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ABSTRACT

This investigation of the relationship of computer anxiety reduction to instructional strategies and learner characteristics used multiple repeated measures in a 2x2x2 quasi experimental design with arousal-seeking tendency, coping style, sex, computer skill mastery, and locus of control as the independent variables. Discrete dependent variables were pre- and post-computer anxiety and computer confidence scores. Pre- and post-tests were administered, and 10 randomly selected students kept journals of their thoughts and feelings during the 8 weeks of treatment. The subjects--120 students (61 male, 58 female, one non-report) enrolled in an introductory computer literacy and survey course at a large university--were assigned to two treatment levels: demonstration of computer skills by the instructor without hands-on experience and practice for students (control group), and demonstration with hands-on experience and practice in class (experimental group). The content covered and the laboratory assignments--creation of two spreadsheets--were the same and the time on task approximately equal. While statistical analyses showed no significant differences on the measures in the eight research hypotheses, analyses of journal entries showed more positive and fewer negative journal entries by students in the experimental group than in the control group. The experimental subjects also reported a decreased number of negative feelings, whereas the control subjects reported an increased number of negative feelings. It is suggested that, although the two treatments over a short period of time may not make very much difference in the anxiety, confidence, and performance of young, relatively motivated learners, if other affective concerns such as attitudes are important factors, then hands-on computer instruction is preferred. (56 references) (BBM)

Title:

The Effects of Two Instructional Conditions on Learners' Computer Anxiety and Confidence

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The Effects of Two Instructional Conditions on Learners' Computer Anxiety and Confidence.

In spite of the diffusion of computers into our society, there remains a large number of people who continue to suffer from computer anxiety. Zelman (1986) reported the results of a 1985 survey of over 2 million school teachers by the Corporation of Public Broadcasting in which 31% of the respondents felt uncomfortable using computers and 13% reported avoiding computers. Computer anxiety appears to be a problem for a large number of people.

Computer anxiety is generally viewed as a form of state anxiety associated with computer use (Howard, 1984; Cambre & Cook, 1985) and is usually defined in a manner such as "the fear or apprehension felt by individuals when they used computers, or when they considered the possibility of computer utilization" (Simonson, Mauer, Torardi, & Whitaker, 1987, p. 238). This fear or apprehension is generally believed to cause debilitating thoughts. These thoughts negatively affect learning by interfering with the processing and encoding of information during instruction.

As our society becomes more dependent upon retrieval of information, computer technology permeates our organizational structures. Nearly half of all white-collar workers are using computers in their daily work (Howard, Murphy, & Thomas, 1987). Sanders and Stone (1986) report that the U. S. Department of Labor estimates that for this next generation as much as 75% of all jobs will involve the use of computers. This importance of computer-related skills for future career requirements, makes the issue of computer anxiety a contemporary issue in education. Because of the size and the importance of this problem, we need to analyze the results of research on computer anxiety so that we can more seriously address learners suffering from the debilitating effects of computer anxiety.

Most of the literature on computer anxiety involves case studies. These articles relate experiences involving teaching of workshops or courses with computers and reflections of the authors perceptions about what works or does not work. While these articles may be helpful to those designing and delivering computer instruction, they contribute very little to the development of a research base in computer anxiety.

Howard, Murphy, and Thomas (1987) state that future research needs to examine the types of instructional strategies that are most effective in reducing computer anxiety. Tobias (1979) suggests that it is important to investigate the aptitude-treatment-interactions in areas of anxiety, in order that we can better fit anxiety reduction strategies to the individual characteristics of learners.

Purpose of the Study

Because the literature is lacking research that investigates the influence of specific instructional strategies on the reduction of computer anxiety for learners, this need should be addressed. In view of the importance of computer anxiety and attitudes toward computers to the instruction and training of learners, the purpose of this study, therefore, was to investigate the relationship of computer anxiety reduction to instructional strategies and learner characteristics.

Specifically, this study sought answers to the following broad questions:

1. What type of instructional intervention contributes to reduced computer anxiety?
2. What learner characteristics interact with the types of instructional interventions that reduce computer anxiety?
3. What is the nature of the learners' perceptions that occur during instructional reduction of computer anxiety?

Anxiety

In spite of a trend toward increased research in the area of human anxiety, anxiety as a construct has still resisted a consensus of its definition and measurement (Cambre &

Cook, 1985). There is, however, a commonality to most definitions of anxiety---"a fear about something in the future" (Howard & Smith, 1986). Cattell & Scheier (1958) using factor analytic studies developed the concepts of two types of anxiety. The first, called trait anxiety, is a generalized anxiety or a global, basic, and permanent tendency to be anxious. The second, state anxiety, is a situation specific, fluctuating, and transitory tendency to become anxious.

Eysenck (1979) and Tobias (1979) have suggested that anxiety is particularly debilitating to learning when the task is difficult and when there is a strong need for memory in performance of the task. It is, therefore, important to intervene and facilitate the reduction of anxiety when its effects are impairing.

Tobias (1979) proposed a model for the effect of anxiety on learning from instruction. This model suggested that anxiety interferes most with learning before, and during input by the learner. Before processing, anxiety acts as a diversion to attention. During processing, anxiety directly interferes with the cognitive processing and storage of information by the learner. Postprocessing anxiety obstructs later retrieval of content mastered during instruction. Based on this model, Tobias made recommendations regarding instruction which is expected to reduce the effects of anxiety on learning. He suggested that instruction for anxious learners should allow learners to repeat content and reduce the extent to which learners must rely on memory.

M. W. Eysenck (1984) stated that actual performance for high anxiety individuals and low anxiety individuals is less clear than the anxiety differences. He stated that experimental evidence suggests that high anxiety learners compensate for decreased cognitive capacities (due to anxiety related task- irrelevant cognitive activities) by increasing effort on the task. Anxiety level, itself, is not the determining factor on behavior and choice. It is necessary, therefore, to look at the interaction of anxiety stimuli and specific characteristics of the learners, which might help predict or interpret their behaviors under conditions of anxiety.

Activation Theory

Activation Theory (Berlyne, 1960; Fiske & Maddi, 1961; Malmo, 1971) as it applies to anxiety has typically involved three concepts: impact, activation, and arousal. Impact can be thought to be the momentary contribution of a stimulus to the reticular arousal system (RAS), a network of nerve cells that extends through the lower brain. Activation is the degree of physiological excitation in the RAS. Activation level is related to the intensity of the impact, but can vary due to the influence of changes in the somatic, or physical, state of the individual. Arousal is the actual manifestation of the activation in the individual, such as the emotions of anxiety or anger. Arousal, in turn, affects activation through feedback, by changing the impact of other stimuli.

The relationship of performance to activation and arousal (Fiske & Maddi, 1961; Malmo, 1971) has been summarized in three statements: (a) there is an optimal level of arousal for best performance; (b) above or below this optimal level, performance is relatively impaired; and (c) performance impairment increases with the distance from the optimal level. Studies (Hines & Mehrabian, 1979; Mehrabian & West, 1977; Russell & Mehrabian, 1975) have shown a detrimental effect of relatively high levels of arousal on performance and attitude in work situations. Russell and Mehrabian (1975) also found that in unpleasant situations, avoidance behavior is a direct correlate to arousal state. The optimal level of arousal varies from individual to individual.

Arousal-Seeking Tendency

Each individual has an optimal level of arousal, not only for performance, but also for emotional comfort. A person's preferred arousal level (Mehrabian & Russell, 1974) is closely related to his or her preference for an environment. The avoidance or attraction of individuals for a stimuli, such as a computer, is related to not only their level of arousal, such as anxiety, but also to their preferred level of arousal. Mehrabian and

Russell (1974) have isolated a homogenous trait they call "arousal-seeking tendency" which is a measure of that level of arousal that individuals find most comfortable. The arousal-seeking tendency was defined as the extent of the level of arousal that an individual finds most comfortable.

Mehrabian & Russell (1974) developed the Arousal-Seeking Tendency Scale (ASTS). They administered the ASTS and other inventories to 530 subjects. Results showed that ASTS scores were significantly correlated to state anxiety, trait anxiety, and extrovertism. Mehrabian (1977), using 325 college undergraduates, found other significant correlates to the ASTS. Sensitivity to rejection was negatively and moderately correlated to ASTS scores. Achieving tendency, extrovertism, and dominance were moderately positively correlated to ASTS scores.

Mehrabian (1978), in a later study of 118 undergraduates, investigated individual reactions to positive and negative situations. Results showed that high arousal seekers showed a significantly greater approach tendency for preferred environments than low arousal seekers. This pattern was also significant for positive work environments. Arousal-seeking tendency is associated with an individual's response to stimuli, i.e. anxiety level. Anxiety, as an emotion, would only be expected to be detrimental when the level of arousal is much higher or much lower than the learner's preferred arousal level. When looking at anxiety levels and changes in those levels, it is probably important to consider the learner's arousal seeking tendency. Arousal-seeking tendency was, therefore, included as a variable in this study.

Anxiety Coping Style

How the learner deals with anxiety stimuli are also important factors relating to the influence of instructional interventions. Tucker (1986) stated that regulatory biases affect the activation and arousal systems, and that "the most adaptively significant is the bias toward internal versus external determination of the information flow" (p. 293). This bias is probably associated with clearly discernable personality traits (Tucker & Williamson, 1984). Some learners, when at high anxiety levels, seek external stimuli as their preferred source of information. Other learners adapt to high anxiety levels by focusing attention inward, thus ignoring outside stimuli and information. These internally adaptive individuals, while reducing anxiety levels, would probably not undergo cognitive changes in relation to computer skills and attitudes, when experiencing computer anxiety during instruction.

Miller (1987) has suggested such a personality trait. She proposed two styles for coping during stressful events: monitors (externally oriented, information seekers) and blunters (internally oriented, distractors). For example, under the anxiety of an impending surgical procedure, a monitor would want to know as much as possible about the procedure to better deal with the stress. A blunter, on the other hand, would prefer to be told as little as possible--ignorance is bliss. Coping style was defined as the degree to which individuals monitor versus blunt stimuli from their environment when experiencing anxiety. Miller asserts that the degree of monitoring and blunting can be measured using the Miller Behavioral Style Scale (MBSS).

Several studies have looked at coping style and its relationship to arousal and arousal-seeking tendencies. Sparks and Spirek (1988) reported two studies aimed at investigating differences between high monitoring subjects and high blunting subjects. Results showed a significant main effect for coping style, with monitors having higher anxiety levels than blunters. Results showed that coping style was significantly related to anxiety levels and preferred behaviors toward stress.

Hines and Mehrabian (1979) found that monitors and blunters differed significantly in avoidance of unpleasant settings. Monitors in the 325 undergraduate sample showed more avoidance responses to unpleasant stimuli than did blunters.

The importance of coping style to instruction and anxiety is that under stressful computer anxiety in an instructional setting, blunters would be expected to prevent assimilation of instruction and potential anxiety reducing interventions by blocking or distracting external stimuli (such as instructional information). Coping style can have an influence on changes in computer anxiety levels, and was, therefore, included as a variable in this study.

Locus of Control

A major cause of computer anxiety has been suggested to be associated with a feeling that one has lost control of outcomes when interacting with a computer (Bloom, 1985; Honeyman & White, 1987; Meier, 1985). The focus of most research done on perceptions of personal control has involved the concept of locus of control, developed out of social learning theory (Rotter, 1954; Rotter, Chance, & Phares, 1972). The concept of locus of control emerged due to systematic differences in expectancies following reinforcement (Rotter, 1975). Locus of control (Rotter, 1966) is a term used to describe a generalized expectancy for internal versus external control of reinforcements. Belief in internal control is a result of a perception that events are contingent upon ones behavior. Perceptions of external control are views that reinforcements are the result of such factors as luck, chance, or fate. Locus of control does not refer to the actual extent of control the individual has in a situation, rather it refers to the individuals perception of control (Rotter, 1975).

The generalizability of locus of control is important. Rotter (1975) emphasized that specific experiences in a particular situation, not only determine expectancies for that situation, but also for other situations. He theorized that in more novel or ambiguous situations (as long as it is not perceived to be random) the learners rely on their generalized expectancy. This is because they have no specific expectancy in a situation that is new to them. Phares (1976) reported that personality characteristics have been found to be generally associated with external locus of control individuals. Among these is a high level of succorance, a need for assistance under conditions of distress. Externals would, therefore, function better in anxious situations when help or assistance is available.

Because computer experiences are relatively novel for beginners, locus of control has been investigated as a potential correlate to computer anxiety. Studies (Howard, Murphy, & Thomas, 1987; Morrow, Prell, & McElroy, 1986) have found a significant relationship between locus of control and computer anxiety in college students. Lazarus (1966) proposed that individuals with internal locus of control beliefs are better equipped psychologically to handle perceived threats and are, therefore, less likely to be anxious in a threatening situation. Locus of control was, therefore, investigated as a variable in this study.

Sex Differences

There are several differences between male students and female students that would be expected to impact the influence of instruction on computer anxiety. Wolleat, Pedro, Becker, and Fennema (1980) administered the Mathematics Attribution Scale (MAS) to 1224 secondary students enrolled in college preparatory mathematics classes. Females exhibited significantly more of the learned helplessness (external locus for success and internal locus for failure) in their responses, even after achievement level was separated out. These types of differences, although potential factors, are not identifiable with measures of locus of control.

Mehrabian (1977) found significant sex differences in coping styles, with females more likely to monitor under stress. His results also showed that these monitoring coping styles increased avoidance responses in unpleasant situations. It would be expected that females would, therefore, be more avoidant of computers when experiencing similar levels of anxiety as males. Males, on the other hand, would be more likely to blunt instruction and intervention under high levels of computer anxiety.

Studies (Cambre & Cook, 1987; Raub, 1981; Rohner & Simonson, 1981; Rosen, Sears, &

Weil, 1987), have also found significant correlations of computer anxiety levels to the learner's sex. These studies have shown females to possess higher levels of computer anxiety.

The interaction effects of the sex of the learner with other variables can be quite complex. It can, however, be used to make certain predictions of behavior. The learner's sex was, therefore, included as a variable in this study.

Computer Anxiety

Computer anxiety can be viewed as a form of state anxiety associated with computer use (Cambre & Cook, 1985; Howard & Smith, 1986). Computer anxiety was defined as "the fear or apprehension felt by individuals when they used computers, or when they considered the possibility of computer utilization" (Simonson, et al., 1987, p. 238). Researchers (Cambell, 1986; Simonson, et al., 1987) have used state-anxiety instruments to validate computer anxiety scales.

Because state anxiety is transitory in nature, its levels can be changed by interventions. Thus, anxiety reducing strategies can be expected to achieve changes in computer anxiety. Studies (Cambre & Cook, 1987; Howard, Murphy, & Thomas, 1987; Raub, 1981) have, in fact, shown that instruction can reduce computer anxiety in most learners.

While research about students' attitudes toward computers was performed as early as 1965 (Mathis, Smith, & Hansen, 1970), the study of computer anxiety as a construct was begun by Powers, Cummings, and Talbott in 1973 (Cambre & Cook, 1985). Much of the literature on computer anxiety involves case studies (Howard & Kernan, 1989). Other studies (Cambre & Cook, 1987; Howard & Smith, 1986; Loyd & Gressard, 1984; Raub, 1981; Simonson, et al., 1987) have looked at correlations between computer anxiety and learner characteristics, and the overall influence of computer instruction on computer anxiety scores. There is very limited data regarding the effect of specific instructional methods on computer anxiety. None of these studies had, in fact, investigated the relationship of specific instructional strategies or interventions to computer anxiety.

Researchers (Banks & Havice, 1989; Bloom, 1985; Winkle & Mathews, 1982) stated the importance of using instructional strategies to reduce anxiety-related fears toward computers. Very few studies, however, have actually investigated the effect of instruction on individuals' computer anxiety. Cambre and Cook (1987) investigated factors related to computer anxiety and overall changes in computer anxiety scores over a five-day (10 hour) instructional workshop. The subjects (N=865 pretreatment; N=770 posttreatment), who signed up for an open introductory computer workshop, ranged in age from 9 to 75 years. Computer anxiety was measured by response to one embedded item "I am afraid to use computers." Precourse computer anxiety was significantly related to sex, but not age. Postcourse computer anxiety was significantly related to age, but not sex. Due to complete anonymity of the subjects, individual changes in computer anxiety could not be examined. The overall reported computer anxiety levels were, however, dramatically reduced.

Honeyman and White (1987) examined the effect of instruction on computer anxiety based upon the level of previous computer experience. The subjects (N=38) were students enrolled in an introductory computer course for teachers and administrators. The treatment involved 60 hours of instruction on the use of application software, with approximately 80% of the instructional time working on the computers (two persons per computer). The STAI was used to measure the level of anxiety with computers prior to instruction, at the midpoint of instruction, and the penultimate instructional session. Sex, age and occupation were not significantly related to anxiety scores. Previous level of experience was only related to beginning state anxiety. Overall state anxiety scores and last half anxiety scores were significantly improved during the instruction.

Howard (1986) then used a pre-post study on 39 managers enrolled in EMBA classes to investigate the effect of a microcomputer training session on computer anxiety and attitudes. Subjects were randomly assigned into the treatment and control groups. The treatment group received one and one-half hours of instruction and hands-on practice with Lotus 1-2-3 and use of DOS commands, while the control group received a lecture on BASIC programming over the same amount of time. While the treatment group had marginal reduction of computer anxiety, the control group had substantially raised level of computer anxiety. Results also showed no significant differences in treatment effect between the high anxiety subjects and low anxiety subjects.

Howard, Murphy, and Thomas (1987) looked at the effect of instructional sequence of BASIC (an unfriendly programming language) and VISICALC (a more user-friendly program) on computer anxiety and the relationship between computer anxiety and learner characteristics. One treatment group was taught BASIC before VISICALC, while the other group was exposed to VISICALC first. The 44 subjects were nonrandomly assigned into treatment groups. While computer anxiety scores were reduced over the five-week introductory computer course in the college of business, there were no significant differences between the two treatment groups. They used the same instruments as Howard's (1986) previous studies. Pretest computer anxiety was found to be significantly correlated (p=.05) to locus of control, math anxiety, trait anxiety, computer knowledge, computer experience, and class rank.

Because computer anxiety is a perception of threat or a fear relating to computer interaction, early strategies which are aimed at improving confidence would be expected to act as a positive intervention technique. Such confidence-building strategies in computer instruction would be expected to decrease fear of failure with computers---a factor in computer anxiety (Johanson, 1985; Rosen, Sears, & Weil, 1987). Cattell and Scheier (1958) concluded from an analysis of 13 studies investigating over 800 variables relating to anxiety, concluded that anxiety does, indeed, appear as a lack of confidence. Computer confidence in this study will be defined as the degree of positive expectancy of ones abilities and efficacy felt by individuals when they used computers, or when they considered the possibility of computer utilization.

M. W. Eysenck (1979) and Tobias (1979) stated that anxiety interferes with attention to task, and processing and encoding of information. Based upon this information-processing model, they recommend that instruction for anxious learners should allow learners to repeat content and reduce reliance on memory. Hands-on practice or experience during the instruction would also be expected to help maintain the learners' attention to the instructional task.

Bloom (1985) stated that through practice, learners who experience success build their confidence levels. Keller (1983), Keller and Kopp (1987), and Keller and Suzuki (1988), as part of an instructional design model for motivating learners, identified learner practice of new knowledge in a supportive atmosphere, such as with the instructor available, as motivating for students. Practice as a component of learner performance after demonstration of a skill is an element of Gagne's (1977) events of instruction. Practice is "one of the most powerful components in the learning process" (Dick & Carey, 1985, p. 138).

The practice, however, may be most helpful if it immediately follows the demonstration of the skill during instruction. Widmer and Parker (1983) prescribed the use of immediate hands-on practice for computer learners in order to reduce computer anxiety. Ernest and Lightfoot (1986) and Lewis (1988) also suggested that computer anxiety can be reduced if the instructor's demonstration of computer skills be immediately followed by learners' hands-on practice.

Giving learners opportunities for hands-on experience and practice of recently learned computer skills during instruction allows for the recommended repetition and improved information storage. Furthermore, as the learners successfully master computer skills, with the help of these strategies, their expectancy for success increases. This improvement in confidence level can be expected to reduce feelings of fear-related anxiety.

The literature supports the use of instructional interventions to reduce anxiety and fears related to computers during learning. Opportunities to practice computer skills, immediately after demonstration and during the instructional process is believed to be an important strategy for the reduction of computer anxiety. The treatments this study, therefore, investigated were the use of hands- on computer experience and practice as part of the instructional process and absence of computer practice during instruction. Because the learner's mastery of computer skills and confidence toward computers are believed to be linked to computer anxiety reduction, they were also investigated as variables in this study.

Methods

This study used multiple repeated measures in a 2 x 2 x 2 quasiexperimental design with in-class hands-on computer experience and practice during instruction, arousal-seeking tendency, coping style, sex, computer skill mastery, and locus of control as the independent variables. Each of the independent variables had two levels: (a) in-class hands-on computer experience and practice during instruction (hands-on computer experience or no hands-on computer experience), (b) sex (male and female), (c) arousal-seeking tendency (high and low arousal seeking), (d) coping style (high and low monitoring), and (e) locus of control (high and low externality). The dependent variables for this study, pre and post computer anxiety and computer confidence scores, were discrete variables.

Subjects

The subjects were 120 students (61 male, 58 female, and one non-report) enrolled in an undergraduate level introductory computer course at a large midwestern university. This course is a computer literacy and survey course with computer mastery emphasis in the use of electronic spreadsheets. Although this is a required course in the College of Business, many students with other majors enroll in this course. They averaged 20.7 years of age, however 68% were either 19 or 20 years of age at the beginning of the study. A majority of the subjects were, therefore, what might be termed traditional freshmen and sophomores.

The subjects had self-selected into the specific laboratory and lecture sections. Random assignment of subjects into treatment groups was not practical in this type of study in a natural setting. However, it was believed that assignment into sections, to some extent performed by computer because of the high demand for this offering, should provide fairly similar treatment groups.

The subjects had very little previous experience in the content to be taught during the treatments. At the beginning of the study, 61% of the subjects reported having no previous computer spreadsheet experience, and 86% reported using computers with spreadsheets or databases less than ten times.

Procedures

The two graduate assistants who volunteered to participate each had one of their two sections randomly assigned to one of the two treatment levels, the other section was then assigned into the other treatment. Because the laboratory sections of this course are traditionally taught in a lecture style with demonstration of computer skills by the instructors without the students at computers, the sections that were assigned to the no hands-on treatment were run in the usual manner, without hands-on computer experience and practice during the instruction. The section assigned to in-class hands-on computer experience during instruction, met in a different location for the eight week treatment period of the study, a computer lab in another building on campus that was approximately one-half mile away.

The subjects were given the pretests during the first lecture session of the second week of the semester, at which point the enrollments had become relatively stable. Due to time limits and constraints by the coordinator of the course, the pretest instruments were administered in the lecture class at a point when all of the treatment laboratory sections had met once. After the eight-weeks of instructional treatment, the subjects were then given the posttest instruments during the laboratory class (where the attendance rate was higher) to decrease the attrition rate. The resulting data were analyzed based upon the research questions.

Three subjects in each treatment section/class (a total of twelve subjects) were randomly selected and asked to complete a journal of their thoughts and feelings during the period of the treatment. Seven subjects (five males and two females) declined participation and other randomly selected subjects were asked to volunteer until the twelve volunteers were obtained.

The journals were collected from the subjects at the end of the eight week treatment period. Two subjects, one from each of the hands-on treatment sections, did not return their journals were eliminated from the analysis. The ten returned journals were coded and analyzed for the subjects' cognitive and affective perceptions of the computer instruction using content analysis techniques and qualitative matrix analyses to identify trends in responses.

Instructional Treatments

Instruction was primarily similar in the two treatments, except for the opportunity for students to have in-class hands-on computer experience and practice of skills during portions of the instruction. This contrasted with the other treatment, the traditional instruction for these classes, which consisted of the instructors demonstrating the computer skills and then repeating the demonstrations or answering students' questions. In both treatments the instructors demonstrated the computer skills using a personal computer, a liquid crystal display panel, and overhead projector. The traditional course structure only gave hands-on experience outside of class while the students were basically on their own, the laboratory room aides typically only helped with hardware problems. Both treatments included the same types of assignments, requiring outside hands-on computer experience in the laboratory room or some other computer environment. In each group students, on the average, waited three to four days to work on the computer outside of class.

The content covered during the treatment period -- handling of floppy discs, basic DOS commands, and spreadsheet operations -- was the same, and time on task was approximately equal in the two treatments. Specifically, the instructional treatment was composed of eight scheduled 50 minute laboratory sections, one per week. Students were first oriented to the computer, use of the keyboard, handling of diskettes, and basic DOS commands. Then instruction in the use of VP Planner, an electronic spreadsheet application program, was given during the last six-weeks of the treatment period. Spreadsheet skills taught during the treatment ranged from relatively simple operations such as using menus, saving, and loading files to more complex concepts such as the use of mixed cell addresses, formulas, and functions.

On the average, the instructor would spend the first 15 minutes of the class to occasionally take attendance, collect assignments, return graded work, administer short quizzes, and set up the demonstration computer, projector, and software. Of the remaining 280 minutes of instructional time-on-task in the lab classes during the hands-on treatment, approximately 200 - 220 minutes of time was spent by the students getting hands-on computer experience during the classroom instruction. Because the completion of laboratory assignments required computer work outside of class in the general computer laboratory room, all students in both treatments working on assignments received hands-on computer experience to some extent beyond the manipulated instructional treatments.

The two laboratory assignments during the treatment period involved the creation of spreadsheets using formulas or functions to calculate data, a budgetary spreadsheet (calculating monthly income and expenses for a fictional company) and a financial spreadsheet (calculating monthly payment amounts for various loan amounts at a number of different interest rates). Two laboratory quizzes were also administered during the treatment period and contributed toward the subjects laboratory grade. The first quiz covered basic information about floppy diskettes and simple spreadsheet terms. The second quiz was over spreadsheet formulas, operations, and more advanced terms.

The eight-week treatment period was used in the design of this study for reasons of ethics. This design allowed learners in both treatment groups to have approximately half of the course with the same traditional instructional techniques. Hands-on computer experience and practice during instruction was not expected to have detrimental effects on learners. If, however, the hands-on computer experience and practice during instruction had a positive effect, as expected, on the subjects over the course of the study, then this design diminished any disadvantage the other treatment group or those not participating in the study (but still being graded with those in the practice group) may have experienced over the total period of the course. Limited availability of the computer facility did not allow the other sections to have later access to the hands-on treatment as an alternative to the design.

Instructors

One faculty member, the coordinator of the course, taught the two large lecture classes for all twelve sections of this offering. Six graduate assistants each taught two of the laboratory sections, which met once a week for a 50 minute session. Two of the six graduate assistants volunteered to participate in the study. Two graduate assistants expressed an interest in participating, but declined due to scheduled back-to-back classes. It was not practical to teach consecutive classes ten minutes apart in two different areas of the campus. The other two instructors declined participation in the study without explanation for their decision.

Both lab instructors participating in the study had previous experience in teaching the laboratory section of the course and were Master's Degree level Graduate Assistants. They both stated prior to the study, that they thought the hands-on treatment would be better for the students, and therefore were happy to participate in the study. The instructors did not have the same teaching style, one was more serious but was better organized and more helping to the students. Both instructors were fairly consistent in style across the treatments. The instructors did not have previous experience in teaching this course with students' hands-on computer experience during the instruction. While one of the instructors adapted quickly to the new teaching environment, the other had some difficulty keeping the entire class on task when helping individual students to solve problems during the instruction. After the third week, the researcher suggested some teaching strategies to that instructor in order to improve the quality of hands-on time for the subjects, and immediate improvements were made.

Instrumentation

Subjects were given a packet containing a battery of instruments for the pretest during their first lecture meeting of the second week of classes in the spring semester. Administration of the pretest to the 250 students in each lecture section required approximately 35 minutes. These tests have been selected as measures of the variables investigated in this study. At the end of the eight-week study, a posttest was administered to the subjects in the treatment laboratory sections. Administration of the posttests to the approximately 40 subjects in each laboratory section required approximately 15 minutes.

Computer Anxiety. Computer anxiety, defined as the fear or apprehension felt by individuals when they used computers, or when they considered the possibility of computer utilization, was measured with the Computer Anxiety Subscale of the Computer Attitude Scale (CAS) (Gressard & Loyd, 1984). This scale contains ten items and uses a four-level Likert-type response scheme. Loyd and Gressard (1984) report this subscale of the instrument to have a coefficient alpha reliability of .86. The instrument was validated by judges ratings and an factor analysis of the ratings of 155 subjects. Computer anxiety scores may range from 10 to 40. High scores represent high levels of computer anxiety. The computer anxiety score was measured by summing the decoded responses to the items in the Computer Anxiety Subscale.

Computer Confidence. Computer confidence, defined as the degree of positive expectancy of ones abilities and efficacy felt by individuals when they used computers, or when they considered the possibility of computer utilization, was measured with the Computer Confidence Subscale (CCS) of the CAS (Loyd & Gressard, 1984a). This scale is comprised of 10 four-level Likert-type items. The CCS has a .95 alpha reliability coefficient. Validity was shown through a .73 correlation to computer anxiety scores and a factor analysis which showed loadings for the computer confidence items in a separate factor from the computer anxiety and liking items. The computer confidence score was measured by summing the decoded responses to the Computer Confidence Subscale. CCS scores may range from 10 to 40. High scores represent high levels of computer confidence.

Coping Style. Coping style, defined as the degree to which individuals monitor versus blunt stimuli from their environment when experiencing anxiety, was measured with the Miller Behavioral Style Scale (MBSS). The MBSS consists of four hypothetical stress situations, each of which is followed by four monitoring strategies and four blunting strategies. Subjects selected those strategies they would be likely to use. Miller (1987) reports the MBSS test-retest reliability over a 4-month period for this scale, $r = .75$, and scores have been found to be unrelated to sex, race, and age. The MBSS was validated experimentally, with blunting scores having a strong negative correlation (-.79) to observed monitoring behavior and the alpha coefficient for the blunting scale = .68 (Miller, 1987). Total score was derived by subtracting the number of blunting strategies selected from the number of monitoring strategies chosen. Scores may range from +16 to -16, and positive scores represent monitors and negative scores identify blunters.

Arousal-Seeking Tendency. The arousal-seeking tendency, defined as the extent of the level of arousal that an individual finds most comfortable, was assessed with the Measure of Arousal-Seeking Tendency (MAT) (Mehrabian & Russell, 1974). This 40-item instrument uses a nine level Likert-type format. The MAT has a four to seven week test-retest reliability of .88, and a Kuder-Richardson reliability coefficient = .87 (Mehrabian & Russell, 1974). Scores were measured by summing the coded responses to all forty items. Arousal-seeking tendency scores on this scale range form -160 to +160. High scores on this scale represented high arousal seeking-tendency.

Locus of Control. Rotter's (1966) 29-item Internal-External Control Scale (IECS) was used to measure the extent to which each subject holds generalized external control beliefs versus internal control beliefs. Using six filler items to disguise the purpose of the test, 23 internality-externality items are used to determine each subjects degree of externality. Scores may range from zero to 23. High scores on this scale represented a more external orientation. These generalized beliefs are most closely associated for an individual in a novel situation. The IECS has reported internal reliability estimates from .65 to .79 (Harrow & Ferrante, 1969). Test-retest reliabilities over a six-week period have been reported as .75 (Phares, 1976). The items in the scale were validated against ratings on subjects by physicians and nurses (Rotter, 1966).

Computer Experience. The amount of various types of computer experience by the subjects before and after treatment was assessed by questions regarding previous wordprocessing, programming, spreadsheet, database, and recreational use. Responses were assigned numerical values from 0 to 5 for each of the four questions, with high scores representing more computer experience in each of the four categories.

Computer Skill Mastery Level. The degree of computer skill mastery was measured by using the average of the grades obtained for computer laboratory class during the eight-week treatment period. The four grades during the treatment period were based on two in-class quizzes and two out-of-class assignments involving applications of spreadsheet skills taught during the laboratory class. High grades represented high computer skill mastery levels and were assigned by intervals corresponding to ranges of five percentage points.

Data Analysis

Descriptive statistics for this study include means for each treatment group in the measures of computer skill mastery level, MBSS, MAT, IECS, pre and post Computer Anxiety, pre and post CCS, scores. The number of male and female subjects and subjects' ages are reported for the total sample and for each treatment group. Means for each type of computer experience for both treatment groups before and after treatment are also reported. The mean response measures of the perceived interest, relevance, and satisfaction levels of the treatment laboratory classes, attendance rates, and time lag after class until working on computers are reported.

In order to address the research questions, analyses used two-way analysis of variance (Time X Treatment) on one repeated factor (Pre- and Post- Computer Anxiety; and Pre- and Post- Computer Confidence), three-way analysis of variance (Time X Treatment X Locus of Control, Sex, Coping Style, and Arousal-Seeking Tendency) on one repeated factor (Pre- and Post- Computer Anxiety), and partial correlations for the combined treatments on variables (Computer Skill Mastery Level to Computer Anxiety; and Computer Skill Mastery Level to Computer Confidence). Alpha for these statistical tests was set at 0.05.

The subjects' entries into the journals were coded using content analysis techniques and analyzed using qualitative matrix analysis techniques (Miles & Huberman, 1984). The horizontal categories in the matrix were consecutive two- week time periods during the study. The vertical categories were identified through a content analysis of the subjects' journal entries, including both positive and negative perceptions of the subjects.

Data

One hundred forty-seven subjects participated in the study. Twenty-seven subjects were eliminated from data analysis, due to attrition and excessive missing or out-of-range responses. The in-class hands-on computer experience during instruction treatment group contained 51 subjects and the no hands-on computer experience during instruction treatment contained 69 subjects. Sixty-one percent of the total subjects, and 61% in each treatment group reported they had never used a computer spreadsheet or database before the study.

Table 1
Comparisons of Mean Scores for Hands-On and Non-Hands-On Treatment Groups on Computer Anxiety, Computer Confidence, Locus of Control, Arousal-Seeking Tendency, and Coping Style Measures

Treatment Group	Computer Anxiety		Computer Confidence		Locus of Control	Arousal-Seeking Tendency	Coping Style
	Pre	Post	Pre	Post			
Hands-on	17.9	17.5	30.5	31.6	10.3	-19.7	1.79
No Hands-on	20.3	19.3	29.5	30.0	10.3	-26.0	3.11

The distributions by sex in the hands-on and no hands-on treatment groups were 26 males and 25 females, and 35 males and 33 females, respectively. The mean age of subjects in each group was 21 years. The mean pre- and post- anxiety, pre- and post-confidence, locus of control, arousal-seeking tendency, and coping style scores for the hands-on treatment group and the other treatment group are summarized in Table 1. Pretest computer anxiety and coping styles were significantly different ($p < .05$) for the two treatment groups.

The two groups had similar computer experience prior to the study (See Table 2). The only significant ($\alpha = .05$) differences in reported previous experience between the treatment groups was in the category of computer programming, with the hands-on subjects averaging approximately six more programming experiences than the other treatment subjects. The largest gain in computer experience for both treatment groups was in the category of database and spreadsheet use, because the lab instruction primarily covered computer spreadsheet applications. The subjects in each group waited an average of three to four days to work on computers after of class.

Table 2
Comparisons of Means for Hands-On and Non-Hands-On Treatment Groups on Pre- and Post Measures of Computer Experience for Wordprocessing, Spreadsheet/Database, Programming, and Recreation

Treatment Group	Wordprocessing		Database/ Spreadsheet		Programming		Recreation	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Hands-on	1.69	1.92	0.73	1.51	1.73	2.06	2.82	3.22
No Hands-on	1.70	2.07	0.70	1.42	1.12	1.39	2.83	3.15

NOTE. 1 = none; 2 = one to 10 times; 3 = 11 to 20 times; etc.

Analyses of variance for the eight research hypotheses showed no significant differences between the treatment groups, or the interactions, on the repeated measures of computer anxiety and computer confidence. Analyses of the journal entries, however, suggest some perceptual or experiential differences between the groups.

Journals

Categories of the subjects' perceptions were determined on the basis of the content of the entries in the ten journals. Journal entries were then coded by category, treatment, sex, and time period. Frequencies of coded entries were placed into a matrix (See Table 9, next page) in order to analyze changes over time and to identify trends in the entries by treatment group.

Some trends from the matrix analysis include the different distribution of comments between the two groups regarding either dislike for the laboratory instruction or dislike for the learning environment. Two entries (or .50 entries per subject) from the journals of the hands-on during instruction treatment subjects and 14 entries (or 2.33 entries per subject) from the other treatment subjects expressed a dislike for lab instruction or environment. Many more subjects in the treatments not having hands-on experience during instruction were negative about the laboratory learning experience.

A second unbalanced distribution was also identified from entries describing a liking for the laboratory instruction and learning environment. Six comments (or 1.50 entries per subject) by the hands-on treatment and two (or .33 entries per subject) by the other treatment were about liking the laboratory sessions. Hands-on treatment subjects made positive statements about the laboratory learning experience at a higher rate.

Table 9
Matrix of the Ratio of Coded Comments in Journals to Number of Subjects in the Hands-On and Non-Hands-On Treatment Groups by Two Week Time Period

Comment Category	First Two Weeks		Second Two Weeks		Third Two Weeks		Fourth Two Weeks	
	H*	N**	H	N	H	N	H	N
Anxiety	.75	.33	.25	.00	.00	.00	.00	.17
Negative Feelings	.50	.00	.25	.17	.25	.50	.00	.17
Dislike Lab Instructn.	.00	.33	.25	.33	.00	.50	.25	.33
Dislike Lab Envirnmt.	.00	.67	.00	.00	.00	.00	.00	.17
Confidence	.75	.50	.25	.00	.25	.33	.25	.00
Positive Feelings	.25	.25	.00	.17	.00	.00	.25	.67
Like Lab Instruction	.25	.17	.25	.17	.00	.17	.25	.00
Like Lab Envirnmt .	.25	.00	.00	.00	.25	.00	.25	.00
Internalization	.00	.00	.00	.00	.00	.17	.75	.17

NOTE. Values shown are the ratio of responses to the total number of subjects in group

* Hands-on During Instruction Treatment Group $n = 4$
** No Hands-on During Instruction Treatment Group $n = 6$

Entries specifically about the laboratory environment also showed differences between the treatment groups. All three positive comments about the laboratory environment were made by subjects in the hands-on treatment group. All five negative comments about the laboratory environment, on the other hand, were by subjects in the other treatment group.

Another pattern appeared as a change in the ratio of entries over time. In the category of negative feelings, the ratio of the number of entries per subject by the hands-on treatment subjects to the number of entries per subject by the other treatment subjects changed from 4.50:1.00 over the first four weeks to 1.00:2.33 over the last four weeks of the study. Entries were also analyzed by sex of the subject. While female subjects did report more thoughts and feelings overall than males, there were no discernable patterns of either positive or negative entries favoring either sex.

Discussion

The nonsignificant results of the analyses of variance may be due to the short treatment time. Honeyman and White (1987) only found significantly improved state anxiety scores for subjects after approximately 24 hours of hands-on computer instruction. Howard, Murphy and Thomas (1987) found no differential effects by treatment on computer anxiety after approximately 12 hours of hands-on computer instruction. These studies suggest that more hands-on computer experience during instruction, than the approximately three and one-half hours of treatment in this study, may be necessary to show significant differences between treatments.

The design of the study limited the treatment time to one-half of the laboratory instruction in the course as a compromise between the desire to have the maximum amount of treatment and the ethical considerations of all of the students enrolled in the course. The researcher did not want to put any students, whether participating or not participating in the study, at a large disadvantage of any type over the entire period of the course. Grades of some students on some of the assignments might have been influenced by the experiences related to the treatments. Limits on the availability of the computer facility used in the study did not allow for alternative designs which might ethically allow a longer treatment period, such as letting all sections use the facility the second half of the semester.

The low nonsignificant relationship of computer skill mastery level with computer confidence and anxiety is suggested within some of the anxiety literature. Eysenck (1984) explains that the performance levels of high anxiety and low anxiety subjects does not differ by a large degree. He summarizes the research that suggests highly anxious learners typically compensate for decreased cognitive abilities (due to anxiety) by increasing their effort on the learning task.

Analysis of variance calculations showed computer anxiety for the total sample to vary significantly by subjects' externality. This fact supports the computer anxiety literature, that locus of control is more directly related to computer anxiety than is achievement. The perception of control over ones success or failure with computers is related to the degree of anxiety one feels when interacting with computers (Bloom, 1985; Honeyman & White, 1987; Meier, 1985).

Changes in computer confidence significantly interacted with time for the total sample, while changes in computer anxiety did not significantly interact with time. This suggests that the effect of both treatments during the three and one-half hours of on task instruction over eight weeks is sufficient to produce significant changes in the confidence of learners. This also suggests that significant changes in confidence toward computers may take place more easily than changes in computer anxiety, or that the computer confidence subscale may be more sensitive than the computer anxiety subscale to the changes occurring in the subjects during the study.

While, statistical analyses showed no significant differences on the measures in the eight research hypotheses, analyses of the journal entries of the subjects in the two treatments did suggest some differences. The hands-on computer experience during instruction treatment subjects showed more positive and fewer negative journal entries than the other treatment. The hands-on treatment groups also reported a decreased number of negative feelings, while the other treatment groups recorded an increased number of negative feelings from the first half to the last half of the study. These patterns suggest that some differences by treatment groups, not significantly measurable by the instruments, may have occurred in the thoughts and feelings of the subjects during the period of the study.

When the hands-on treatment subjects were asked on the posttest "How did your having an opportunity to work at the computer during the computer lab classes affect your learning?", 53% of those subjects responded that "it helped my learning a lot," and 86% of those subjects reported that it helped to some extent. When asked a similar question "How did your having an oppor-tunity to work at the computer during the computer lab classes affect your confidence?" 32% of those subjects responded that it helped a lot, and 82% reported that it helped to some extent.

In spite of the implied changes in the affect of the subjects, these results suggest that more than the eight hours of instruction and three and one-half hours of hands-on computer practice during instruction may be necessary to significantly change learners' computer anxiety scores over non-hands-on treatments. Especially when working on relatively advanced computer skills,such as spreadsheet applications, in an introductory computer class with a minimum of laboratory experience, more time interacting with computers may be needed to make a significant impact on the computer anxiety levels of students.

Attendance of the laboratory sections differed significantly by treatment group, only 41% of the hands-on treatment group reported attending all eight laboratory classes during the study, while 74% of the subjects in the other treatment group reported attending all eight laboratory sections. The fact that both hands-on treatment groups met on Friday afternoon, while the other treatments met on Monday and Wednesday afternoon, may account for the attendance differences. The overall effect may have been minimal, only 11.8% and 7.2% of the hands-on and other treatment group subjects, respectively, missed more than one class. A cause of this difference in attendance rates may have been the different laboratory class location, about one-half mile from the Business College building, for the hands-on treatment group.

Another problem involved a potential leveling effect. On the pretest measure of computer anxiety, 10 subjects (8.3% of the sample) scored a ten---the lowest possible score---reflecting a lack of measurable computer anxiety. These subjects would not be able to show improvement to their posttest scores. Eight other subjects (6.7% of the sample) scored an eleven and had little chance of significantly improving their scores. A majority of these (ten subjects) were in the hands-on treatment groups (20% of that sample) compared to eight in the non-hands-on (12%), were in this range of extremely low computer anxiety scores. These differences may have impacted on the results.

Additionally, the instructors had not previously taught this class in a computer laboratory. One of the instructors was able to adjust the instruction in the new environment to keep the subjects on task when giving individual help. The other instructor, however, had some difficultly. Only after three weeks of treatment did this instructor become comfortable with teaching in the new environment. Several of the students were observed to be visibly distressed by the lack of attention for up to five minutes at a time. This confounding condition may have diminished the effects of the hands-on treatment for some students in that treatment class.

Summary

Analyses of sex, arousal seeking tendency, coping style, locus of control, and computer skill mastery on changes in computer anxiety and confidence showed no significant differences by treatment. Additional qualitative and quantitative data, however, suggested that the treatments may have had different affective effects on the some perceptions of the subjects. These results suggest that for short periods of time hands-on vs. non-hands-on instruction may not make very much difference in the anxiety, confidence, and performance of young relatively motivated learners. However if other affective concerns, such as attitudes, are important factors, then hands-on computer instruction is preferred.

A need for further research is suggested using similar treatments to this study, but with more sections involved, over a longer time period, with a delayed post-test the following semester. Such a study would better examine the effects of the treatment in a natural setting over the typical time period of an introductory course, as well as the long range effects of the instruction, while reducing some of the confounding variables and limitations of this study.

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