45.

Conclusions

Since almost 80% of all votes for support went for some form of human mediated support, it would appear that this research reinforces a wide range of the literature which purports, in general, that social presence, if not physical presence, is an important factor in communication and education. Indeed scaffolding itself would seem to be a personal task. This research shows that, 1) in terms of student votes for support, there is a very strong preference for some form of personal mediation of help, primarily from a friend or tutor, and somewhat less so from teachers, and 2) perhaps more significantly, that computer anxious students have the greatest need for human support. Students have a far greater desire for some form of human support than they do for either machine-based support, or paper-based support alone.

Table 23 (repeated)

Chi-squares Tests of significance for all (Task Factors by mediation of support) scaffolding

Scaffolding-support mediation	χ^2	signif.	df
Technical Factor with HUMAN Support	3.024	.696	5
Technical Factor with MACHINE Support *	18.735	.002	5
Technical Factor with PAPER Support	9.713	.084	5
Communication Factor with HUMAN Support	6.323	.276	5
Communication Factor with MACHINE Support*	16.14	.007	5
Communication Factor with PAPER Support	6.266	.281	5
P&P Factor with HUMAN Support	6.064	.194	4
P&P Factor with MACHINE Support*	9.475	.050	4
P&P Factor with PAPER Support	4.211	.378	4

* Significant at .05 or less

Table 23 shows that of the nine possible combinations of support on task-factors, the only significant differences between the high and low groups, at the .05 level, were found with using machine support on any of the three task-factors. While overall, both the high and low computer anxiety students preferred to use human mediation of support on all three tasks, a significant difference in Computer Anxiety Group preferences showed up when it came to using machine support on the same three tasks.

The moderate correlation between computer anxiety, experience, and confidence would seem to support the belief that those who are less computer anxious tend to have greater expertise and confidence in their ability to appropriately use the various available mediations of support. Based on the literature on negative effects of anxiety, and this research, one may well come to the conclusion that they also make better, or more useful, choices of support than do their more anxious counterparts.

Paper-based support options are also avoided in general, being the least desirable form of support, and computer anxiety is not a great factor here. This may be due in part to the nature of the paper-based options for support that were used in this research. Time (and perceived effort?) may well have turned all students away from selecting paper-based options of support. In other words, the investment in time spent reading paper-based materials may not be seen as profitable or as useful as other alternatives that provide quick answers.

The difference in preferences for paper-based support between high and low computer anxiety students was borderline significant, indicating in a sense an overall rejection of this option as a support tool. On reflection, it seems that the paper-based forms of support required greater planning and forethought which may play a part in their overwhelming rejection. The use of paper-based options may in fact fit the scenario of the leaky roof syndrome – when it is raining it is too late to make repairs to the roof, and when it is not raining, making repairs (planning ahead) is at the bottom of one's priorities.

A factor analysis of task-factors by types of mediation of support showed that when it comes to differences between the computer anxious and the non-anxious, students are most alike on preferring human support and rejecting paper-based support. The only significant difference between the high and low computer anxiety groups was when it came to receiving machine-based mediation of support. In other words, computer anxious students also reject support from their computers. While this finding may seem to be expected, it does verify that the students who are most at-risk in using their computer for learning are also most at-risk for getting help delivered by their computer, and that they need to be treated differently when it comes to providing them with computer-based support, especially when the support options are limited to machine mediation.

Implications for Theory

Vygotsky's (Vygotsky 1978; Vygotsky 1994) work stresses that social interaction and support are an integral part of learning advanced skills in what he refers to as the Zone of Proximal Development. Those who would benefit from being in the zone, and are ready to improve their skills are vulnerable to their emotional states. The quality of the support and interaction is important if students are going to become confident users of technology in learning. The immediate implication from this study is that those students who are the most anxious need to move on to higher levels of independent functioning with the judicious offering of technical support.

This study verifies that those students who are most anxious about using the computer believe they need different help, and also gain the most confidence when given the support of their choice. Appropriate support will mean greater freedom for the student to choose his or her own means of support, and to adapt to the changing task and demands.

The presence of other persons in the anxiety provoking situation has been seen in boys intimidating girls in the area of mathematics anxiety and computer anxiety (Brosnan, 1999) and test anxiety (Zeidner, 1998). The potential for cognitive disruption, overstimulation, and emotional harm is very real and needs to be considered in the online mediated course.

Evaluative anxiety can be present in many forms and settings. The presence of other persons in the anxiety provoking situations has been found to be a real problem that brings new factors into the performance related situation: Communication researchers point out the audience effect (McCroskey 1976), and test anxiety research (Zeidner, 1998) mentions the Observer Effects, or that girls working in cohort with boys around computers or in science classes, can add to the stress levels, apparently bringing the possibility of failure to the forefront of the anxious person's thinking. Now we also have the possibility of being evaluated in online learning, where simply posting a message gives one public exposure to an indeterminate and invisible world.

The possible presence of evaluation from teachers is a curious pattern that needs to be examined. The concern about avoiding teachers as a source of help may come from the belief that asking teachers for help will expose the student to ridicule or will expose their ignorance to others, such belief show a lack of trust or faith in the teacher.

The cause and effect question still remains: Does computer anxiety prevent students from gaining more experience and associated confidence, or does their self perception of their lower levels of skills (Brosnan, 1999), their lower levels of perceived experience, and their associated lower confidence engender their higher levels of anxiety (Zeidner 1998)? Factor into this quandary the individual sensitization levels of each individual, that is, the individually unique sense of doom that acutely anxious individuals may have when they feel trapped and keenly aware that they are not good at asking for, or getting, the help they need (Sieber, 1977, Zeidner, 1998).

Research needs to be done to better distinguish between more or less permanent trait levels of arousal and anxiety and to investigate how these levels of anxiety fluctuate across situational contexts, or result in state anxiety levels. In terms of options for the instructor, practical ways are needed for identify those students who are most at-risk and to deal with them in an ethical and caring way. Outside of the clinical setting, options are limited, but clarity of purpose at the instructional levels could make a significant difference if the instructors know that they have options for dealing with extremes of anxiety.

It is quite possible that those with the least experience or highest computer anxiety may be well aware that their computer skills levels are inadequate or minimal and believe that almost anyone can provide them with the help they need. Further research is needed to clarify the distinction between the students who are computer anxious with good cause, and can be remediated and those who are pathologically anxious (Weil and Rosen, 1997).

Implications for Practice

So much of what needs to be said in this area cannot be adequately dissected into recommendations for instructor and those for the institution, especially when one believes in the concept of the learning community. What an instructor can do is strongly tied to the institutions and social expectations. For example the instructor who is using Lotus Notes in an online community is functioning in a different world from the one who is using Blackboard.com. Likewise, financial constraints on pre-enrollment testing and training of students will influence the readiness of students for online learning.

Recommendations for the Institution

Perceptions of computer anxious students about the unreliable nature of computers magnify their feelings of danger and the possible penalties for making mistakes, and this tends to make them avoid the object of their emotional turmoil.

It seems necessary to remove the boundaries around university programs in such a way that we can reduce dependance on discrete units of learning and to provide more or less continuous and on-demand learning and support. One solution would be to create computer labs which are designed for entry level students, labs that are dependable and not overloaded with excessively complex software that may cause hardware or software conflicts (Scull, 1999). Instead of lab monitors who guard the equipment, it is important for labs to be staffed with tutors who are trained not to give answers (take over the keyboard) but to help students learn to solve their problems with help. In addition, for those labs without onsite support, it is essential to provide communication tools such as telephones for those who feel the need to speak to another human, in order for them to call whomever they feel could be of help. Scull (1999) refers to the use of friendship networks of cohort users who support each other in time of need. Reducing barriers to communication tools in labs could go a long way toward reduction of the feeling of isolation and entrapment that some students feel experience in the computer lab.

One practical step would be to teach students and trainers alike to communicate at a lower level of technical language and avoid jargon. Although every field demands a specialized language, temptations to use it with novices must be resisted in the support profession. It is important to create support materials for novices to that they can search in a language they understand, and make available training materials that communicate at different levels of vocabulary, as the novice's language and understanding develop.

Even though students need to learn the language of technology, support should also be given in terms they can understand, obviously; this is most important for the most computer anxious students. For them, instructions must be shorter and expressed in a level of language they can remember. Support providers must trained to remember that technical terms are new to the novice learner, or anxious learner, technical is much like a foreign language, and these complex words and acronyms are meaningless to them.

Where these terms cannot be broken down into simple terms the support persons who use these words must find alternative ways of explaining them, or take the time to teach them what the new terminology in simple terms. If necessary, efforts should be made to ascertain the students' level of expertise and anxiety levels when they first attempt to enter a course that demands higher levels of competence than they are prepared for. Where there are tools to do so, new students should go through an initial assessment aimed at helping them get ready for their learning, guiding them in overcoming lack of basic skills, and providing personal information (tracking system) to support personnel/system for future assessment.

Recommendations for The Instructor

Etiquette, Netiquette, and Individual Security

Just as there is a new focus on reducing bullying in the public schools, so too we need to teach appropriate online communication skills to both students and instructors. Instructors and institutions need to create workshops for teaching online behaviors, that is what kinds of behaviors will or will not be tolerated, and those which are poor manners. On the positive side, instructors must model good communication etiquette in order to teach these behaviors, to prevent students from assuming the worst for example, for attacking another speaker or online poster before first getting clarification or feedback to correct misinterpretations and faulty assumptions. Poor training in communication, especially online communication, often results in flaming, which is typified by lack of empathy, and leads some to respond in a harsh manner to the postings of others, or to pass hasty and presumptuous judgements about the intentions of others. This same thing happens in face-to-face communication situations, but it is also easier to be trigger such responses when the other person's humanity is not visible. Students need to be overtly taught that in a world where visual, auditory, and tactile clues are missing, that much OF a message is missing, and that often too much negative intent is assumed.

Recommendations for Future Research

It would seem to be profitable to replicate this research in a computer lab setting in where it would be possible to more accurately monitor and log students' computer actions, to daily or periodically question them on their problems and needs for the previous day, and ascertain their help-seeking behaviors as they occur. A further step away from the lab would to replicate a variation of this research using logbooks or journals, much like television ratings researchers monitor an audience's viewing behavior. This would have the added of allowing the students to monitor their own help-seeking behaviors, encouraging meta-cognitive skills that they may not otherwise develop.

Such research may also yield the best results when it focuses on those who may be least academically prepared, naive, or less confident, and may be pursuing their degrees on a part-time basis from their homes. These are the students who may feel the most dependent on other people for their support systems but may have to depend on the computer and books for help. A need exists to assess students' technological competence, and their emotional states, and then to offer alternative avenues of support, somewhat like the Open University, where Distance Learning students can drop into local centers for support, as they need it. Regardless of the desire to mechanize computer-based delivery of instruction it may still be necessary to humanize the support system in order to help the weakest students stay afloat.

Online and various independent forms of study are becoming increasingly popular because of the benefits available. But, caution must be exercised to ensure that those who enter these programs are well served in order to minimize undue frustrations and high dropout rates. Problems need to be addressed in the area of support in order for students to make the transition to competent and confident learners.

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Appendix A

Informed Consent Script to be read to students

AUTHORIZATION: I am John H. Griffin (or instructors name here) and I/we am/are conducting the study of student computer anxiety and experience, and confidence in using various computer-based support options.

The title of study is *The Relationship Between Computer Anxiety, Computer Experience, and Confidence in Support*.

Principle investigator is : John H. Griffin, a graduate student from the School of Applied Health and Educational Psychology, Oklahoma State University.

The purpose of this research is to explore and evaluate students attitudes and perceived needs for help in the computer-based learning environment.

You will be asked to fill out the demographic questionnaire (about 3 minutes); a computer attitudes survey (about 5 minutes); a support survey about your experience, confidence and support needs (5-10 minutes).

You will be asked to fill out a series of questionnaires which may take 30 minutes. There are no risks to you the student, and this research will provide information about how to better provide "help" services.

Information you provide will be kept confidential and your name or identity will not be connected to your responses in any way. Your name, or suitable pseudonym and phone number will be kept temporarily with your responses, <u>if and only if</u> you volunteer to be contacted at a later date in order to provide further clarifications of your responses.

There are no anticipated risks to you as a result of your participation in this study. If any risks do exist, they are minimal and do not exceed those ordinarily encountered in completing an in-class assignment.

Benefits of this study include further knowledge and understanding of your support needs while taking computer-based online courses.

You must be 18 years of to participate in this study. Your participation is entirely voluntary and you will not be penalized for refusing to participate. You are free to withdraw your consent and end your participation at any time, without penalty, by contacting the principle investigator, or your instructor. For further information about this research, please contact the John H. Griffin, the principle investigator at 405-377-3666 or for more information about your rights as a participant contact: Sharon Bacher, IRB Executive Secretary, Oklahoma State University, 203 Whitehurst, Stillwater, OK 74078. Phone: 405-744-5700.

Appendix B

Demographics

For each number, please place a check in the box which most closely applies to you.

1. Age:

☐ less than 20 ☐ 20 – less than 25 ☐ 25 – less than 30
☐ 30 – less than 35 ☐ 35 – less than 40 ☐ 40 – less than 45
☐ 45 – or greater

2. College level:

☐ 1st year ☐ 2nd year ☐ 3rd year ☐ 4th year
☐ Bachelors ☐ Masters ☐ Doctorate

3. College enrolled in:

☐ College of Agricultural and Environmental Sciences
☐ College of Arts and sciences
☐ College of Business Administration
☐ College of Education
☐ College of Veterinary Medicine
☐ College of Human Environmental sciences
☐ College of Engineering Architecture and Technology

4. Sex: ☐ Male ☐ Female

5. Computer most often used: ☐ Mac ☐ IBM/compatibles ☐ Unix/Linux

6 Marital Status: ☐ Single ☐ Married ☐ Divorced ☐ Partnered

7. Ethnicity: ☐ Native American ☐ Asian American ☐ African American ☐ Caucasian
Other ____________

8. Have you ever taken:

☐ Correspondence study course ☐ Independent study
☐ Satellite or Television course ☐ Computer based/delivered

9. Have you taken formal computer courses in college/university? If yes, please indicate below:
Programming ____ Word Processing ____ Other (please describe below)

____

____

Appendix C
Computer Attitude Scale - Anxiety
CASA Instrument by Loyd and Gressard

SURVEY OF ATTITUDES TOWARD LEARNING ABOUT
AND WORKING WITH COMPUTERS

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

		Strongly Agree	Slightly Agree	Slightly Disagree	Strongly Disagree
1.	Computers do not scare me at all.	☐	☐	☐	☐
2.	Working with a computer would make me very nervous.	☐	☐	☐	☐
3.	I do not feel threatened when others talk about computers.	☐	☐	☐	☐
4.	I feel aggressive and hostile toward computers.	☐	☐	☐	☐
5.	It wouldn't bother me at all to take computer courses.	☐	☐	☐	☐
6.	Computers make me feel uncomfortable.	☐	☐	☐	☐
7.	I would feel at ease in a computer class.	☐	☐	☐	☐
8.	I get a sinking feeling when I think of trying to use a computer.	☐	☐	☐	☐
9.	I would feel comfortable working with a computer.	☐	☐	☐	☐
10.	Computers make me feel uneasy and confused.	☐	☐	☐	☐

Instrument courtesy of Brenda H. Loyd and Clarice P. Gressard, University of Virginia

Appendix D

Computer Experience and Scaffolding Confidence

Instructions:

For the purposes of these questions, assume that you need to take a certain course in order to get credit in your major area of interest, but you CANNOT enroll in a traditional college or university program to take this course. Your only option to learn what you need and desire to know, or get credit for the course is to enroll in a computer-based online course. Described below are typical tasks that you might need in order to perform well in this computer-based online course

Directions: Assume that the online course you are taking requires use of the following tasks (listed below). First in column **A**, to the right, circle the letter indicating your current level of experience with each task listed in the column below. Then, in column **B** to the far right, mark your current **confidence** in successfully completing the same set of tasks. Tasks:	**A.** For each task item mark your current level of experience below: a. None/never used b. Very Little c. Some d. Moderate e. Extensive	**B.** For your online course work you need to learn to perform better in each area below. Consider each task and mark how much **confidence** you have that you can improve your performance at each task independently, on your OWN: a. None b. Very little c. A small amount d. A moderate amount e. A lot f. Absolute
1. Use word processing software such as Microsoft Word, Word Perfect, etc.	a. b. c. d. e.	a. b. c. d. e. f
2. Subscribe to, and participate in a Listserv	a. b. c. d. e.	a. b. c. d. e. f.
3. Manipulate data, e.g., Excel, Access, Lotus 1,2,3, etc.	a. b. c. d. e.	a. b. c. d. e. f.
4. Use presentation software, e.g., Power Point, Photo Delux, Illustrator, or similar	a. b. c. d. e.	a. b. c. d. e. f.
5. Use design programs, e.g., Netscape Composer, Lotus Domino, Page Mill, Front Page, etc to create a web page	a. b. c. d. e.	a. b. c. d. e. f.
6. Use Email programs	a. b. c. d. e.	a. b. c. d. e. f.
7. Talk to others in an online chat room	a. b. c. d. e.	a. b. c. d. e. f.
8. Talk to others using an Internet telephone	a. b. c. d. e.	a. b. c. d. e. f.
9. Install and use a web cam on your computer	a. b. c. d. e.	a. b. c. d. e. f.
10. Download files from the Internet	a. b. c. d. e.	a. b. c. d. e. f.
11. Use drawing programs to create your own artwork	a. b. c. d. e.	a. b. c. d. e. f.
12. Browse and search the Internet for academic articles	a. b. c. d. e.	a. b. c. d. e. f.
13. Add a printer and the printer related software	a. b. c. d. e.	a. b. c. d. e. f.
14. Create folders, save, rename, and copy files on your computer	a. b. c. d. e.	a. b. c. d. e. f.
15. Download and install software to use streaming audio or video	a. b. c. d. e.	a. b. c. d. e. f.
16. Use threaded discussion data bases for academic group discussions	a. b. c. d. e.	a. b. c. d. e. f.
17. Use one of the instant messaging services	a. b. c. d. e.	a. b. c. d. e. f.
18. Install software on your computer	a. b. c. d. e.	a. b. c. d. e. f.
19. Use FTP to upload a file	a. b. c. d. e.	a. b. c. d. e. f.
20. Install a modem and its software	a. b. c. d. e.	a. b. c. d. e. f.
21. Use boolean logic with an online search engine to find information on the web	a. b. c. d. e.	a. b. c. d. e. f.

Directions: Below is the same list of tasks needed in your online course. In column **C** on the right, circle the letter indicating the type of help that you would need MOST in order to be able to <u>perform better</u> at the same task. Last, in column **D**, circle the letter that best represents how **confident** you are that with this help you could successfully complete each of the tasks independently. Tasks:	**C.** For each task item circle the ONE type of help you need most in order to **improve your level** of performance at each task: I prefer help from: a. A friend b. A tutor or nearby expert c. A teacher d. Drop-down help windows e. Instructions/FAQ's from Internet/online f. An intelligent program g. An instruction manual h. A manual such as Windows for Dummies i. A comprehensive textbook/program or course	**D.** Given that you have the type of help specified in column **C**, how much **confidence** do you have that you could successfully complete the task independently: a. None b. Very little c. A small amount d. A moderate amount e. A lot f. Absolute
1. Use word processing software such as Microsoft Word, Word Perfect, etc.	a. b. c. d. e. f. g. h. i.	a. b. c. d. e. f.
2. Subscribe to, and participate in a listserv	a. b. c. d. e. f. g. h. i.	a. b. c. d. e. f.
3. Manipulate data, e.g., Excel, Access, Lotus 1,2,3, etc.	a. b. c. d. e. f. g. h. i.	a. b. c. d. e. f.
4. Use presentation software, e.g., Power Point, Photo Delux, Illustrator, or similar	a. b. c. d. e. f. g. h. i.	a. b. c. d. e. f.
5. Use design programs, e.g., Netscape Composer, Lotus Domino, Page Mill, Front Page, etc to create a web page	a. b. c. d. e. f. g. h. i.	a. b. c. d. e. f.
6. Use Email programs	a. b. c. d. e. f. g. h. i.	a. b. c. d. e. f.
7. Talk to others in an online chat room	a. b. c. d. e. f. g. h. i.	a. b. c. d. e. f.
8. Talk to others using an Internet telephone	a. b. c. d. e. f. g. h. i.	a. b. c. d. e. f.
9. Install and use a web camera on your computer	a. b. c. d. e. f. g. h. i.	a. b. c. d. e. f.
10. Download files from the Internet	a. b. c. d. e. f. g. h. i.	a. b. c. d. e. f.
11. Use drawing programs to create your own artwork	a. b. c. d. e. f. g. h. i.	a. b. c. d. e. f.
12. Browse and search the Internet for academic articles	a. b. c. d. e. f. g. h. i.	a. b. c. d. e. f.
13. Add a printer and the printer related software	a. b. c. d. e. f. g. h. i.	a. b. c. d. e. f.
14. Create folders, save, rename, and copy files on your computer	a. b. c. d. e. f. g. h. i.	a. b. c. d. e. f.
15. Download and install software to use streaming audio or video	a. b. c. d. e. f. g. h. i.	a. b. c. d. e. f.
16. Use threaded discussion data bases for academic group discussions	a. b. c. d. e. f. g. h. i.	a. b. c. d. e. f.
17. Use one of the instant messaging services	a. b. c. d. e. f. g. h. i.	a. b. c. d. e. f.
18. Install software on your computer	a. b. c. d. e. f. g. h. i.	a. b. c. d. e. f.
19. Use FTP to upload a file	a. b. c. d. e. f. g. h. i.	a. b. c. d. e. f.
20. Install a modem and its software	a. b. c. d. e. f. g. h. i.	a. b. c. d. e. f.
21. Use boolean logic with a search engine to find information on the web	a. b. c. d. e. f. g. h. i.	a. b. c. d. e. f.

Appendix E

Follow-up Contact Information Form

Dear Students:

The researcher (that's me) would like to contact some persons later who represent a particular group such as the highly computer anxious, or the "supremely" confident computer user in order to clarify issues, beliefs, etc. relating to their responses. If you would like to participate please sign your name or pseudonym below and write in a phone number where you can be reached.

No one will contact you unless you are willing to sign your name and include a phone or email address allowing the researcher to keep track of your instruments long enough to compare all your responses and contact you in reference to you response. I will only keep your contact information and forms/instruments together until the research has been completed.

Your name or pseudonym ____________________________You phone number_______________________
or your Email______________________

Serial Number from cover _____________

Thank you very much for your cooperation.

Your help is greatly appreciated!

Appendix F

Factor Loadings

Table 33

Factor analysis table used to create Task-factors

Tasks*	Factor 1	Factor 2	Factor 3
1 Use word processors	.22768	.38272	.55308
2 Subscribe to Listserv	.23238	.25024	.47619
3 Manipulate data	.24559	.18772	.70421
4 Use presentation software	.19271	.22536	.77773
5 Use design (web)programs	.29906	.12761	.65114
6 Use Email	.17077	.69409	.23269
7 Talk in chat room	.12706	.82286	.19064
8 Talk w/ online telephone	.26540	.59140	.19675
9 Install & use webcam	.55527	.32702	.24743
10 Download file	.44393	.57191	.24459
11 Use drawing programs	.32286	.41269	.42928
12 Browse & search internet	.37929	.62365	.23988
13 Add a printer	.69758	.26659	.20666
14 Create folders	.48955	.52797	.26078
15 Streaming audio & Video	.56996	.35535	.22971
16 Threaded discussions	.40897	.36249	.37552
17 Use IM services	.25634	.65997	.19712
18 Install software	.77592	.24237	.19615
19 Use FTP	.60134	.23722	.31036
20 Install a modem & software	.75356	.11056	.33544
21 Use boolean logic on search engine	.42185	.26286	.34494

* 21 Tasks with their abbreviated labels

Appendix G

IRB Approval

Oklahoma State University
Institutional Review Board

Protocol Expires: 9/26/02

Date: Thursday, September 27, 2001 **IRB Application No** ED0225

Proposal Title: A STUDY OF THE RELATIONSHIP BETWEEN COMPUTER ANXIETY, COMPUTER EXPERIENCE, AND CONFIDENCE IN SUPPORT

Principal Investigator(s):

John Griffin
1108 S. Stanley
Stillwater, OK 74078

Kay Bull
419 Willard
Stillwater, OK 74078

Reviewed and Processed as: Exempt

Approval Status Recommended by Reviewer(s): Approved

Dear PI :

Your IRB application referenced above has been approved for one calendar year. Please make note of the expiration date indicated above. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval.
2. Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved projects are subject to monitoring by the IRB. If you have questions about the IRB procedures or need any assistance from the Board, please contact Sharon Bacher, the Executive Secretary to the IRB, in 203 Whitehurst (phone: 405-744-5700, sbacher@okstate.edu).

Sincerely,

Carol Olson

Carol Olson, Chair
Institutional Review Board

VITA 2

John Henry Griffin

Candidate for the Degree of

DOCTOR OF PHILOSOPHY

Title: THE RELATIONS AMONG COMPUTER ANXIETY, COMPUTER EXPERIENCE, AND PERCEIVED CONFIDENCE IN SCAFFOLDING

Major Field: Educational Psychology (Instructional Design)

Biographical:

Personal Data: Born in Dallas Texas, July 18, 1947, the son of Billy Roe and Gladys S. Griffin. Married to Frances Elaine Kaufman on August 23, 1970.

Education: Graduated from Richland Hill High School, Fort Worth Texas, May 1966; BA degree in Radio-Television-Film from University of Houston in December 1973; Master of Science Degree at Oklahoma State University, 1988; Completed the requirements of Doctor of Philosophy, in Educational Psychology, December 2002.

Professional Experience: Antisubmarine Warfare Technician, 2nd. Class, USNR-TAR; Broadcast Engineer; Electronics Technician, UKSM-W; Three Feathers Associates, research assistant; Technical Support Agent, Creative Labs; Test file Room, Department Evaluation project. Applied Behavioral Studies in Education Department; Electronics; Graduate Teaching Assistant; Online Teaching Assistant, Dr. Kay Bull, SAHEP Oklahoma State University; Graduate Teaching Assistant, University Testing and Evaluation Services 1999 - present;

Professional Memberships: Association for Educational Communications and Technology