Order Number 9401940

Computer anxiety: Its related characteristics and its relationship to achievement in computer literacy of Slippery Rock University students

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Nova University, 1991

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Computer Anxiety: Its Related Characteristics and Its Relationship to Achievement in Computer Literacy of Slippery Rock University Students

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A Dissertation Submitted to the Central Staff of
the Center for Computer and Information Sciences of
Nova University
in Partial Fulfillment of the Requirements for
the Degree of Doctor of Education

August, 1991

Nova University
Center for Computer and Information Sciences

I certify that I have read and am willing to sponsor this dissertation submitted by Linda M. Boettner. In my opinion, it conforms to acceptable standards and is fully adequate in scope and quality as a dissertation for the degree of Doctor of Education (Ed.D.) at Nova University.

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Acknowledgments

My sincere gratitude is extended to my committee chairman Dr. John Kingsbury for his support and encouragement not only during the writing of this dissertation but also throughout my entire academic career with Nova University. I also wish to express my appreciation for the time and assistance given to me by the remaining members of my committee, Dr. George Fornshell and Dr. Richard Hunkler. An extra thank you is offered to Dr. Hunkler who helped me deal with details on a regular basis through the entire dissertation process.

This dissertation would not have been possible without the cooperation of several colleagues at Slippery Rock University. Mr. Frank Hulick, Mr. Govinda Rao, Mrs. Debra Hulick, and Mrs. Karen Ryder generously donated their class time to permit, and in some cases to execute, the administration of the standardized tests used to collect data. I also extend my appreciation to all of the students who willingly served as subjects.

I gratefully acknowledge the assistance and cooperation given to me on this project by the entire staff of the Instructional Resources Center at Iowa

State University. The staff granted me permission to use the standardized tests for data collection and answered any questions which I had.

My deepest thanks and affection are owed to my husband Bill for his constant support in spite of the disruption caused in our lives by my change in employment and pursuit of advanced degrees. He truly has been and continues to be the wind beneath my wings.

Abstract

This study was designed to investigate what effects the completion of a computer literacy course had on computer-related anxiety, what factors were correlated with computer anxiety, and what relation computer anxiety had to achievement in computer literacy. The possible correlates of computer anxiety considered in this study were gender, the number of semesters of previous computer experience, the number of university credit hours completed, and cumulative quality point average. Analyses were conducted to identify any differences in computer anxiety levels among groups of subjects with different declared major areas of study.

Slippery Rock University undergraduates (_N_ = 325) who were enrolled in the university's computer literacy course in the 1991 spring semester were surveyed before and after completing the course. Data about the subjects' computer anxiety levels and achievement in computer literacy were collected by means of standardized tests, and the demographic data for the subjects were gathered through a questionnaire and through the university's mainframe computer.

Hypotheses were tested at the 0.05 confidence level using either a point biserial correlation coefficient, a Pearson product moment correlation coefficient, a t-test for paired variates, or an analysis of variance. Because the analysis of variance indicated differences among the groups with different major areas of study, the Scheffe test was applied to identify which pairs of groups differed.

Of the possible correlates of computer anxiety tested, only gender and the number of university credit hours completed were found to be not significantly related to computer anxiety. The number of semester of previous computer experience was inversely related to computer anxiety, and both cumulative quality point average and achievement in computer literacy were determined to be positively correlated to computer anxiety. Differences in the mean computer anxiety levels of the groups of subjects were identified.

Based upon the results of this study, several curricular recommendations were made. Recommendations for future study suggested expanding the study to encompass more semesters and a larger population of subjects.

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Chapter 1

Introduction

Background

The continued infiltration of technology into nearly every phase of modern organizational existence has not been without difficulties. It has been estimated that more than half of the office work force currently use computers daily (Tom, 1987), and many blue-collar workers are now required to perform data entry tasks in lieu of the more traditional paper work often necessary in their jobs. However, employees sometimes resist technological changes and do not integrate the new technology into their work routines (Fann, Lynch, & Murranka, 1989). Such resistance causes problems and eventually disrupts the flow of information within the organization. Furthermore, if the introduction of the new technology causes undesirable or rapid change, the result on employees can be the production of stress, leading to anxiety, loss of productivity, and fear of the unknown (Khosrowpour & Culpan, 1989).

Thus, with the increasing reliance on computers, the needs and demands for computer literacy are growing. As educational systems strive to prepare students for participation in the work force, many students find that computers have become a part of their educational experiences (Norales, 1987). Not all students are comfortable with learning about computers, and educators are sometimes faced with an adult learner's fear of computers (Lewis, 1987). The list of fears about computers that novice users have include fear of breaking the computer, fear of appearing stupid, fear of encountering incomprehensible error messages, fear of losing control, and fear of a sense of futility (Kennedy, 1988). Although the reasons for these fears are most often ungrounded, it has been indicated that such computer anxieties are related to the achievement of college students enrolled in classes requiring the use of computers (Marcoulides, 1989).

The Problem

Students' discomfort with or avoidance of computers due to anxiety is likely to become a negative factor for them in a society where computer competence is increasingly vital for success in many professions. Given this necessity of using computers in many vocations, efforts must be made to find ways to reduce computer anxiety. The Computer Science Department at Slippery Rock University offers a computer literacy course every semester for students who are not majoring in computer science. The university does not require a student to enroll in this course, but each of several departments do require that it be taken by students whose major areas of study are within the department's discipline. Many students at Slippery Rock avoid computers and their use by postponing enrollment in this literacy course until not enrolling in it becomes a threat to a timely graduation. Others display extreme caution when using computers and attempt to complete any necessary computer work in as short a time as possible.

This study was undertaken, therefore, to research (a) what effects the completion of this university-level computer literacy course had on the students' computer-related anxiety, (b) what characteristics were correlated with computer anxiety, and (c) what relation computer anxiety had to achievement in computer literacy. Characteristics tested for correlation with computer anxiety included gender, the number of university credit hours completed, previous experience with computers (measured in terms of the number of semesters of formal classroom contact with computers), and cumulative quality point average. The computer anxiety levels of students grouped by major area of study was investigated.

The Hypotheses

The first hypothesis was that students who complete the computer literacy course at Slippery Rock University will demonstrate a lower computer anxiety level after the completion of the course than before it.

The second hypothesis was that there is a relationship between the pretest computer anxiety scores of the students who complete the computer literacy course at Slippery Rock University and their achievement in computer literacy.

The third hypothesis was that computer anxiety is correlated with gender, number of university credit hours completed, previous computer experience, and cumulative quality point average.

The fourth hypothesis was that the level of computer anxiety at the beginning of the computer literacy course will differ among groups of students with different major areas of study.

The Definition of Terms

Achievement in computer literacy. Achievement in computer literacy was operationally defined for the purpose of this study as the signed difference of a subject's posttest score on the Standardized Test of Computer Literacy minus his or her pretest score on the same instrument.

CAIN. CAIN is the abbreviation used for the Computer Anxiety Index which was used to measure students' computer anxiety (Maurer & Simonson, 1984a).

Computer anxiety. Computer anxiety is "the fear or apprehension felt by an individual when using computers, or when considering the possibility of computer utilization" (Montag, Simonson, & Maurer, 1984, p. 5). It is assumed that this fear is disproportionate to any actual threat presented by a computer.

Computer literacy. Computer literacy was operationally defined in this study as knowledge of basic computer terminology and such computer concepts as basic historical information on the development of computer technology, the common uses for computers in modern society and business, and the currently available types of software and hardware.

STCL. STCL is the abbreviation used for the Standardized Test of Computer Literacy which was used to measure students' knowledge of computer topics generally included in computer literacy courses (Montag & Simonson, 1984).

The Assumptions

The first assumption of this study was that the use of computers and the demand for computer-literate individuals will continue.

The second assumption was that the problem of computer anxiety hindering many individuals from reaching their potential productivity levels will not disappear by itself.

The third assumption was that the group of students who enroll in Slippery Rock University's computer literacy course during a specific semester is representative of the student population who will enroll in the course at some time during the educational process at that university.

The Limitations

This study did not compare or attempt to indicate the relative effectiveness of various possible treatments of the computer anxiety problem.

This study did not attempt to evaluate the effects of an instructor's teaching style on computer anxiety or on achievement in computer literacy.

This study was limited to the Slippery Rock University students who enrolled in the computer literacy course during one semester.

The Significance of the Study

Several departments at Slippery Rock University offer courses in which the use of a computer is required. However, these courses generally do not instruct students how to use either the computer or the necessary software. Each student is expected to possess that knowledge or to acquire it outside of these courses.

If it can be shown that completion of a course which includes instruction on the use of computers and specific software packages can significantly reduce computer anxiety and that lower anxiety levels are related to achievement when computers are used, then there exists a basis upon which some university-wide curriculum decisions can be made. Recommendations can be made concerning computer literacy as a possible prerequisite to enrollment in certain courses. The characteristics being investigated in this study for their possible correlations with computer anxiety could enhance these recommendations. Indications may be found as to when in the educational process a student could benefit from a computer literacy course, which major fields of study could be strengthened by requiring such a course, and how an instructor might teach the course.

Chapter 2

Review of the Literature

Research on Attitudes toward Computers

In search of optimal learning conditions for computer-using courses and vocations, several researchers have recently turned their attention to computer attitudes. Since positive attitudes toward computers correlate positively with useful computer-related skills (Kay, 1989b), an understanding of computer attitudes has been sought. Factors such as gender, age, and experience with computers have been studied to identify correlates of attitudes toward computers.

Norales (1987) attempted to determine postsecondary students' attitudes toward computers in an attempt to assist educators in curriculum planning and development. In a study of 109 university freshmen and sophomores enrolled in an introductory information systems course, the subjects responded to a questionnaire of items dealing with attitudes toward computers. Findings led the researcher to conclude that the subjects seemed (a) to view computers as a means of preparing for future employment, (b) to enjoy experiences with computers, (c) to perceive computers as an essential component in modern society, (d) to realize that technology has solved some major problems, (e) to recognize that technology and computers can be time-saving devices, and (f) to have positive attitudes toward computers, regardless of gender.

Increasing the number of demographic variables being studied, Morris (1988) focused on the relationships of age, income, level of education, and gender with attitudes toward computers. The sample of 380 subjects, selected from among the residents of two counties in Indiana, possessed the following characteristics: ages ranged from 17 to 90 years; annual incomes ranged from less than $10,000 to more than $50,000; and educational levels ranged from less than high school to college graduate. The sample contained slightly more females than males. A survey of Likert-type items was used to assess the subjects' attitudes toward computers. Gender showed only a weak, non-significant correlation with attitude, and income demonstrated no direct effect on attitudes toward computers. Both age and education were found to be related to attitudes, with the researcher concluding that education was likely to be of greater importance than age.

Kay (1989a, 1989b) conducted a study of 383 student teachers to explore differences between males and females in computer attitudes, computer literacy, computer locus of control, and commitment to computers. Each subject completed a survey of the affective and cognitive aspects of computer attitudes; five areas (experiences, basic skills, awareness, application software, and programming) of computer literacy; locus of control specific to the use of computers; and commitment to computers as demonstrated by the actual use of computers, an interest in them, and the promotion of their use. Kay (1989a) reported no significant gender differences in attitudes toward computers. However, males scored significantly higher in all five areas of computer literacy and on the computer locus of control scale. The latter score indicated that males perceived computer-related events to be more contingent upon their own behavior than the result of luck, chance, or some powerful other. Males also showed significantly more commitment to computers, with commitment being measured by a self-report instrument querying the subjects' intentions to participate in computer-related activities. Kay (1989b) concluded that positive attitudes toward computers were "correlated with strong computer-related skills and a perceived high degree of control over the computer" (p. 462).

To investigate how attitudes affected the use of microcomputers, Fann et al. (1989) designed a study of 829 undergraduates who were enrolled in a course requiring that at least one letter be written using a microcomputer. Subjects completed questionnaires with items pertaining to their prior experience with microcomputers and word processing, their attitudes toward computers, their use of computers during the semester in which the study was conducted, and their plans for their future use of microcomputers. The results indicated that subjects with more computer experience had more positive attitudes toward computers and that subjects with more positive attitudes were more likely to use the computer for optional assignments and predicted more use of the computer in the future.

Similar research (Byrd & Koohang, 1989) was conducted with 75 college students enrolled in introductory computer-based education courses and with a Likert-type instrument to measure attitudes toward computers. The results of the study suggested that having had computer experience was effective in creating positive attitudes toward computers and their usefulness and that a positive attitude toward the usefulness of computers was related to anticipated future use of computers.

Koohang (1989) studied what were termed as four types of attitudes toward computers (anxiety, confidence, liking, and perception of usefulness) and their associations with gender, keyboard familiarity, programming knowledge, word processing knowledge, database knowledge, and spreadsheet knowledge. Eighty-one university students participated in the study by completing a computer attitude scale and supplying the needed computer background data. The results indicated no significant gender differences, but significant relationships were found between the attitude components and each of the other variables.

In an attempt to duplicate and confirm previous research findings, Violato, Marini, and Hunter (1989) developed a four-factor model of attitudes toward computers and used it to study attitudes toward computers in prospective teachers. The four factors of the model were gender differences, comfort with computers, liking to interact with computers, and the perceived value of computers. A group of 401 undergraduate education majors participated in the study and completed a teacher computer attitude scale. Data from the subjects were fit to the researchers' four-factor model and then analyzed. The analysis indicated significant gender differences, and correlations were identified between liking to interact with computers and comfort with them and between liking to interact with computers and the perceived value of them.

To study the relationships between attitudes toward computers and the amount of computer use, Wu and Morgan (1989) surveyed 127 university students for data concerning their ownership of microcomputers, the number of hours per week spent using a microcomputer, and the number of hours per week spent using a mainframe computer. An instrument to measure perceptions about computers was constructed and administered by the researchers. Based upon their major fields of study, the subjects were separated into two groups for data analysis. One group contained those subjects with technologically-oriented majors such as engineering and computer science, and the other was comprised of those subjects with majors in the humanities and social sciences. It was determined that the students' attitudes varied by gender, by the type of computers used, and by the amount of time spent using computers. Those who spent more time using either type of computer had more favorable attitudes than those who used the computers less often, and males were slightly more positive about computers than females were.

Research on Computer Anxiety

Recent attention has also been directed toward computer anxiety and its effects. It has been hypothesized that computer anxiety in college students could present a significant barrier to developing positive attitudes toward computers, to learning about their technology, and to acquiring skills necessary for their use (Raub, 1981/1982). Reluctance to use computers has caused difficulty in implementing computer-assisted instruction and in convincing educators to integrate the use of computers into the curriculum (Violato et al., 1989).

Noting that computer anxiety in teachers using computer-assisted instruction could create apprehensive students, Winer and Bellando (1989) sought explanations for teachers experiencing difficulties in mathematics and computer literacy. Having found a model of vocational behavior developed by Holland (1985) to be useful in understanding success and satisfaction not only in employment but also in computer literacy training, these researchers questioned if the same model could be used to understand computer anxiety. A study was designed using college students with a variety of major fields of study in an attempt to obtain a range of Holland vocational-personality types. The subjects completed three standardized measures, one each for computer anxiety, mathematics anxiety, and vocational personality. The data led to the conclusion that students of different vocational-personality types differed significantly in their levels of computer anxiety. Moderate correlations were found between computer anxiety and mathematics anxiety in the subjects.

Howard, Murphy, and Thomas (1987) undertook a study to determine whether computer anxiety was significantly reduced in students enrolled in an introductory computer programming course, to determine whether the reduction of computer anxiety was significantly greater for students to whom user-friendly software was taught prior to user-hostile software, and to investigate the nature of computer anxiety by testing for relationships between it and locus of control, cognitive style, mathematics anxiety, trait anxiety, computer knowledge, computer experience, grade point average, age, and class rank. A questionnaire was composed from several already existing instruments and was administered as a pretest to gather the pertinent demographic data and to measure computer anxiety and the possible correlates listed above. The subjects were separated into two treatment groups, one of which was taught user-friendly software followed by user-hostile software and the other was taught the same software but in the reverse order. Both groups were then posttested at the end of the course with the computer anxiety instrument. Analysis of the data revealed that an introductory programming course was successful in significantly reducing computer anxiety. However, no significant differences were found in the computer anxiety levels of the two treatment groups. Of the nine factors explored for relationships with computer anxiety, three exhibited no correlation with it. Those three factors were cognitive style, grade point average, and age. Class rank (freshman, sophomore, junior, or senior) was negatively correlated with computer anxiety. Locus of control and trait anxiety were found to have moderately significant correlations with computer anxiety. Only mathematics anxiety, computer knowledge, and computer experience were determined to strongly correlate with computer anxiety. The researchers suggested that segregating computer anxious students into separate classes could be beneficial to both students and instructors. Since no alterations in the design of the programming course had been made for this study, the researchers theorized that perhaps greater reductions in computer anxiety could be realized in sections of a course specifically designed for computer anxious students.

In a study of 91 university students, Jones and Wall (1989) investigated the effects of a computer literacy course on students' computer anxiety levels and the relation of the levels of computer anxiety to the students' final grades in the literacy course. The amount of experience with computers, age, and gender were also examined for relationships to computer anxiety. The subjects were tested with a computer anxiety scale at the beginning and at the end of the computer literacy course, and they were asked to supply demographic data including age, gender, class rank, and the number of previous computer courses. No significant differences between the pretest computer anxiety scores and the posttest scores were found, and no significant relationships were indicated between the students' final grades and their levels of computer anxiety. Posttest computer anxiety scores, but not pretest scores, were significantly related to the number of previous computer courses. A significant relationship existed between computer anxiety levels and age but not between computer anxiety and gender.

Looking for factors related to computer anxiety in younger students, Hayek and Stephens (1989) used 52 senior high school students as subjects. Each subject was enrolled in a computer programming course. During the first week of the course, a demographic survey was completed by the students; and tests for computer anxiety, computer science aptitude, and mathematical competency were administered. The requested demographic data included each student's background in mathematics, the student's initial contact with a computer at school, the student's use of a computer on a job, the student's access to a computer in the home, the parents' educational background, and the parents' use of a computer on the job. At the end of the course, the computer anxiety instrument was readministered, and the final course grade for each student was recorded. The results revealed that students who had a computer at home had a lower level of computer anxiety than those without a computer and that students who had used computers prior to high school had a lower level of computer anxiety than those with no experience. Use of a computer on the job by a student, use of a computer on the job by the parents, the college degrees of the parents, and the gender of the student had no significant relationship to the student's level of computer anxiety. Students with lower levels of computer anxiety were found to attain higher levels of achievement in the programming course.

Williams and Johnson (1990) investigated the differences between the computer anxiety levels exhibited by education students and the levels exhibited by computer science students in a study involving 129 subjects. An instrument to measure computer anxiety was administered to the 65 education students by an education faculty member while a computer science faculty member administered the same instrument to the 64 computer science students. A significantly higher level of computer anxiety was found in the education students than in the computer science students, and further analysis indicated that females had a higher level of computer anxiety than males did.

A study which included 335 subjects was designed and conducted by Kernan and Howard (1990) to determine if computer anxiety and computer attitudes could be differentiated empirically. The subjects were all students in an introductory computer course; and several instruments, including both already existing and researcher-constructed, were used to assess the subjects' reactions to computers. The results indicated that computer anxiety could be distinguished from computer attitudes in a reliable and valid manner, and the researchers concluded that these two constructs should be explored independently rather than as though they were interchangeable concepts.

Research on Attitude and Anxiety Scales

Brown, Brown, and Baack (1988) identified three components of attitudes toward computers. These components included a behavior component which reflects an individual's action toward the computer, an affective component which indicates a person's inner feelings toward the computer, and a cognitive component which encompasses the beliefs held about computers. Several scales for measuring the components of attitudes toward computers have been introduced recently (Brown et al., 1988; Kernan & Howard, 1990; Koslowsky, Lazar, & Hoffman, 1988; Roszkowski, Devlin, Snelbecker, Aiken, & Jacobsohn, 1988). While these scales were designed to evaluate computer attitudes, Kernan and Howard (1990) reported the existence of evidence that many also measure some aspects of computer anxiety.

At least four different instruments for measuring computer anxiety have been developed in the last decade (Dukes, Dicenza, & Couger, 1989; Kernan & Howard, 1990): the Attitudes Toward Computers scale, the Computer Anxiety Index, the Computer Attitude Scale, and the Blomberg-Erickson-Lowery Computer Attitude Task. Dukes et al. (1989) demonstrated that these four instruments were highly intercorrelated, but Kernan and Howard (1990) noted that three of them were multidimensional scales. That is, they seemed to measure various attitudes toward computers as well as computer anxiety. The Attitudes Toward Computers scale, the Computer Attitude Scale, and the

Blomberg-Erickson-Lowery Computer Attitude Task identify not only computer anxiety but also such factors as the impact of computers on society, computer appreciation, computer confidence, and computer liking.

Summary

The recent research conducted on computer anxiety has produced varying results. Variables found to be significantly related to computer anxiety in some studies have been judged as unrelated to it in others. But whatever the causes and whatever the contributing factors are, means of reducing computer anxiety must be identified and implemented if computer education is to be effective. As more students are taught about computers, it is becoming more apparent that not everyone is comfortable with the technology. Although few strategies for reducing computer anxiety have been developed and little research has been done to determine the effectiveness of these strategies (Marcoulides, 1989), the literature (Lewis, 1988) does contain several suggestions for instructor behaviors and techniques to aid in successfully using computers in the classroom. These suggestions include the following:

1. Determine what the students expect to gain from the computer course, and match the course content to those expectations.

2. Be certain that the instructors are competent in and comfortable with the skills that the students will be expected to acquire.

3. Have access to sufficient numbers of computers for the number of students.

4. Give careful, step-by-step instruction through which much early success will be assured.

5. Remove some of the mystery of the computer by examining its working parts if possible. Literally take apart a computer.

6. Attempt to identify the students' worst fears, and demonstrate how these fears are usually not realized.

7. Recount personal experiences as a beginning computer user to relax learners and to give them some comfort with their own start.

8. Avoid computer jargon.

9. Provide frequent opportunities for hands-on experience.

10. Encourage learners to share their successes as well as their difficulties.

11. Reserve time in each class period for open discussion.

12. Reassure learners that it is all right to make mistakes.

Although it can be identified and even related to some other factors, few solutions to the computer anxiety problem in adult learners have been offered. Bloom (1985) advocated that any treatment of computer anxiety should be aimed at changing students' attitudes and suggested that a program of conceptual education, skill building, and practice be used. Konar, Kraut, and Wong (1986) concluded that training programs beginning with simple skills, as opposed to beginning with in-depth concepts, were more likely to reduce the fear of computers.

Chapter 3

Procedures and Methodology

The Subjects

The potential subjects were the students enrolled in the twelve sections of Slippery Rock University's computer literacy course, titled Computer Concepts, offered during the spring semester of the 1990-91 academic year who attended class on the day selected to administer the pretests. Permission to conduct research at Slippery Rock University with these subjects is contained in Appendix A on page 67. Three hundred sixty students were pretested and became the prospective subjects for this research. Once a student had been pretested, he or she was dropped as a subject in this study only if the student withdrew from the literacy course or withdrew from the university. Thirty-five students were dropped during the time of data collection. An attempt was made to contact each of these students by telephone to ascertain the reasons for either withdrawing from the course or withdrawing from the university. The information obtained from these contacts is shown in Appendix H on page 115 and Appendix I on page 116. The remaining 325 students were retained as subjects and were included in the data analyses that were conducted.

The Instruments

The Computer Anxiety Index (CAIN), created by Matthew Maurer and Michael R. Simonson and available through the Iowa State University Research Foundation, Inc., (Maurer & Simonson, 1984a) was selected from among the scales for measuring computer anxiety. The CAIN is a pencil and paper test of the attitudinal components of behaviors typically exhibited by computer anxious individuals. It contains 26 items with responses structured along a Likert-type 6-point scale from "Strongly Agree" to "Strongly Disagree." Maurer's master's thesis on the development and validation of this measure of computer anxiety (cited in Dukes et al., 1989) reported high levels of test-retest reliability ($\underline{r}$ = 0.90) and internal consistency (Alphas = 0.94 and 0.96) for the instrument, and several successful validity tests have been conducted on the CAIN (Dukes et al., 1989; Maurer & Simonson, 1984b). The instrument has been normed for groups of college students, junior high students, teachers, professionals, users, and others (Montag et al., 1984). The 26 CAIN items are listed in Appendix C on page 71.

The Standardized Test of Computer Literacy (STCL) was also developed at Iowa State University by Mary Montag and Michael R. Simonson (Montag & Simonson, 1984). The STCL is a pencil and paper test of competency in general computer literacy. It is comprised of three sections which can be administered individually or as a whole (Montag et al., 1984). Each section is a timed thirty-minute test. So as not to require that three days at the beginning of the semester and three days at the end of the semester be necessary to administer the STCL, the investigator decided to administer only Section #1 of this test. Section #1 contains 29 multiple choice items, with five choices of answers per item, which test knowledge of computer system functions, computer system configuration, computer hardware, computer software, the historical development of computers, and the operation of computers. Moreland (1989) reported that the STCL demonstrated good internal consistency (0.86 in the pilot test and 0.87 in a sample of more than 300 college students tested for normative purposes) and that it received a positive response when 34 computer education specialists evaluated its validity. The 29 items of Section #1 of the STCL are enumerated in Appendix D on page 73.

Permission to reproduce and to administer the items of the above two instruments is given in Appendix B on page 70.

The survey of general and historical data was an investigator-constructed instrument which requested the data needed for the proposed correlational tests. The survey items asked for name, gender, and the number of prior classes in which a computer was the main object of learning. The survey items are shown in Appendix E on page 83.

The Data Collection and Statistical Treatment

The data indicating the subjects' computer anxiety levels and knowledge of computer literacy topics were collected during two administrations of the CAIN and the STCL. One administration was done at the time of the second scheduled class meeting of the first week of the semester for each section of the Computer Concepts course, and the other administration was done during the first scheduled class meeting of the last week of the semester. The investigator administered the research instruments to as many subjects as possible. Where schedule conflicts made it impossible for the investigator to administer the instruments, a member of the Computer Science Department faculty conducted the administration. All administrators were given copies of the instruments' publishers' instructions, and all administrations were done according to those instructions.

The data concerning each subject's major area of study, cumulative quality point average, and number of credit hours completed were collected from the database of students available via the mainframe computer of Slippery Rock University. (To test the possibility of a recording error, the investigator, after collecting the data on all 360 possible subjects, chose 75 subjects at random and re-collected the data for those subjects. Since the second set of recorded data matched the original set, it was concluded that the probability of a recording error was very small.)

The subjects' responses to each of the two administrations of the CAIN and the STCL were computer graded, using the answers supplied by the instruments' publishers, and converted to anxiety scores and computer literacy scores. (All of the collected data were entered into a statistical package designed for a microcomputer and distributed by SPSS Inc. (1988) in Chicago, Illinois.) The statistical analyses described below were performed.

The first hypothesis. The null statement of the first hypothesis was as follows: There is no difference between the pretest computer anxiety scores for Slippery Rock University students enrolled in the computer literacy course and the posttest computer anxiety scores for the same students.

The data to test this null hypothesis were obtained from the two administrations of the CAIN. These data fell into the observation category discussed by Leedy (1989). These observations were the subjects' scores on the CAIN and were quantified and numerical. Each subject's score, derived from the student's CAIN responses, was a discrete value in the range from 26 to 156, with higher numbers indicating more computer anxiety.

The subjects' responses on the CAIN were converted to an anxiety score for each subject. The response designated by the instrument's authors as indicative of the least amount of anxiety had been assigned a weight of one by the authors. The neighboring response had been assigned a weight of two, the next distant response a weight of three, and so on across the six-point response scale, with the response at the opposite extreme of the scale having been assigned a weight of six. The sum of the weights assigned to a subject's responses to the 26 CAIN items comprised his or her anxiety score.

The t-test for paired variates (Alder & Roessler, 1964) was employed to compare the subjects' pretest and posttest scores. Leedy (1989) stated that this test is used to determine whether two large, related samples differ to a significant degree. The two samples to be compared were paired data drawn from one population, where each pair was comprised of the pretest computer anxiety score and the posttest computer anxiety score for one subject. Using the t-test, the null hypothesis was tested for significance at the 0.05 confidence level.

The second hypothesis. The null statement of the second hypothesis was as follows: There is no relationship between the pretest computer anxiety scores for Slippery Rock University students enrolled in the computer literacy course and the achievement in computer literacy scores for the same students.

The data used as one variable in testing this null hypothesis were obtained from the CAIN as described above. The data for the second variable were obtained from the STCL. These data also fell into the observation category discussed by Leedy (1989), and these observations were quantified and numerical. Each subject's score for the STCL was a discrete value in the range from 0 to 29, indicating the number of questions answered correctly.

The subjects' responses on the STCL were converted to an achievement score for each subject. The achievement score was computed according to the operational definition of achievement in computer literacy stated in Chapter 1 on page 5. Based on that operational definition, each achievement score was a signed value in the range from -29 to +29.

A Pearson product moment correlation coefficient (Gerberich, Green, & Jorgensen, 1962) was used to determine the relationship, if any, between the pretest computer anxiety score and the achievement in computer literacy score. Leedy (1989) stated that this test is used to indicate the degree of relatedness between two continuously-valued variables being correlated and that it "reveals the nature of the relationship: whether the facts are closely or distantly related" (p. 199). Using the Pearson product moment correlation coefficient, the null hypothesis was tested for significance at the 0.05 confidence level.

The third hypothesis. The following null hypotheses were formulated from the third hypothesis:

1. There is no relationship between the pretest computer anxiety scores for Slippery Rock University students enrolled in the computer literacy course and the gender of the same students.

2. There is no relationship between the pretest computer anxiety scores for Slippery Rock University students enrolled in the computer literacy course and the numbers of university credit hours completed by the same students.

3. There is no relationship between the pretest computer anxiety scores for Slippery Rock University students enrolled in the computer literacy course and the numbers of semesters of previous computer experience of the same students.

4. There is no relationship between the pretest computer anxiety scores for Slippery Rock University students enrolled in the computer literacy course and the cumulative quality point averages of the same students.

The data used as one variable in testing each of these null hypotheses were obtained from the CAIN as described above. The data for the second variable in the first and third null hypotheses were obtained from the subjects via the demographic data survey. The data for the second variable in the second and fourth null hypotheses were obtained via the university's mainframe computer from existing databases. All of these data fit into the observation category discussed by Leedy (1989), and these observations were quantified and numerical. (Gender was converted to numeric representation by arbitrarily giving female a value of 0 and male a value of 1.)

A point biserial correlation coefficient (Young & Veldman, 1965) was used to determine the relationship, if any, between the pretest computer anxiety scores and gender. Leedy (1989) stated that this test is used to indicate the association between two variables when one is continuous and the other is a true dichotomy. Using the point biserial correlation coefficient, the null hypothesis was tested for significance at the 0.05 confidence level.

A Pearson product moment correlation coefficient (Gerberich et al., 1962) was used to determine the relationship, if any, between the pretest computer anxiety score and each of the remaining variables listed above: the number of semesters of formal computer experience, the number of university credit hours completed, and the cumulative quality point average. Leedy (1989) stated that this test is used to indicate the degree of relatedness between two continuously-valued variables being correlated. Using the Pearson product moment correlation coefficient, these null hypotheses were tested for significance at the 0.05 confidence level.

The fourth hypothesis. The null statement of the fourth hypothesis was as follows: There are no differences among the pretest computer anxiety scores for the groups of Slippery Rock University students enrolled in the computer literacy course, where the groups are formed based upon the students' declared major fields of study.

The data to test this null hypothesis were obtained from the CAIN. These data fell into the observation category discussed by Leedy (1989). These observations were the subjects' scores on the CAIN and were quantified and numerical. Slippery Rock University has assigned each academic department to one of three colleges: the College of Arts and Sciences (CAS), the College of Education and Human Service Professions (CEHSP), and the College of Information

Science and Business Administration (CISBA). Each subject who had declared a major area of study was placed in the group corresponding to the college containing the academic department offering the major. All students with no declared major area of study were placed into a fourth group called UNDECLARED. Appendix J on page 119 lists the academic departments within each college at Slippery Rock.

An analysis of variance (Sanders, 1990) was employed to compare the pretest computer anxiety scores from each of the defined groups. Leedy (1989) stated that this test is to be used when data from independent samples are being compared. The groups represented independent samples since no subject was assigned to more than one group. Using the analysis of variance, the null hypothesis was tested for significance at the 0.05 level. When differences occurred among the groups, the Scheffe test (Winer, 1962) was applied to discern where those differences lay. Winer (1962) stated that the Scheffe test is one technique employed to make all possible comparisons when a multiple comparison procedure is needed with an analysis of variance test. Winer (1962) further stated that, among the available procedures for multiple comparisons, this test minimizes the possibility of rejecting a true hypothesis.

Chapter 4

Results

The 325 subjects involved in this study were tested twice with the CAIN and the STCL. A pretest was conducted during the first week of the 1991 spring semester, and a posttest was conducted during the last week of the same semester. Demographic data for each subject were collected using an investigator-constructed questionnaire and accessing the databases stored in Slippery Rock University's mainframe computer. The raw demographic data collected are shown in Appendix F on page 84, and the raw data collected from the pretest and posttest administrations are given in Appendix G on page 100.

The First Hypothesis

Shown in Table 1 are summary statistics for the two administrations of CAIN.

The differences between each subject's pretest and posttest scores on the CAIN were analyzed by a paired t-test. The results of the analysis are shown in Table 2.

An inspection of Table 2 reveals that, for the null hypothesis concerning the difference between the

Table 1

Pretest and Posttest Scores on the Computer Anxiety Index

Administration of the CAIN	Mean	Standard deviation	Minimum	Maximum
Pretest	65.006	19.824	26	142
Posttest	59.606	19.612	26	120

Table 2

Paired T-Test for Pretest and Posttest Computer Anxiety Index Scores

Measurement	Value
Mean of the differences	5.400
Standard deviation of the differences	16.551
Degrees of freedom	324
t	5.88 **

** $p <= 0.01$

pretest and the posttest computer anxiety scores, the *t* value is significant at the 0.05 confidence level. Thus, this null hypothesis was rejected; and it was concluded that there are significant differences between the pretest computer anxiety scores for Slippery Rock University students enrolled in the computer literacy course and the posttest computer anxiety scores for the same students.

The Second Hypothesis

An achievement in computer literacy score was computed for each subject by subtracting the subject's pretest STCL score from the posttest STCL score. A summary of the raw pretest STCL scores, the raw posttest STCL scores, and the derived achievement scores is given in Table 3.

The achievement scores and the pretest CAIN scores were tested using a Pearson product moment correlation coefficient. A correlation coefficient of r = 0.1293 was computed and was determined to be significant at the 0.05 confidence level. Thus, the null hypothesis concerning the pretest computer anxiety scores and the achievement in computer literacy scores was rejected; and it was concluded that there is a significant relationship between the pretest computer anxiety

Table 3

Pretest and Posttest Scores on the Standardized Test of Computer Literacy and the Derived Achievement Scores

Score	Mean	Standard deviation	Minimum	Maximum
Pretest STCL	11.400	3.493	0	22
Posttest STCL	13.142	3.800	3	23
Achievement	1.735	4.133	-17	12

scores for Slippery Rock University students enrolled in the computer literacy course and the achievement in computer literacy scores for the same students.

The Third Hypothesis

The subjects were grouped by gender, and the pretest CAIN scores for the two groups were analyzed. A summary of the pretest CAIN scores for each group is displayed in Table 4.

A point biserial correlation coefficient of r = 0.0740 was computed and was determined to be not significant at the 0.05 confidence level. Therefore, the null hypothesis stating that there is no

Table 4

Pretest Scores on the Computer Anxiety Index by Gender

Gender	Frequency	Mean	Standard deviation
Female	166	66.440	21.029
Male	159	63.509	18.429

relationship between the pretest computer anxiety scores for Slippery Rock University students enrolled in the computer literacy course and the gender of the same students was not rejected.

Table 5 contains a summary of the demographic data collected for each subject dealing with the number of semesters of previous computer experience, the number of university credit hours completed, and the cumulative quality point average. To the nearest percent, 35% of the subjects in this study had no previous experience with computers while 36% had one semester, 18% had two semesters, 4% had three semesters, 5% had four semesters, and 2% had five semesters of experience. The number of university credit hours completed ranged from zero to 186, with

Table 5

Previous Computer Experience, Credit Hours Completed, and Quality Point Average (QPA)

Data item	Mean	Standard deviation	Minimum	Maximum
Previous semesters	1.157	1.221	0	5
Credit hours completed	53.778	36.411	0	186
Cumulative QPA	2.631	0.697	0.000	4.000

the mean being 53.778. Of the 325 subjects, 107 were freshmen, 71 were sophomores, 99 were juniors, and 48 were seniors. The quality point averages of the subjects varied from 0.000 to 4.000 on a 4.000 scale.

The results of the planned Pearson product moment correlation tests between each of the items shown in Table 5 and the pretest CAIN scores are given in Table 6.

As is shown in Table 6, the correlation coefficient for the number of university hours completed is not significant. Therefore, the null

Table 6

Pearson Product Moment Correlation Coefficients for Demographic Data Items and the Pretest Scores on the Computer Anxiety Index

Data item	r
Previous semesters	-0.292 **
Credit hours completed	0.061
Cumulative QPA	0.127 *

Note. QPA = quality point average.

* $p \le 0.05$

** $p \le 0.01$

hypothesis stating that there is no relationship between the pretest computer anxiety scores for Slippery Rock University students enrolled in the computer literacy course and the number of university credit hours completed by the same students was not rejected.

However, Table 6 indicates that the correlation coefficient for the number of semesters of previous computer experience is significant at the 0.05

confidence level. Thus, the null hypothesis concerning previous computer experience and the pretest computer anxiety scores was rejected; and it was concluded that there is a significant relationship between the pretest computer anxiety scores for Slippery Rock University students enrolled in the computer literacy course and the number of semesters of previous computer experience of the same students.

Further, Table 6 shows that the correlation coefficient for cumulative quality point average is significant at the 0.05 confidence level. Thus, the null hypothesis concerning cumulative quality point averages and the pretest computer anxiety scores was rejected; and it was concluded that there is a significant relationship between the pretest computer anxiety scores for Slippery Rock University students enrolled in the computer literacy course and the cumulative quality point averages of the same students.

The Fourth Hypothesis

The subjects were grouped according to the colleges which contain the departments offering their major areas of study. The pretest CAIN scores for each group are summarized in Table 7. It should be noted that the group of subjects within the College of

Table 7

Pretest Scores on the Computer Anxiety Index by College of the Major Area of Study

College	Frequency	Mean	Standard deviation	Minimum	Maximum
CAS	39	67.872	20.429	35	127
CEHSP	139	70.072	20.771	31	142
CISBA	104	57.202	15.343	26	102
UNDECLARED	43	64.907	20.390	34	125

Note. CAS = College of Arts and Sciences; CEHSP = College of Education and Human Service Professions; CISBA = College of Information Science and Business Administration.

Education and Human Service Professions contained 78 prospective teachers whose future employment duties could include classroom instruction using computers.

The mean scores shown in Table 7 were tested using an analysis of variance. The results of the analysis are displayed in Table 8.

Table 8

Analysis of Variance for Pretest Scores on the Computer Anxiety Index for Subjects with Different Major Areas of Study

Source	Degrees of freedom	Sum of squares	Mean squares	*F*
Among groups	3	10221.961	3407.320	9.34 **
Within groups	321	117104.027	346.810	
Total	324	127325.988		

** $p <= 0.01$

The computed *F* ratio was determined to be *F* = 9.34, a value significant at the 0.05 confidence level. Thus, the null hypothesis concerning the computer anxiety scores for groups of subjects was rejected; and it was concluded that there are significant differences among the pretest computer anxiety scores for the groups of Slippery Rock University students enrolled in the computer literacy course, where the groups are formed based upon the students' declared major areas of study. Because differences were indicated among the groups of subjects, the Scheffe test was performed to identify exactly which groups differed from each other. The *F* critical value for all groups was found to be 3.97 for a 0.05 confidence level. Table 9 lists the computed *F* ratio for each pair of groups.

Table 9

F Ratios for the Scheffe Comparison Test

Comparison	*F*
CAS vs CEHSP	0.135
CAS vs CISBA	2.950
CAS vs UNDECLARED	0.164
CEHSP vs CISBA	9.004 *
CEHSP vs UNDECLARED	0.800
CISBA vs UNDECLARED	1.650

Note. CAS = College of Arts and Sciences; CEHSP = College of Education and Human Service Professions; CISBA = College of Information Science and Business Administration.

* $p <= 0.05$

An inspection of Table 9 reveals that only one pair of groups differed significantly. The group of subjects whose major areas of study were within the College of Education and Human Service Professions had a mean computer anxiety score which was significantly higher than that of the group whose major areas of study were within the College of Information Science and Business Administration.

<u>Summary</u>

The difference between the subjects' computer anxiety levels at the beginning of the computer literacy course and their computer anxiety levels at the end of the course was found to be significant. Of the characteristics tested for correlations, achievement in computer literacy, the number of semesters of previous experience with computers, and cumulative quality point average were determined to be significantly related to computer anxiety. The relationship between computer anxiety and gender and the relationship between computer anxiety and the number of university credit hours completed tested as not significant. Differences in the mean levels of computer anxiety for groups of subjects with different major areas of study were found.

Chapter 5

Discussion, Implications, and Recommendations

Discussion and Implications

The number of student withdrawals between the time of the pretest and the time of the posttest administrations of the standardized tests was 35, representing 9.72% of the prospective subjects. An inspection of Appendices H and I on pages 115 and 116, respectively, shows that none of the contacted prospective subjects withdrew either from Slippery Rock University or from the computer literacy course because of this study. However, some of the reasons given for withdrawal from the course appear to involve computer anxiety. Reasons expressing an inability to complete assignments in timely fashion, an inability to keep pace with the class, or a fear of a low grade resulting in a decline in quality point average may have a computer anxiety component.

Differences in computer anxiety between the genders which were found in earlier studies (Lewis, 1988; Violato et al., 1989; Williams & Johnson, 1990; Wu & Morgan, 1989) were not supported by this study. This research identified no significant differences, at the 0.05 confidence level, between the computer anxiety in females and that in males. Perhaps a change in the philosophy and practices of educators is partially responsible for the apparent reduction or elimination of the gender differences. In the past, males generally received more encouragement and support, and more pressure in some cases, to excel in the male-dominated disciplines of mathematics, science, and technology. Even if females had the intellectual skills for these domains, the skills often remained underdeveloped without an opportunity and the encouragement for growth. But recent years have seen a change in the educational community. Renewed and increased concern over the United States' ranking in technology among the world leaders has led to an emphasis in education on mathematics, technology, and the sciences. The encouragement in these areas has not been solely for males but rather for all students. The microcomputer revolution that has been occurring in elementary and secondary schools has provided a key opportunity for overcoming the gender-related stereotyping traditionally connected with technology. Males and females can be equally encouraged to learn about and to use computers. Thus, the changing socialization patterns for the genders may be contributing to fewer and lesser differences in computer anxiety levels between females and males. Even though both female and male instructors taught the computer literacy course during this study, no attempt was made to discern whether the gender of the instructor had an effect on the computer anxiety levels of the subjects.

Intuitively, it is reasonable to expect that the more computer experience a person has, the less computer anxiety he or she will feel. The analyses conducted in this study strongly supported this expectation in that the number of semester of previous computer experience was significantly, at the 0.01 confidence level, inversely correlated with computer anxiety. It is difficult, if not impossible, however, to interpret this correlation as a cause-and-effect relationship. It is not certain whether the lack of computer experience caused the computer anxiety or whether the computer anxiety and a fear of the technological unknown resulted in a lack of computer experience.

Further evidence to support the above expectation was found when the pretest computer anxiety levels were compared to the posttest levels. An average drop of

5.4 points in anxiety scores, more than 8% of the mean pretest score, was found. This decline was significant at the 0.01 confidence level, indicating that the completion of a one-semester computer literacy course significantly reduced computer anxiety levels. This study did not attempt to establish causation for the decline. However, it seems reasonable to speculate that the computer knowledge and computer experience gained by the subjects from the computer literacy course contributed to the reduction in computer anxiety.

The finding that the number of university credit hours completed was not significantly related to computer anxiety is an indicator that computer anxiety is not characteristic of any particular rank (freshman, sophomore, junior, or senior). It appears that computer anxiety is a problem faced by students at all levels of progress in their university education.

Unlike the findings in a study conducted by Howard et al. (1987), this study's results indicated a significant, at the 0.05 confidence level, positive correlation between cumulative quality point average and computer anxiety. A positive correlation indicates that the higher a subject's quality point average is, the higher the subject's level of computer anxiety is. Such a correlation could have resulted because brighter students may have a fear of a drop in quality point average coupled with a fear of the computer when enrolling in a course which demands frequent use of a technological unknown. The two fears may fuel each other, resulting in a higher incidence of computer anxiety.

The significant differences between groups of subjects formed on the basis of declared major areas of study provide several implications for educators. Instructors must be aware of the wide variation in the characteristics of their students as computer users in relation to the students' previous computer experience, knowledge of software, and types of previous training. Many groups of students may require a variety of training options to meet their varying needs. Novice users may need much convincing that their time and frustrations at the beginning will be outweighed by benefits in the future. Learning a set of commands for a particular application software package may be compared to learning the multiplication tables: the drills do not appear to have any efficiency or use at first, but once learned they provide a means for completing tasks that were previously cumbersome or difficult. Other students may find that a computer-literate friend may be a more expedient or beneficial source of information than is a formal training program. Individual differences exist and must be recognized.

Post-secondary instructors need to assess their students continuously to remain aware of changes in their backgrounds of computer use and familiarity. As students receive more exposure to microcomputers in their elementary and high school educations, instructors need to respond to this increasing computer expertise. Without necessitating a rewriting of the curriculum for university courses, higher expectations in the form of more frequent and more complex computer assignments can address this need.

Of the 139 subjects in the College of Education and Human Service Professions (CEHSP), 78, representing 24% of all the subjects, had declared a major area of study which would result in the issuance of a teaching certificate at completion. These students aspiring to become teachers were within the group of subjects who demonstrated the highest mean computer anxiety level in this study. If Winer and Bellando (1989) were correct in stating that a teacher who is apprehensive about using computers may create computer-apprehensive students, then a critical problem faces those who feel that computer anxiety should be eliminated in a technological society. Action is necessary to reduce computer anxiety in prospective educators before they are given control of a classroom and perpetuate a negative response toward computers and their use.

Howard et al. (1987) suggested that it is so imperative to design introductory computer courses with careful consideration of the target audience that segregation of students on the basis of computer anxiety is needed. These researchers stated that such segregation could be accomplished through the use of a pretest to identify highly computer anxious students. The identified students could then be partitioned into separate sections of the training course. It is reasonable to believe that the computer anxious sections could be taught in a way that would reduce computer anxiety. Since math anxiety and computer anxiety are somewhat similar phenomena (Howard et al., 1987) and successful treatments for math anxiety have been developed, it appears optimistic that just-as-successful treatments can be found for computer anxiety. Segregation could also benefit students who have more computer knowledge, more computer experience, and less computer anxiety by permitting more advanced and accelerated material and an escape from the boredom and discouragement of a course directed at the computer illiterate.

The unexpected result in this study was the significant, positive correlation between computer anxiety and achievement. The literature review conducted as part of this research found only three earlier studies which investigated the relationship between computer anxiety and achievement, and each of the earlier studies used the subjects' performance in a selected course as the measure of achievement. Jones and Wall (1989) found no significant relationship between university students' final grades in a computer literacy course and their levels of computer anxiety. Hayek and Stevens (1989) reported that the final grades in a high school programming course were inversely related to the students' computer anxiety levels. In contrast, Bracey (1988) found a strong positive relationship between the number of completed homework assignments in a computer information systems course and the university students' levels of computer anxiety. Unlike these earlier studies, this investigator's research employed a standardized test of computer literacy as a measure of achievement. A standardized test was used instead of such measures of achievement as final grades because several instructors were involved in the teaching of the sections of the computer literacy course from which the subjects came and the standardized test seemed to be a more uniform measure.

However, a close examination of the current study's methods and procedures reveals a possible explanation for the positive correlation between achievement and computer anxiety. The standardized test of computer literacy used was a pencil and paper test of knowledge of computer system functions, computer system configuration, computer hardware, computer software, the historical development of computers, and the operation of computers. But no subject had to use a computer to complete any part of the test. Thus, the computer anxiety of the subjects may not have played a major role in the demonstration of the knowledge of the concepts learned in the course. A test of practical application of the computer skills learned in the computer literacy course may have produced a very different result. Further research is needed, however, to determine if this conjecture is indeed an explanation of the results obtained in this study.

Recommendations

The following recommendations concerning the curricular issues of a computer literacy course are offered:

1. Recognize the impact that the computer has had and is having, and recognize the need for a computer literate society.

2. Include computer literacy as a basic skill requirement of all Slippery Rock University students to provide an opportunity to present basic computer skills and concepts and to reduce computer anxiety. All incoming students could be given a test on which a passing grade would exempt the student from being required to enroll in the computer literacy course.

3. Make the computer assignments in the computer literacy course practical applications of the software and skills being taught, applications that are likely to be used in the future by the students. This approach should help to reinforce the ideas that

computers are useful and that the skills being learned will be used in the workplace.

4. Encourage prospective teachers to complete more than one university-level computer science course in an attempt to reduce their computer anxiety levels even further. Many of them, especially those interested in elementary education, are likely to be expected to make regular use of a computer as part of the curriculum.

5. Explore the possibility of creating homogeneous sections of the computer literacy course, where the segregation is done on the basis of computer experience or computer anxiety. This could give novice users the opportunity to acquire new skills without the added pressure of having to compete with some experienced users and could give experienced users the opportunity to progress further than would be possible in a course aimed at beginners.

These recommendations for future study are made:

1. Replicate this study over a period of several semesters to increase the population size in an effort to produce information on a broader spectrum of Slippery Rock University students.

2. Replicate this study using subjects from several different universities to obtain information on a broader spectrum of society in general.

3. Replicate this study using an in-house test as a measure of achievement rather than the standardized test of computer literacy used in this study. The in-house instrument could test both the concepts presented and the computer skills taught in the course, perhaps resulting in a more complete indication of achievement.

4. Conduct research which investigates the relationship between the changes in the computer anxiety levels of the students in the computer literacy course and the teaching styles of the instructors of the course.

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Appendix A

Permission to Conduct Research at Slippery Rock University

PROTOCOL FOR CONDUCTING RESEARCH ON HUMAN SUBJECTS

INSTITUTIONAL REVIEW BOARD FOR THE PROTECTION OF HUMAN SUBJECTS

SLIPPERY ROCK UNIVERSITY

THIS DOCUMENT MAY BE REPRODUCED BY TYPEWRITER OR WORD PROCESSOR TO ALLOW FOR ADDITIONAL SPACE IN ANSWERING QUESTIONS. RESPONSES MUST BE TYPED OR REPRODUCED VIA WORD PROCESSOR.

Project Title: Computer Anxiety: Its Related Characteristics and Its Effect on Achievement in Computer Literacy of SRU Students

Principle Investigator (Faculty/Staff): Linda Boettner
Computer Science Department

Co-Investigator(s): none

Project Period: Spring Semester, 1991
Location of Study: SRU

Source of Financial Support: Self-Financed

1. Hypothesis to be tested: There is no significant difference in the level of computer-related anxiety in students before and after completion of a computer literacy course at the university level.

2. Human Subjects:
   Number: 300   Ages: 18-22+   Gender: both
   Race: no restriction

   A) Diagnostic criteria for inclusion: enrolled in CpSc 110 at SRU

   B) Criteria for rejection: withdrawal from CpSc 110

   C) Restrictions (if any) on use of other drugs/treatments: none

3. Experimental Design:

   A) What kind of controls will be used: no control group to be used

   B) Single-blind, double-blind, other: single-blind

   C) If randomized, how: not applicable

   D) Plans for statistical analysis: Wilcoxon signed rank test and correlation coefficients will be computed

   E) Radiation to be used: results will be reported in a dissertation required for the investigator's doctoral program

4. What will be done to subjects? (Attach sheet if necessary)

   A computer-anxiety measure, a computer literacy measure, and a survey for historical data will be administered to the subjects at the beginning and at the end of the literacy course in which the subjects are enrolled.

   A) What treatments, normally used, will be omitted for this study? none

   B) What could possibly go wrong during the study? nothing

   C) How will you protect against or treat these adverse effects? not applicable

   D) What are the hazards of being in the control group? none

   E) What details of the study are kept secret from the subjects? The measure of computer anxiety will be identified as an opinion survey rather than as an anxiety measure.

   F) Payment amount (if any) for the subjects? none

5. What are the potential benefits for the subject, as well as benefits which may accrue to society in general, as a result of this study?
   Evidence may be found to indicate that CpSc 110 Computer Concepts ought to be required of all students at Slippery Rock University or at least be included in the proposed liberal education program.

6. Analyze the risk-benefit ratio (i.e., what benefits outweigh the foreseeable potential risks to the subjects of this study).
   not applicable since there are no risks

7. Other pertinent information: none

Linda Boettner	S. W. Joshi
Principal Investigator	Department Chairperson
	December 11, 1990
Co-Investigator	Date

Appendix B

Permission to Reproduce and to Administer the Instruments

College of Education
Instructional Resources Center
Quadrangle Building
Iowa State University
Ames, Iowa 50011

January 7, 1991

Linda M. Boettner
Computer Science Department
106 Maltby Center
Slippery Rock University
Slippery Rock, PA 16057

Dear Mrs. Boettner:

Having purchased a site license and having agreed to acknowledge the assistance and cooperation of the Instructional Resources Center and its staff, you are granted permission to reproduce and to administer both the Computer Anxiety Index and the Standardized Test of Computer Literacy as needed for the data collection phase of your doctoral dissertation. Permission is also given to include a copy of the tests' items as appendices in the dissertation proposal and in the final dissertation document.

Sincerely,

Michael R. Simonson
Professor

Appendix C

The Instrument for Measuring Computer Anxiety

COMPUTER OPINION SURVEY

Instructions: Please indicate how you feel about the following statements. Use the scale below to indicate your feelings. Mark the appropriate circle on your answer sheet.

1 = Strongly agree	4 = Slightly disagree
2 = Agree	5 = Disagree
3 = Slightly agree	6 = Strongly disagree

1.	Having a computer available to me would improve my productivity.	1 2 3 4 5 6
2.	If I had to use a computer for some reason, it would probably save me some time and work.	1 2 3 4 5 6
3.	If I use a computer, I could get a better picture of the facts and figures.	1 2 3 4 5 6
4.	Having a computer available would improve my general satisfaction.	1 2 3 4 5 6
5.	Having to use a computer could make my life less enjoyable.	1 2 3 4 5 6
6.	Having a computer available to me could make things easier for me.	1 2 3 4 5 6
7.	I feel very negative about computers in general.	1 2 3 4 5 6
8.	Having a computer available to me could make things more fun for me.	1 2 3 4 5 6
9.	If I had a computer at my disposal, I would try to get rid of it.	1 2 3 4 5 6
10.	I look forward to a time when computers are more widely used.	1 2 3 4 5 6

11. I doubt if I would ever use computers very much. 1 2 3 4 5 6

12. I avoid using computers whenever I can. 1 2 3 4 5 6

13. I enjoy using computers. 1 2 3 4 5 6

14. I feel that there are too many computers around now. 1 2 3 4 5 6

15. Computers are probably going to be an important part of my life. 1 2 3 4 5 6

16. A computer could make learning fun. 1 2 3 4 5 6

17. If I were to use a computer, I could get a lot of satisfaction from it. 1 2 3 4 5 6

18. If I had to use a computer, it would probably be more trouble than it was worth. 1 2 3 4 5 6

19. I am usually uncomfortable when I have to use computers. 1 2 3 4 5 6

20. I sometimes get nervous just thinking about computers. 1 2 3 4 5 6

21. I will probably never learn to use a computer. 1 2 3 4 5 6

22. Computers are too complicated to be of much use to me. 1 2 3 4 5 6

23. If I had to use a computer all the time, I would probably be very unhappy. 1 2 3 4 5 6

24. I sometimes feel intimidated when I have to use a computer. 1 2 3 4 5 6

25. I sometimes feel that computers are smarter than I am. 1 2 3 4 5 6

26. I can think of many ways that I could use a computer. 1 2 3 4 5 6

Appendix D

The Instrument for Measuring Computer Literacy

SECTION #1

Instructions: Read each question carefully and then select the most appropriate answer from the five choices and mark the appropriate circle on the answer sheet. If you do not know the answer, try to make an educated guess if possible, otherwise leave the item blank.

1. Which of the following is the primary reason that program instructions and data are handled by modern digital computers in binary form?

   a. A given value may be represented in binary form using fewer place values than would be required in base ten.
   b. Binary numbers are easier for the operator to enter into the keyboard than are base ten numbers.
   c. It is simplest to design circuits which operate in only two logical states rather than ten separate states.
   d. Binary numbers more accurately represent logical operations than would the far preferable base 8 system.
   e. The binary number system is a traditional, though unnecessary, holdover from the days of vacuum tube technology.

2. The major purpose of a computer software program is to

   a. supply instructions to the computer.
   b. read punched cards into the computer.
   c. develop an algorithm for problem solving.
   d. design input data for the computer.
   e. output the results of the operation of the computer.

3. Computer systems are commonly used to perform "data processing" functions. This term may best be described as

   a. the process of critically analyzing large sets of data and making subjective decisions based on that data.
   b. a type of information management used primarily in business and government applications, usually involving statistical operations.
   c. the exclusive domain of mainframe computers--data processing is beyond the capabilities of a microcomputer because of its limited memory.
   d. the process of handling information, including such operations as sorting, calculating, recording, classifying, and summarizing.
   e. the process of adding, subtracting, multiplying, and dividing numbers in base two.

4. Place in order from first to last the operations that take place as a problem is being solved with the aid of a computer.

   1. print a report
   2. read data into the computer
   3. develop and program an algorithm
   4. calculate the results
   5. code the data onto input medium

   a. 1,2,3,4,5
   b. 2,1,5,4,3
   c. 3,5,2,4,1
   d. 5,4,3,2,1
   e. 3,5,1,2,4

5. Computers and certain computer peripherals may be classified as either digital or analog devices. Which of the following groups includes exclusively digital hardware devices?

   a. CPU, RAM chip, game paddle
   b. ROM chip, serial interface card, microprocessor
   c. CPU, compiler, word processing program
   d. RAM chip, ROM chip, operating system
   e. BASIC, integrated circuit, interpreter

6. Computer hardware represents only a portion of the cost of a complete computer system because

   a. disk drives, printers and other peripheral devices are quite expensive.
   b. quality computer systems, such as Apple IIe or the IBM PC, require extra interface cards and controller cards in order to be fully functional.
   c. a computer's true cost must be weighed against the eventual savings in time and human resources that the computer makes possible.
   d. the operating system and other modern language programs resident in ROM must be obtained at extra cost.
   e. computer hardware cannot function without adequate software, that represents an additional expense.

7. Batch processing refers to a processing mode in which

   a. a program is run with direct interaction between the computer and the user, usually with the program on magnetic tape or disk.
   b. a batch of data is collected over an extended period and then processed concurrently using multiple processing units.
   c. a program is run without interaction between the computer and the user. The program with its data is submitted to computer usually on punched cards, and results are then inserted as required by the program.
   d. many computers are networked together so many programs can be processed at one time.
   e. microcomputers are connected to mainframe computers in a time-sharing situation.

8. Which of the following groups of computer terms does not refer exclusively to computer hardware?

   a. CRT, CPU, RAM chip
   b. speech synthesizer, disk drive, graphics digitizing pad
   c. letter quality printer, ROM chip, I/O connector
   d. integrated circuit, BASIC, diskette, power supply
   e. keyboard, disk drive, video monitor

9. Which of the following best depicts a special purpose computer system?

   a. microcomputers in a network configuration for classroom use
   b. a mainframe computer with time-share terminals
   c. a personal computer with a printer for wordprocessing
   d. a climate control computer for a building
   e. a minicomputer with dedicated terminals

10. Which of the following groups of computer hardware and software are representative characteristics of a MICRO COMPUTER system?

   a. 5 1/4 inch floppy disk, 5 megabytes of read only memory, card reader
   b. microprocessor, BASIC, 5 1/4 inch floppy disk
   c. dual disk drives, microprocessor, time-sharing system
   d. BASIC, 5 megabytes of read only memory, time-sharing system
   e. card reader, microprocessor, 5 megabytes of read only memory

11. Which of the following best reflects the relationship between microcomputers, minicomputers, and mainframe computers in terms of the average memory capacity? (ordered from least to greatest average memory capacity)

   a. mainframe, microcomputer, minicomputer
   b. microcomputer, mainframe, minicomputer
   c. microcomputer, minicomputer, mainframe
   d. They all are capable of having equal memory capacity.
   e. The memory capacity depends on the cost of the system, so it is not possible to order them by category of computer.

12. Several microcomputers connected together with communication lines in order to access the same programs and data is an example of

   a. time-sharing.
   b. multiple-processor.
   c. networking.
   d. interface interaction.
   e. modulation-demodulation.

13. Serial communication refers to

    a. transferring information from one computing device to another eight bits at a time.
    b. transferring information from one computing device to another one bit at a time.
    c. communicating with the computer via a series of bit to byte interactions.
    d. communicating with the computer via a series of programming statements.
    e. transferring information from the program to the central processor one bit at a time.

14. Which of the following is a common function of operating systems?

    a. Providing an orderly and consistent input/output environment for the various elements of the computer.
    b. Permitting compatibility among all microcomputers, regardless of the microprocessors they incorporate.
    c. Controlling the voltage levels supplied by the power supply.
    d. Determining the number of bits in each of the computer's data words.
    e. Providing a list of user-friendly commands so that the user can operate the system.

15. Computer hardware failures are most often caused by

    a. dusty operating environment.
    b. cold operating environment.
    c. physical abuse of the hardware.
    d. power line spikes, dropouts, and surges.
    e. defective software.

16. A primary function of the Central Processing Unit of a computer is to __________ information.

    a. store
    b. input
    c. output
    d. input/output
    e. analyze/manipulate

17. Which of the following is not necessary for the proper care and maintenance of computer systems?

    a. the use of voltage-controlled and filtered circuits when supplying power to the computer
    b. maintaining a relative humidity of 40 - 60% to minimize static electricity
    c. providing adequate air circulating around the computer
    d. maintaining a dust-free operating environment
    e. maintaining a room temperature of at least 68 degrees

18. A microcomputer system is not well suited fro performing complex statistical functions on large data sets because

    a. the built-in video displays of most microcomputers would be too small to show the many values and formulas in a typical statistical software package.
    b. microcomputer systems generally do not have sufficient memory for storage of elaborate programs and large amounts of data.
    c. no microcomputer system can handle such functions. To do any kind of number-crunching work, you need a larger computer.
    d. microcomputers are not equipped with disk drives and thus cannot load large statistical programs from disks.
    e. microcomputers represent an inexpensive, very limited class of computers and are good for little more than arcade-type games.

19. Which of the following statements is not true concerning RAM and ROM?

    a. Information stored in RAM can be changed by the user, while information stored in ROM cannot be changed by the user.
    b. Information stored in both RAM and ROM will be destroyed if the power to the computer is turned off.
    c. ROM stores the control program of the computer.
    d. The amount of RAM in a computer determines the memory density of the computer.
    e. RAM is volatile and ROM is nonvolatile.

20. Below is a block diagram of a computer system with arrows indicating the sequence of data movement within the system. Which of the following are the most appropriate labels for the components?

```
                 -------
                |   1   |
                 -------
                  /|\ |
                   |  |
                   | \|/
 -------         -------         -------
|   2   |---->|   3   |---->|   4   |
 -------         -------         -------
```

a. 1-memory
   2-input
   3-processor unit
   4-output

b. 1-input/output device
   2-CPU
   3-RAM
   4-ROM

c. 1-video display
   2-keyboard
   3-disk drive
   4-printer

d. 1-processor unit
   2-input device
   3-memory
   4-output device

e. 1-arithmetic/logic unit
   2-control unit
   3-operating system
   4-input/output device

21. A disk operating system is a special category of software that allows the computer to

a. use magnetic disks for long term memory storage.
b. operate disks that allow several computers to be connected to one another.
c. receive disk information from devices such as modems.
d. present computer disk operation information to the user.
e. expand the usefulness of Read Only Memory in a disk.

22. The type of memory that is most likely to be of interest to a prospective microcomputer buyer (for the reason given) is:

a. EPROM, because the ability to erase and reprogram memory is needed if one is to run application programs.
b. PROM, because all memory units in a computer are erased each time the power is shut off or a new disk is booted.
c. ROM, because the amount of ROM in a computer determines the size of programs a computer can run and the amount of data which can be stored on disks.
d. RAM, because a computer with an insufficient amount of RAM may not be able to load and run some of the application programs.
e. Stringy-floppy storage, because the ability to link (string) files is important to many microcomputer users.

23. Which of the following statements concerning computer software is false?

a. Computer software could be defined as the programs, procedures and associated documentation concerned with the operation of computer hardware systems.
b. A program written in BASIC to add numbers together and print their total is an example of computer software.
c. The information coded on Read Only Memory chips in a computer is actually software.
d. Lists of instructions to the computer are called software.
e. When peripheral boards and other devices intended to expand a computers capabilities are added to a microcomputer they are defined as software expansions.

Questions 24 and 25 each describe a historical computing device. Identify the correct device for each description.

24. This item was the first device that used punched cards of instructions to control the operation of a machine.

    a. Mark I
    b. Analytic engine
    c. ENIAC
    d. Hollerith's tabulating machine
    e. Jacquard's loom

25. This device was the first automatic electronic digital computing device to be developed, but did not receive recognition until years later.

    a. UNIVAC
    b. Atanasof-Berry Computer (ABC)
    c. EDVAC
    d. Analytic engine
    e. Pascal's calculating machine

26. Four generations of modern computers can best be characterized by which group of words?

    a. punched cards, printed lines, control panels, diskettes
    b. math tables, difference engine, analytical engine, calculator
    c. vacuum tubes, transistors, integrated circuits, microprocessors
    d. Aiken, Mauchly, Eckert, Jobs
    e. relays, electromechanical, vacuum tubes, transistors

27. Formatting a magnetic floppy diskette is the process of

    a. telling the computer how to set the top and side margins for final printing of a document.
    b. copying a set of programs you have written onto a backup data disk.
    c. checking to see if the disk you have purchased is the proper size for your computer's disk drive.
    d. organizing the disk into tracks and sectors to enable the computer to store information on it.
    e. instructing the disk drive to accept the diskette.

28. You have inserted a disk into the disk drive of a microcomputer. What is the usual next step in running a program stored on the disk?

    a. type the command that results in a listing of the program statements.
    b. type the command that results in the program being loaded into the computer's memory.
    c. type the command that results in the execution of the program.
    d. type the command that results in saving the program on the disk.
    e. type the command that "boots" the disk operating system.

29. Which of the following Disk Operating System commands would you expect to result in a list of programs on a disk?

    a. LIST
    b. RUN then LIST
    c. UNLOCK, then RUN, then LIST
    d. CATALOG
    e. LOAD CATALOG, then RUN

Appendix E

The Instrument for Gathering Demographic Data

Instructions: Answer each of the following questions by writing the requested data or by checking the appropriate response.

1. Your name: ________________________________

2. Gender: ___ female ___ male

3. How many SEMESTERS of computer courses have you completed prior to this course? DO NOT INCLUDE THIS COURSE IN YOUR ANSWER.

   In high school: ___ 0 ___ 1 ___ 2 ___ 3

   ___ 4 ___ more than 4

   In college: ___ 0 ___ 1 ___ 2 ___ 3

   ___ 4 ___ more than 4

Appendix F

Raw Demographic Data for 325 Subjects

Subject	Gender	# Semesters of Previous Experience	Credit Hours Completed	Quality Point Average	College
001	Female	0	15	3.200	CEHSP
002	Male	2	114	2.256	CISBA
004	Female	4	86	3.500	CEHSP
005	Female	4	76	3.625	CEHSP
006	Female	3	79	3.468	CISBA
007	Female	1	12	2.500	CISBA
008	Female	0	9	4.000	CEHSP
009	Female	3	124	3.248	CEHSP
010	Male	1	128	2.269	CEHSP
011	Male	1	9	2.667	CISBA
012	Male	1	27	2.222	CAS
013	Female	2	15	2.600	CISBA
014	Female	0	18	2.500	UNDECLARED
015	Female	0	77	3.000	CEHSP
016	Female	2	21	1.875	CEHSP
017	Female	0	63	2.636	CISBA
018	Male	1	55	2.086	CAS
019	Female	2	99	2.552	CEHSP

Subject	Gender	# Semesters of Previous Experience	Credit Hours Completed	Quality Point Average	College
020	Female	1	64	3.643	CISBA
021	Female	1	47	2.660	CISBA
022	Female	0	0	0.000	UNDECLARED
023	Male	1	67	3.000	CISBA
024	Male	0	86	2.708	CISBA
025	Male	2	15	2.400	UNDECLARED
026	Female	1	78	2.400	CEHSP
027	Female	2	64	3.115	CEHSP
028	Male	1	113	3.283	CISBA
030	Female	0	63	2.476	UNDECLARED
031	Female	0	32	1.761	UNDECLARED
032	Male	0	0	0.000	UNDECLARED
033	Male	1	87	2.083	CEHSP
034	Male	1	78	3.103	CEHSP
035	Female	2	18	2.000	CISBA
036	Male	4	97	3.300	CISBA
037	Female	1	73	2.127	CISBA
038	Female	2	19	3.400	CISBA
039	Female	1	78	3.461	CEHSP
040	Male	0	65	2.365	CEHSP
041	Female	1	45	2.875	CISBA

Subject	Gender	# Semesters of Previous Experience	Credit Hours Completed	Quality Point Average	College
043	Male	2	69	2.579	CEHSP
044	Male	1	64	2.875	CEHSP
047	Male	5	15	2.000	UNDECLARED
048	Male	0	12	3.500	UNDECLARED
049	Male	1	13	2.000	CEHSP
051	Female	1	31	3.258	CAS
052	Male	2	113	2.679	CEHSP
053	Male	0	77	2.400	CISBA
054	Male	0	80	1.955	CEHSP
055	Female	0	15	3.400	CEHSP
056	Male	2	12	2.000	CEHSP
057	Male	1	66	2.522	CAS
058	Male	0	129	3.566	CAS
059	Male	1	70	2.356	CAS
060	Male	0	36	2.500	UNDECLARED
062	Female	0	58	4.000	CEHSP
063	Male	3	78	3.577	CISBA
064	Female	2	34	2.682	CEHSP
065	Female	0	6	4.000	CISBA
066	Female	3	78	2.500	CISBA
067	Male	0	114	3.286	CAS

Subject	Gender	# Semesters of Previous Experience	Credit Hours Completed	Quality Point Average	College
068	Male	0	0	0.000	CAS
069	Female	4	15	3.600	CISBA
070	Female	2	19	3.200	CISBA
071	Male	1	74	2.167	CEHSP
072	Female	0	120	2.655	CAS
074	Male	0	134	2.075	CAS
075	Female	2	45	2.578	CAS
076	Male	2	31	2.032	UNDECLARED
077	Male	2	12	1.200	CISBA
078	Male	5	29	2.724	CEHSP
079	Female	2	15	2.600	CEHSP
080	Male	1	60	2.636	CEHSP
081	Female	0	15	2.800	CISBA
082	Female	0	76	3.194	CEHSP
084	Female	2	15	2.000	CISBA
085	Male	1	70	2.151	CEHSP
086	Male	0	34	2.378	CEHSP
087	Female	2	60	2.883	CEHSP
088	Male	0	12	2.000	UNDECLARED
089	Female	0	50	3.200	CISBA
090	Female	0	15	3.400	CEHSP

Subject	Gender	# Semesters of Previous Experience	Credit Hours Completed	Quality Point Average	College
091	Male	1	24	2.667	CISBA
093	Female	0	12	2.750	CEHSP
096	Female	2	58	2.063	CISBA
097	Male	0	15	3.200	CISBA
098	Female	1	15	3.200	CEHSP
099	Female	0	15	3.000	UNDECLARED
100	Female	1	16	2.158	UNDECLARED
101	Female	0	16	3.063	UNDECLARED
102	Female	1	13	2.250	CEHSP
103	Female	1	15	3.400	CEHSP
104	Male	1	91	3.600	CEHSP
105	Male	1	105	2.213	CISBA
106	Female	1	15	1.400	CEHSP
107	Female	1	44	3.659	CISBA
109	Male	0	9	2.000	CISBA
111	Male	2	30	2.357	UNDECLARED
112	Female	0	50	3.280	CAS
113	Male	0	82	3.275	CAS
114	Female	0	71	2.200	CEHSP
115	Male	2	64	2.090	UNDECLARED
116	Female	2	113	3.936	CAS

Subject	Gender	# Semesters of Previous Experience	Credit Hours Completed	Quality Point Average	College
117	Female	1	15	3.000	UNDECLARED
118	Female	5	72	2.836	CEHSP
119	Female	2	82	3.937	CEHSP
120	Male	5	12	2.500	CISBA
121	Female	1	39	3.077	CISBA
122	Male	1	44	3.021	CISBA
123	Male	4	64	2.208	CISBA
124	Male	0	112	2.212	CEHSP
125	Female	2	12	2.250	CEHSP
126	Female	0	66	2.621	CISBA
127	Male	4	15	2.000	CISBA
129	Male	1	121	2.170	CEHSP
130	Female	3	85	2.965	CEHSP
131	Male	0	54	2.408	CEHSP
132	Female	1	48	3.646	CAS
133	Female	1	10	2.385	CISBA
134	Female	1	82	3.352	CAS
135	Female	0	15	2.600	CEHSP
136	Male	2	63	2.379	CISBA
137	Male	2	14	2.357	UNDECLARED
138	Female	1	113	3.622	CEHSP

Subject	Gender	# Semesters of Previous Experience	Credit Hours Completed	Quality Point Average	College
140	Male	0	47	3.872	CISBA
141	Male	2	60	2.127	CAS
142	Male	1	38	2.667	CEHSP
143	Male	4	62	2.161	CISBA
144	Female	0	76	1.919	CAS
145	Female	0	62	2.065	UNDECLARED
146	Female	2	124	2.491	CISBA
147	Male	0	77	2.105	CISBA
148	Female	0	76	2.737	CEHSP
149	Male	5	15	3.600	CISBA
150	Male	5	125	2.832	CISBA
151	Male	0	39	2.500	CISBA
152	Male	0	77	2.675	CEHSP
153	Female	0	11	2.455	UNDECLARED
154	Male	1	96	2.039	CEHSP
155	Male	2	108	3.344	CEHSP
156	Male	2	45	2.333	CISBA
158	Male	2	80	2.437	CISBA
159	Female	0	92	3.073	CAS
160	Female	1	42	2.857	CEHSP
161	Male	1	96	2.420	CEHSP

Subject	Gender	# Semesters of Previous Experience	Credit Hours Completed	Quality Point Average	College
162	Female	0	69	2.646	CEHSP
163	Female	0	16	2.688	CEHSP
164	Female	2	52	3.143	CEHSP
166	Male	0	64	2.690	CISBA
167	Male	1	39	1.923	UNDECLARED
168	Female	2	9	1.200	CEHSP
169	Female	1	75	2.826	CISBA
170	Female	0	67	3.313	CEHSP
171	Male	2	35	2.750	CISBA
172	Male	1	77	2.307	CAS
173	Male	0	11	1.267	CAS
174	Male	1	15	2.200	CEHSP
177	Male	1	68	2.234	CEHSP
178	Male	1	15	2.600	CEHSP
179	Male	0	107	2.250	CISBA
180	Female	1	81	3.400	CEHSP
181	Male	1	98	2.475	CEHSP
182	Male	3	67	2.866	CAS
184	Female	1	82	3.488	CEHSP
185	Female	3	67	2.925	CISBA
186	Female	1	0	0.000	CAS

Subject	Gender	# Semesters of Previous Experience	Credit Hours Completed	Quality Point Average	College
187	Female	1	75	3.133	CEHSP
188	Female	1	40	2.175	CISBA
189	Female	0	77	2.347	CEHSP
190	Male	1	102	2.293	CEHSP
191	Male	2	79	2.154	CISBA
192	Male	0	16	3.063	UNDECLARED
193	Female	2	15	2.800	CEHSP
194	Female	0	49	2.592	CAS
195	Female	1	82	3.200	CEHSP
196	Female	1	50	2.660	CEHSP
197	Male	2	115	2.607	CAS
198	Male	0	61	2.266	CEHSP
199	Male	1	15	3.000	CISBA
200	Male	2	69	2.915	CEHSP
201	Male	0	50	2.957	CEHSP
203	Female	1	15	2.500	CAS
204	Female	0	53	2.887	CEHSP
205	Male	0	13	3.538	CISBA
206	Male	1	12	1.200	CEHSP
208	Female	2	128	3.000	CEHSP
209	Female	1	15	2.800	UNDECLARED

Subject	Gender	# Semesters of Previous Experience	Credit Hours Completed	Quality Point Average	College
210	Male	1	62	2.029	UNDECLARED
211	Female	0	15	3.200	CEHSP
212	Male	1	12	2.000	CISBA
213	Male	2	0	0.000	CISBA
215	Male	1	55	2.582	CISBA
217	Male	1	36	2.950	CEHSP
218	Male	1	78	2.397	CEHSP
219	Male	3	16	3.188	CEHSP
220	Male	5	186	2.508	UNDECLARED
221	Male	0	16	3.438	UNDECLARED
222	Female	0	81	4.000	CEHSP
223	Female	2	15	2.000	CISBA
224	Male	2	15	3.200	CISBA
225	Male	1	12	2.308	CISBA
226	Female	0	28	3.250	CISBA
227	Female	0	6	4.000	CAS
228	Female	4	83	2.707	CAS
229	Male	0	42	2.867	CISBA
230	Male	2	15	2.200	CISBA
231	Female	1	108	2.739	CEHSP
232	Female	4	15	2.000	CEHSP

Subject	Gender	# Semesters of Previous Experience	Credit Hours Completed	Quality Point Average	College
233	Male	1	15	2.800	CEHSP
234	Female	0	0	0.000	CEHSP
235	Female	0	39	2.538	CEHSP
236	Male	1	34	3.000	CISBA
238	Male	0	6	1.250	CISBA
239	Female	0	48	3.750	UNDECLARED
240	Female	1	78	3.000	CEHSP
241	Male	1	12	2.250	CEHSP
242	Female	2	16	2.813	UNDECLARED
243	Female	0	0	0.000	UNDECLARED
244	Female	2	21	3.143	UNDECLARED
245	Female	0	64	2.141	CAS
246	Male	1	68	2.070	CISBA
247	Female	0	50	3.809	CEHSP
248	Male	3	18	3.667	CISBA
249	Female	1	14	2.857	UNDECLARED
251	Female	2	13	2.063	CISBA
252	Male	4	68	2.500	CISBA
253	Male	1	129	2.500	CEHSP
254	Male	0	15	2.200	UNDECLARED
255	Female	1	47	2.745	UNDECLARED

Subject	Gender	# Semesters of Previous Experience	Credit Hours Completed	Quality Point Average	College
256	Female	2	15	3.800	CEHSP
257	Male	0	93	2.409	CEHSP
259	Female	0	90	2.426	UNDECLARED
260	Male	0	67	2.676	CISBA
261	Male	1	35	2.395	CISBA
262	Female	1	75	2.987	CEHSP
263	Male	2	82	2.352	CAS
264	Female	1	14	3.214	CEHSP
265	Male	3	70	2.443	CISBA
266	Male	2	34	1.892	UNDECLARED
267	Female	1	119	2.496	CEHSP
269	Male	0	83	2.163	CEHSP
270	Female	0	79	2.759	CEHSP
271	Female	0	78	2.618	CEHSP
272	Female	0	43	2.800	CEHSP
273	Female	1	82	3.506	CEHSP
274	Male	0	95	3.741	CISBA
275	Male	1	14	2.857	CEHSP
276	Male	1	14	2.214	CEHSP
277	Male	0	85	3.067	CISBA
278	Male	4	16	2.125	CEHSP

Subject	Gender	# Semesters of Previous Experience	Credit Hours Completed	Quality Point Average	College
279	Male	2	80	2.200	CISBA
280	Male	0	95	2.611	CAS
281	Male	1	78	2.373	CISBA
282	Female	1	14	3.071	CEHSP
283	Female	0	40	2.811	CISBA
284	Female	1	18	2.500	UNDECLARED
286	Male	0	98	2.046	CEHSP
287	Female	0	48	2.917	CAS
288	Male	1	80	2.974	CISBA
289	Female	0	3	4.000	UNDECLARED
290	Male	1	75	2.831	CISBA
291	Male	2	12	3.250	CISBA
292	Male	1	48	2.400	CEHSP
293	Male	0	103	2.602	CEHSP
294	Male	0	22	2.500	UNDECLARED
295	Female	0	30	4.000	CAS
296	Male	1	111	2.360	CISBA
297	Female	0	116	2.300	CISBA
298	Male	2	12	2.400	CEHSP
299	Female	0	83	2.583	CEHSP
300	Male	1	136	3.164	CEHSP

Subject	Gender	# Semesters of Previous Experience	Credit Hours Completed	Quality Point Average	College
301	Male	2	55	2.438	CEHSP
304	Female	0	64	3.371	CEHSP
305	Female	0	123	3.394	CEHSP
306	Female	0	86	2.543	CEHSP
307	Male	0	66	2.197	CAS
308	Male	1	86	1.600	CISBA
309	Female	1	63	1.750	CISBA
310	Female	1	115	3.313	CEHSP
311	Female	1	79	2.471	CEHSP
312	Male	1	12	2.200	CEHSP
313	Male	0	123	3.420	CAS
314	Female	1	15	2.600	CEHSP
315	Male	5	15	1.500	UNDECLARED
316	Female	1	88	2.896	CEHSP
317	Male	0	37	2.622	CISBA
318	Female	0	118	3.218	CEHSP
319	Male	3	28	3.040	UNDECLARED
320	Female	1	70	2.206	CISBA
321	Female	2	0	0.000	CISBA
322	Female	0	73	2.083	CEHSP
323	Male	2	15	2.400	UNDECLARED

Subject	Gender	# Semesters of Previous Experience	Credit Hours Completed	Quality Point Average	College
324	Female	1	43	3.488	CISBA
325	Female	1	109	2.509	CISBA
326	Female	1	96	2.724	CEHSP
327	Female	0	45	2.867	CEHSP
328	Male	3	99	2.288	CISBA
329	Male	1	45	2.067	UNDECLARED
330	Female	1	9	1.750	CEHSP
331	Female	1	50	3.400	CISBA
332	Female	1	12	2.200	UNDECLARED
333	Female	4	67	2.643	CISBA
334	Male	4	101	2.196	CISBA
335	Female	1	76	2.486	CEHSP
337	Male	0	31	2.500	CAS
338	Male	3	63	2.364	CISBA
339	Female	0	12	3.000	CEHSP
340	Female	1	75	2.320	CAS
341	Male	1	51	1.926	CEHSP
342	Male	1	13	3.077	CEHSP
343	Female	2	15	2.800	CEHSP
344	Female	1	51	3.118	CISBA
345	Female	2	86	2.953	CEHSP

Subject	Gender	# Semesters of Previous Experience	Credit Hours Completed	Quality Point Average	College
346	Female	0	44	3.227	CEHSP
347	Female	1	121	2.817	CISBA
348	Female	4	15	3.200	CISBA
349	Male	1	14	2.929	CISBA
350	Female	0	15	2.600	CAS
351	Male	4	81	2.364	CEHSP
353	Female	0	74	2.708	CEHSP
354	Male	0	73	2.158	CISBA
356	Male	0	12	3.250	CEHSP
357	Female	0	115	3.063	CEHSP
358	Female	1	49	2.930	CISBA
359	Female	3	101	2.949	CEHSP
360	Male	2	57	2.643	CAS

Appendix G

Raw Data from Standardized Tests for 325 Subjects

Subject	Pretest CAIN	Posttest CAIN	Pretest STCL	Posttest STCL	Achievement Score
001	80	95	7	13	6
002	76	77	10	17	7
004	80	85	8	11	3
005	69	42	10	17	7
006	72	70	17	19	2
007	75	54	12	17	5
008	74	55	14	17	3
009	51	37	20	19	-1
010	84	45	12	10	-2
011	39	90	11	8	-3
012	77	78	11	13	2
013	50	33	8	10	2
014	61	108	9	10	1
015	115	88	8	16	8
016	66	63	13	14	1
017	61	37	12	18	6
018	76	75	15	15	0
019	70	49	13	13	0
020	75	63	20	15	-5

Subject	Pretest CAIN	Posttest CAIN	Pretest STCL	Posttest STCL	Achievement Score
021	55	40	6	16	10
022	51	62	5	12	7
023	79	78	15	14	-1
024	26	26	14	15	1
025	66	46	15	3	-12
026	63	38	12	9	-3
027	51	40	13	15	2
028	38	40	13	18	5
030	45	56	13	13	0
031	56	65	11	14	3
032	36	45	10	12	2
033	58	63	10	11	1
034	42	54	9	15	6
035	72	65	7	10	3
036	52	26	22	20	-2
037	55	68	8	14	6
038	75	42	9	12	3
039	88	49	11	15	4
040	44	40	13	17	4
041	58	49	14	15	1
043	72	49	12	15	3
044	60	78	8	11	3

Subject	Pretest CAIN	Posttest CAIN	Pretest STCL	Posttest STCL	Achievement Score
047	48	48	12	15	3
048	34	36	14	10	-4
049	78	70	9	12	3
051	58	61	6	14	8
052	43	45	10	13	3
053	93	100	16	6	-10
054	84	95	11	14	3
055	78	81	12	20	8
056	54	56	13	13	0
057	77	89	8	15	7
058	68	55	15	16	1
059	62	56	11	11	0
060	79	67	10	6	-4
062	67	58	10	15	5
063	49	57	11	20	9
064	68	73	8	12	4
065	54	51	21	17	-4
066	64	71	17	16	-1
067	98	70	8	13	5
068	69	31	12	20	8
069	37	31	11	9	-2
070	76	72	11	13	2

Subject	Pretest CAIN	Posttest CAIN	Pretest STCL	Posttest STCL	Achievement Score
071	86	91	13	15	2
072	59	73	6	12	6
074	54	37	11	14	3
075	38	29	15	18	3
076	49	56	9	5	-4
077	47	61	11	9	-2
078	77	52	15	10	-5
079	33	35	14	17	3
080	59	63	14	15	1
081	42	32	7	10	3
082	44	53	14	18	4
084	49	53	6	11	5
085	56	60	14	17	3
086	76	62	18	13	-5
087	82	93	11	13	2
088	107	83	10	12	2
089	48	56	15	15	0
090	67	42	12	16	4
091	45	49	11	13	2
093	71	88	12	3	-9
096	28	26	18	14	-4
097	52	72	10	7	-3

Subject	Pretest CAIN	Posttest CAIN	Pretest STCL	Posttest STCL	Achievement Score
098	62	71	8	14	6
099	74	66	14	15	1
100	79	37	12	13	1
101	43	49	13	13	0
102	67	62	6	6	0
103	95	92	9	6	-3
104	82	92	8	19	11
105	55	43	12	11	-1
106	59	35	9	14	5
107	82	67	12	17	5
109	71	61	14	16	2
111	58	39	13	11	-2
112	56	44	15	13	-2
113	83	42	9	15	6
114	79	71	13	11	-2
115	65	56	17	19	2
116	58	56	15	17	2
117	66	54	11	13	2
118	34	30	16	15	-1
119	71	48	17	16	-1
120	53	52	10	9	-1
121	62	87	5	17	12

Subject	Pretest CAIN	Posttest CAIN	Pretest STCL	Posttest STCL	Achievement Score
122	88	39	13	18	5
123	68	56	20	3	-17
124	92	79	7	14	7
125	65	84	7	6	-1
126	52	67	7	7	0
127	53	43	14	11	-3
129	103	66	13	16	3
130	46	41	11	14	3
131	79	69	11	14	3
132	72	59	10	16	6
133	60	60	11	15	4
134	48	46	6	12	6
135	44	43	16	9	-7
136	51	36	13	14	1
137	47	39	18	15	-3
138	72	66	6	12	6
140	102	80	7	12	5
141	59	72	13	9	-4
142	56	52	7	13	6
143	67	53	6	6	0
144	76	91	15	9	-6
145	83	66	14	16	2

Subject	Pretest CAIN	Posttest CAIN	Pretest STCL	Posttest STCL	Achievement Score
146	59	51	12	13	1
147	64	62	13	15	2
148	108	108	12	16	4
149	35	26	17	13	-4
150	38	37	14	12	-2
151	65	49	7	14	7
152	66	37	16	15	-1
153	65	57	5	11	6
154	79	75	8	16	8
155	48	49	13	21	8
156	58	42	11	15	4
158	73	52	10	5	-5
159	39	79	9	12	3
160	62	70	15	17	2
161	64	83	9	11	2
162	93	81	9	10	1
163	37	37	10	19	9
164	77	64	11	12	1
166	73	82	10	13	3
167	76	64	13	13	0
168	54	57	5	6	1
169	54	43	15	7	-8

Subject	Pretest CAIN	Posttest CAIN	Pretest STCL	Posttest STCL	Achievement Score
170	61	49	12	17	5
171	48	70	13	16	3
172	74	79	8	12	4
173	54	53	11	18	7
174	82	78	12	18	6
177	54	49	12	11	-1
178	57	52	10	15	5
179	65	26	11	4	-7
180	78	77	17	10	-7
181	61	42	7	16	9
182	53	59	17	21	4
184	125	74	10	19	9
185	46	38	16	15	-1
186	61	37	11	14	3
187	68	43	7	12	5
188	61	51	6	17	11
189	80	49	11	11	0
190	92	89	7	13	6
191	39	29	14	12	-2
192	61	73	12	9	-3
193	35	31	12	14	2
194	113	88	15	15	0

Subject	Pretest CAIN	Posttest CAIN	Pretest STCL	Posttest STCL	Achievement Score
195	79	73	16	16	0
196	79	89	7	13	6
197	68	67	11	10	-1
198	97	99	11	6	-5
199	70	41	12	11	-1
200	56	39	16	14	-2
201	75	62	14	18	4
203	109	105	8	7	-1
204	92	96	5	6	1
205	40	39	16	16	0
206	71	64	9	12	3
208	58	72	17	12	-5
209	70	77	9	11	2
210	56	77	6	4	-2
211	109	92	5	15	10
212	51	47	13	14	1
213	48	56	9	16	7
215	59	66	6	6	0
217	53	59	8	13	5
218	90	61	6	11	5
219	42	35	17	15	-2
220	55	48	6	14	8

Subject	Pretest CAIN	Posttest CAIN	Pretest STCL	Posttest STCL	Achievement Score
221	70	59	11	9	-2
222	97	86	11	10	-1
223	57	74	12	12	0
224	57	56	14	13	-1
225	54	61	10	17	7
226	55	57	16	19	3
227	127	111	14	23	9
228	45	54	18	16	-2
229	64	59	10	14	4
230	44	36	14	13	-1
231	55	65	7	13	6
232	54	96	11	10	-1
233	65	61	10	16	6
234	35	35	9	15	6
235	119	42	12	15	3
236	49	42	8	13	5
238	87	59	0	9	9
239	76	58	17	11	-6
240	107	44	10	8	-2
241	50	47	12	6	-6
242	45	51	12	12	0
243	58	37	12	17	5

Subject	Pretest CAIN	Posttest CAIN	Pretest STCL	Posttest STCL	Achievement Score
244	59	59	9	14	5
245	70	58	12	15	3
246	87	74	10	15	5
247	75	56	16	20	4
248	53	43	10	18	8
249	68	76	13	15	2
251	43	37	9	18	9
252	48	49	21	18	-3
253	50	43	10	14	4
254	52	46	16	13	-3
255	115	113	10	12	2
256	111	92	13	12	-1
257	71	80	12	14	2
259	125	75	10	12	2
260	76	76	8	9	1
261	41	32	14	7	-7
262	56	52	10	15	5
263	35	41	10	12	2
264	51	62	11	15	4
265	47	53	9	9	0
266	53	26	16	16	0
267	73	48	12	18	6

Subject	Pretest CAIN	Posttest CAIN	Pretest STCL	Posttest STCL	Achievement Score
269	74	56	4	6	2
270	61	55	13	15	2
271	85	94	10	12	2
272	52	56	11	15	4
273	81	54	8	16	8
274	77	89	11	18	7
275	62	55	12	15	3
276	45	48	10	10	0
277	81	81	12	17	5
278	66	53	13	17	4
279	55	47	10	14	4
280	66	87	10	5	-5
281	77	78	11	10	-1
282	90	84	10	9	-1
283	30	30	13	12	-1
284	82	102	7	8	1
286	76	67	7	11	4
287	93	75	10	17	7
288	68	80	14	15	1
289	67	60	12	19	7
290	63	50	12	13	1
291	67	74	10	10	0

Subject	Pretest CAIN	Posttest CAIN	Pretest STCL	Posttest STCL	Achievement Score
292	118	101	8	7	-1
293	66	55	7	12	5
294	34	37	11	13	2
295	51	52	19	21	2
296	50	58	11	10	-1
297	47	42	9	11	2
298	63	60	9	9	0
299	108	120	7	6	-1
300	100	49	14	21	7
301	41	47	12	10	-2
304	71	67	11	17	6
305	51	42	8	17	9
306	90	53	15	15	0
307	81	84	9	12	3
308	55	69	16	20	4
309	80	96	12	12	0
310	69	58	7	12	5
311	34	42	13	15	2
312	58	55	10	7	-3
313	55	45	14	16	2
314	76	94	10	17	7
315	71	75	11	9	-2

Subject	Pretest CAIN	Posttest CAIN	Pretest STCL	Posttest STCL	Achievement Score
316	73	63	10	10	0
317	48	58	15	12	-3
318	50	38	13	13	0
319	40	30	7	11	2
320	64	71	4	9	5
321	36	42	16	18	2
322	53	42	13	6	-7
323	86	38	5	7	2
324	65	73	10	18	8
325	44	39	15	14	-1
326	62	67	8	15	7
327	63	51	14	14	0
328	62	53	17	15	-2
329	100	108	14	18	4
330	80	79	10	10	0
331	61	46	17	13	-4
332	60	29	8	5	-3
333	48	38	8	14	6
334	39	37	15	18	3
335	94	81	8	14	6
337	42	39	8	11	3
338	44	40	16	18	2

Subject	Pretest CAIN	Posttest CAIN	Pretest STCL	Posttest STCL	Achievement Score
339	68	49	15	18	3
340	65	69	11	10	-1
341	61	81	12	10	-2
342	142	58	7	13	6
343	105	82	10	12	2
344	39	32	11	8	-3
345	48	40	18	13	-5
346	62	49	7	14	7
347	43	51	13	13	0
348	26	26	11	17	6
349	50	53	14	12	-2
350	84	93	7	5	-2
351	31	29	10	10	0
353	68	83	17	15	-2
354	76	78	10	13	3
356	70	83	10	13	3
357	86	67	14	11	-3
358	40	36	14	14	0
359	40	39	11	10	-1
360	74	87	21	21	0

Appendix H

Prospective Subjects Who Withdrew from Slippery Rock University during This Study

Subject	Reason for Withdrawal
003	transferred to another university
029	died on April 22, 1991
095	was activated for military service in the Persian Gulf
157	had personal problems; reentered in June, 1991
237	returned home to Sweden
303	had personal health problems
355	had financial problems

Appendix I

Prospective Subjects Who Withdrew from the Computer Literacy Course during This Study

Subject	Reason for Withdrawal
042	wanted all hands-on experiences; did not like the concepts portions of the course
045	found the professor uncooperative and unwilling to answer questions
046	*
050	was carrying too many credits and this course was not required
061	was carrying too many credits; reenrolled and completed the course in summer school
073	could not complete the assignments in the allocated time and did not want a grade of F
083	found the pace of a night class too fast
092	*
094	was not earning a grade of C and scholarship was in jeopardy
108	got behind in the assignments; reenrolled and completed the course in summer school
110	made up an incomplete grade in this course from the previous semester

Subject	Reason for Withdrawal
128	found the length of each night class too long
139	*
165	wanted a programming course; enrolled in CpSc 130 Introduction to Programming
175	**
176	**
183	needed time for a job and this course was not required
202	was hospitalized for surgery and missed too many classes to get caught up
207	found 18 credits too many and reduced load to 15 required for the declared major area of study
214	**
216	**
250	was carrying too many hard courses
258	got too far behind in assignments; intends to reenroll later
268	missed too many classes and could not get caught up

Subject	Reason for Withdrawal
285	was attending class hoping that a seat would become available; none ever did and the student could not register for this course
302	found the assignments too time-consuming to be completed while enrolled in three intensive writing courses; intends to reenroll later
336	**
352	needed time for a job and found a night class interferred with a work schedule

* Student could not be reached directly and would not return messages left on an answering machine.

** Student's telephone number was no longer in service; the university's databases showed no other means of contacting the student.

Appendix J

Colleges at Slippery Rock University

College of Arts and Sciences

Art	Biology	Anthropology
English	Chemistry	Geography
Modern Language	Environmental Sciences	Public Administration
Music	Geology	Political Science
History	Mathematics	Psychology
Philosophy	Physics	Sociology
Theatre		Social Work

College of Information Science and Business Administration

Accounting	Economics & Finance
Communication	Management & Marketing

Computer Science

College of Education and Human Service Professions

Administration, Supervision and Field Services

Counseling and Educational Psychology

Dance

Developmental Programs

Educational Studies

Elementary Education/Early Childhood

Special Education

Nursing

Allied Health

Parks and Recreation/Environmental Education

Physical Education

School of Physical Therapy

Vitae

Linda Mary Boettner, the daughter of Melvin W. and Mary E. McBride, was born at home in Brady Township, Butler County, Pennsylvania, on April 24, 1948. She was graduated from Slippery Rock State College in 1969 with a B.A. degree in mathematics, from Slippery Rock University in 1986 with a B.S. degree in computer science, and from Youngstown State University in 1988 with an M.S. degree in computer science/mathematics. She married William A. Boettner in 1968.

Mrs. Boettner's work experience includes (a) teaching mathematics from 1969 to 1986 at Moniteau High School in West Sunbury, Pennsylvania, and (b) teaching computer science from 1985 to the present in the Computer Science Department at Slippery Rock University.

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