AN EXAMINATION OF COMPUTER ANXIETY RELATED TO ACHIEVEMENT ON PAPER-AND-PENCIL AND COMPUTER-BASED AIRCRAFT MAINTENANCE KNOWLEDGE TESTING OF UNITED STATES AIR FORCE TECHNICAL TRAINING STUDENTS

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CHAPTER 1

INTRODUCTION

Background

Since computers were first made widely available at United States Air Force technical training centers, conjecture focusing on the differences in scores between paper-and pencil and computer-based testing has existed. Uncertainties have remained despite the fact that alternate forms of testing instruments have contained identical items. It has been argued that the mode of test administration somehow affects the score. Much of the basis of the notion that differences exist between modes of test administration and test scores lies in the widely held belief among instructors that some students are more anxious about using computers during the testing process.

Although there is no general agreement upon an exact definition of computer anxiety, its presence in educational research literature implies that there is tacit agreement as to its existence (Jones & Wall, 1989-1990). Student reaction to computer anxiety may have several effects on test scores. There may be certain circumstances in which anxiety may facilitate performance. Others argue that there may also be circumstances in which student anxiety may degrade performance (Schwarzer, 1986). Yet a third point of view in assessing the effects of anxiety on students focuses on differing levels of anxiety.

Gaudry and Spielberger (1971) purported that moderate levels of anxiety can be healthy in most students because it indicates an interest in what they are doing. However,

these authors also claimed that low and high levels of anxiety can indicate either an apathetic or fearful attitude, both of which can be detrimental to performance and learning. Considering the various theories surrounding the effects of computer anxiety on student performance, it is not difficult to understand why conjecture in Air Force technical training centers focusing on the differences in scores between paper-and pencil and computer-based testing exists. Computer anxiety is a complex issue, and it is surprising that more is not known about it considering how important computers are becoming in everyday life (Fajou, 1997).

Many Air Force technical training courses have been converting testing modes from paper-and-pencil tests to computer-based tests. The use of computer-based testing programs has been shown to have advantages for developers and instructors in the duration of test construction and scoring accuracy. Because the Air Force enlists personnel from diverse educational backgrounds, many required prerequisites to include previous computer experience cannot be taken for granted. Therefore, it cannot be assumed that students attending Air Force technical training courses have had any computer experience or have developed any skills in working with this type of technology. Since this is the case, students faced with computerized testing may be more anxious about the process.

Parshall and Kromrey (1993) stated that, “when computer-based tests are developed from pre-existing paper-and-pencil tests information is usually required concerning the comparability of examination scores obtained in one mode to scores obtained in the other

mode" (p.1). Since this is the case, differences in test scores that can most likely be attributed to computer anxiety must be considered when comparing test modes. This comparability information is the key to further understanding whether a basis for conjecture exists in Air Force technical training centers.

One of the goals of computing in technical training should be to provide students with the ability to adequately use the available technology. However, not all students approach computer use with the same enthusiasm and confidence regarding the possibilities of their success (Kadhiravan & Balasubramanian, 1998). Current views on computer-based measurement have highlighted the need to explore the role the user's attitude and anxiety may play when the user is tested on computers. Further information on how these factors may affect individual performance and learning is also required.

Significance of the Study

This study has sought (a) to determine the computer anxiety level of students, because it has been regarded as a factor that may affect attitudes towards interaction with computers, and (b) to determine whether any relationship in student performance in either mode of testing exists. This is important because much of the previous work in the field of computer-based testing has suggested further research into how the areas of computer anxiety and attitude affect testing performance. According to Kadhiravan and Balasubramanian (1998), there is growing concern that high levels of computer anxiety may affect an individual's motivation and performance.

Although not a factor in this study, it should also be noted that many studies involving computer anxiety and attitudes have shown major gender differences in attitudes and behaviors toward computers. In many of these cases computer attitudes and behaviors have favored males, and it is not clear how the differences may affect testing performance (McCullough, 1997). This study describes noted relationships between computer anxiety and test performance in both modes.

Information concerning student age and work shift has been gathered, and the results have been studied for relationships across the factors of computer anxiety and testing mode. The results of this study can be useful in military technical training centers and could be used in similar organizations seeking information regarding differences in testing modes.

Theoretical Framework

The theoretical perspectives that shape this study are multifaceted. Much of the early research in the field of computer-based testing focused solely upon the differences between scores of converted paper-and-pencil tests and computer-based tests. The research was needed at the time to broadly establish a balance of scores obtained through either mode of testing. According to Parshall and Kromrey (1993), the comparability of scores obtained on computer and paper versions is needed to establish validity across forms and to ensure that norms, which were developed from a paper-administered version, are usable for the computer version.

In many cases, particularly with regard to multiple-choice tests, studies showed little significant differences in scores on the surface. However, careful analysis of many of the studies revealed that further research is suggested to more precisely assess weak differences in scores between paper-and-pencil and computer-based versions. These studies suggest that other variables may have an impact on the mode of test administration.

Three broad areas of interest are suggested in studies of computer-based testing to be further studied. These areas include studies tailored to measure differences in scores that may result from computer anxiety, gender, and computer experience. For example, a study on the conversion of the Graduate Management Admissions Test (GMAT) conducted by Bridgeman and Cooper (1998) suggested that students with less computer experience may have more difficulty with computerized exams. Also, a study conducted by Igbaria and Parasuraman (1989) on individual characteristics suggested that computer anxiety can affect overall performance. Finally, studies on the differences between the performance of males and females while using the computer have repeatedly shown females as more anxious and less confident than males (Chen, 1986; Collis & Williams, 1987; Raub, 1982; Weil, Rosen, & Wugalter, 1990).

Purpose of the Study

This study has sought to determine whether any significant differences in scores exist between groups of students administered computer-based and paper-and-pencil tests

while measuring the degree of computer anxiety maintained by each student. There are many reasons why the results of this study could prove to be useful. First of all, this study offers evidence concerning the degree of balance between the two modes of testing that have been used in aircraft maintenance technical training. This is an important issue because it helps to establish fair testing for all students.

Beyond this fundamental issue, this study has sought (a) to determine the computer anxiety level of the students because it has been regarded as a factor that may affect attitude towards interaction with computers and (b) to determine if any relationship in student performance in either mode of testing exists.

Statement of the Problem

Technical training students arrive at Sheppard Air Force Base (AFB), Texas, with various levels of computer experience and anxiety toward computer use. If high levels of computer anxiety can affect an individual's performance in general, then the amount of knowledge that students are able to recall while testing with computers is suspect. However, standardizing prerequisite computer skills, in an effort to reduce computer anxiety, would produce additional costs in training. Does the possible benefit of providing prerequisite computer skills among students attending aircraft maintenance journeyman training outweigh the cost of a possible reduction in student performance and learning?

Statement of Hypotheses

Ho_1: There is no significant difference between the scores of students taking the Block One Tests in the traditional paper-and-pencil form versus the scores of students taking the computer-administered versions of the same tests.

Ho_2: There is no significant difference between the scores of students rated with high computer anxiety and students rated with low computer anxiety taking the Block One Tests on the computer-administered versions of the same tests.

Ho_3: There is no significant difference between the scores of students rated with high computer anxiety and students rated with low computer anxiety taking the Block One Tests on the traditional paper-and-pencil form of the same tests.

Ho_4: There is no significant difference between the scores of older students and younger students taking the Block One Tests on the computer-administered versions of the same tests.

Ho_5: There is no significant difference between the scores of older students and younger students taking the Block One Tests on the traditional paper-and-pencil form of the same tests.

Limitations

This study is limited to aircraft maintenance students attending the Aircraft Maintenance Craftsman Courses at Sheppard Air Force Base, Texas. These students are not representative of the general population since they must be actively pursuing upgrade training in an aircraft maintenance career field. The student samples are, however,

representative of the aircraft maintenance craftsman population. Extraneous variables in the sample group were controlled by the random assignment to the treatment group.

Delimitations

Because the aircraft maintenance craftsman career field population is the only one in question, the study is thereby reduced to that population.

Definition of Terms

The following definitions are provided to identify the terms used in this work.

Achievement- The act of accomplishing something successfully, as measured by Block Test scores.

Aircraft maintenance craftsmen- Aircraft maintenance personnel who have attained the highest level of aircraft knowledge and troubleshooting skills. Craftsmen can expect to fill various supervisory and management positions such as expediter, shift leader, element chief, flight chief, task certifier, and various staff positions.

Air Education and Training Command (AETC)- The major command within the U. S. Air Force responsible for recruiting and training officers and airmen for the regular Air Force.

Background Questionnaire (BQ)- Survey developed by the principal investigator consisting of items designed to gather student demographic data and the CAS-R.

Block- One or more related units or modules grouped to cover major subject or task areas of a course. The overall course consists of six blocks.

Block One Test- A 30-item multiple-choice test administered at the completion of the first block of instruction. Each item has four possible choices with one choice being the most correct answer. There were two versions of this test identified by version labels A & B.

Block test: A written test, that measures accomplishment of knowledge-oriented objectives and knowledge components of performance-oriented objectives, covered during a block of instruction. Block tests were sampling tests and were not comprehensive in nature.

Computer anxiety- A fear, dislike, and lack of confidence regarding the use of computers.

Computer Anxiety Scale - Revised (CAS-R)- A Likert-style computer anxiety survey developed by Bandalos and Benson (1990).

Computer gender gap- The apparent difference in attitudes and use of computers between males and females, usually favoring males.

Likert-style surveys- Surveys which ask bipolar questions and require answers ranging on a spectrum from Strongly Agree to Strongly Disagree.

Computer-based testing- Computerized administration of the Block One Test via a computer and network software.

Control group- The group of participants who are not exposed to the treatment being studied.

Traditional paper-and-pencil test- Test taken with a test booklet, number 2 pencil, and optical mark score sheet.

Test reliability- The extent to which test scores are consistent; the degree to which the test scores are dependable or relatively free from random errors of measurement.

Test validity- The extent to which a test does the task for which it is intended. The term validity has different connotations for different types of tests, and, therefore, different kinds of validity evidence are appropriate for each.

Treatment group- Those individuals who experienced the treatment being studied.

Upgrade training- An instructional package designed to qualify an individual for the duties of a higher rank, duty position or program.

Summary

Varying levels of computer anxiety may have an effect on computer-based testing of United States Air Force technical training students. This study has sought to determine the computer anxiety level of the students and tries to determine whether any relationship in student performance on either mode of testing exists. This is important because much of the previous work in the field of computer-based testing suggests further research into how the areas of computer anxiety and attitude affect testing performance. Due to the lack understanding concerning any effects of computer anxiety on computer-based testing, this has been a worthwhile topic to explore, and it makes a significant contribution to the training field.

This study has also sought to determine whether any significant differences in scores exist between groups of students administered computer-based and paper-and-pencil

tests. The results of this study can also add to the existing body of research and literature that has been developed in this area.

CHAPTER 2

LITERATURE REVIEW

Introduction

The quantity of literature written related to the field of computer-based testing is vast. Careful inspection of this entire area of interest shows that there is little agreement and a vague understanding of all of the variables that affect the field and process of computer-based testing as a whole. In order to achieve some manageable view of the literature concerning this field, this chapter is subdivided into areas of interest that contain references to the significant studies previously performed. The areas of interest are as follows: computer anxiety and attitudes, comparing computer-based testing and paper-and-pencil testing, computer-based testing reliability and validity, and gender.

Computer Anxiety and Attitudes

Recently researchers have realized the a need to employ a broad approach to research in the area of attitude towards computers that relies on theories and models from multiple disciplines as a foundation (Goodhue, 1988). Many researchers have hypothesized that relationships between anxiety, attitudes, and motivation have affected computer use. A study by Dyck (1998) explained that computer anxiety could be stated in terms of factors such as direct involvement. A study by Igbaria and Parasuraman (1989) stated that

relationships between computer anxiety and attitudes toward computers remain largely unexplored. Furthermore, many researchers have used the terms computer anxiety and attitudes interchangeably (Coovert & Goldstein, 1980; Gilroy & Desai, 1986; Morrow, Prell, & McElroy, 1986).

The lack of understanding concerning exactly how relationships between anxiety and computer attitudes affect computer testing is obvious when one reviews the current literature. In some cases, theories are borrowed from other disciplines in order to explain perceived relationships between individual behavior and attitudes towards computers (Kadhiravan & Balasubramanian, 1998). Many studies in this area focus upon demographic variables such as age, gender, and computer experience in relation to computer attitudes in general (Dambrot, Watkins-Malek, Silling, Marshall, & Garver, 1985; Gutek & Bikson, 1985). Fewer studies have attempted to tie the influence of computer anxiety and attitudes to performance while using a computer.

Anxiety, as described by Bandalos and Benson (1990), is the fear, dislike, and lack of confidence regarding the use of computers. One study that attempted to make the link between the areas of anxiety and test performance, Llabre et al. (1987), indicated that test administration mode could affect test performance. Many researchers agree that levels of anxiety are greater when computer-based modes of test administration are utilized and that computer anxiety reduces an individual's performance (Kadhiravan & Balasubramanian, 1998).

Comparing Computer-Based and Paper-and-Pencil Testing

Many studies have been conducted to examine the possibilities of differences between computer-based and paper-and-pencil testing. Viewing the works as a whole, patterns in the literature begin to develop that suggest overall conclusions and areas in which further work is needed. Generally speaking, two major areas of testing have been studied for differences between computer-based and paper-and-pencil modes of administration. They have been multiple-choice-type tests and tests with various forms of open-ended questions. Open-ended types of tests can typically range from fill-in-the-blank to short answer to essay-type tests. It is important to differentiate between these two types of tests before attempting to analyze patterns in the available literature.

Many studies conducted on open-ended types of tests have shown score differences between the modes of test administration. Russell (1999) reported that multiple-choice tests do not differ much by mode of administration; however, open-ended responses written on a computer scored substantially higher than those written by hand. This study compared 14 open-ended questions covering writing, science, math, and reading skills. Furthermore, a previous study by Russell and Haney (1997) suggested that the scores attained through open-ended items administered on paper might underestimate the achievement of students accustomed to writing on computers.

Research on multiple-choice tests conducted by Bunderson, Inouye, and Olsen (1989) suggested that the mode of test administration does not significantly affect the test taker's performance. Similar findings in studies by Bergstrom (1992), Mead and Drasgow

(1993), Neuman and Baydoun (1998), and Vansickle, Kimmel, and Kapes (1989) and others suggested that, for multiple-choice tests, administration via computer yields similar results to paper-and-pencil administration. Yet this is not always the case; studies by Eignor (1993), Ponsoda, Wise, Olea, and Revuelta (1997), Straetmans and Eggen (1998) and others show statistically significant differences between the modes of test administration.

Computer-based Testing Reliability and Validity

Two fundamental properties that must be considered during any type of testing are reliability and validity. Three separate studies by Vansickle et al. (1988, 1989, 1992) using three different test instruments consistently showed that computer-based administration to be slightly more reliable than paper-and-pencil administration. One of reasons offered by researchers for the increased reliability of tests administered by computer is greater accuracy in scoring. These findings are also consistent with studies by Vispoel and Coffman (1992) that cited not only higher test reliability but also greater validity than with tests given in paper-and-pencil modes.

Studies focusing on open-ended instruments were the only works noted that raised questions concerning test validity. According to Russell (1999), the mode of test administration may have an extraordinary impact on student performance especially with regard to students with previous computer experience. Since this study was not designed to measure the effect of computer experience on test mode, further conclusions regarding test validity were not made.

Gender

In regard to gender differences and computer use, an overwhelming number of studies conclude that differences do exist. Gender differences in attitudes and behaviors toward computers have been reported in studies by Chen (1986); Collis and Williams (1987); Hess and Miura (1985); Lambert (1991); Raub (1982); Sanders (1984);and Weil et al. (1990). These studies have consistently shown that males have more favorable attitudes towards technology than do females. Additionally, it is indicated that males have more confidence and are less anxious when working with computers. The phenomenon that describes gender differences in regard to technology has come to be referred to in some literature as the computer gender gap.

Many researchers place the blame for any perceived differences between males and females with regard to computer attitudes and anxiety on teachers and society as a whole. Studies on younger students by the American Association of University Women (AAUW) (1998), Rosenberg (1997) and Sanders, Koch, and Urso (1997) have indicated that girls appear to avoid computers and believe that computers are more appropriate for boys. This misguided idea may be perpetuated by female teachers who serve as poor role models for younger girls searching for leadership while interacting with technology. A study by Todman and Dick (1993) found a positive correlation between the attitudes of students and their teachers toward computers.

It is unclear how this profoundly perceived computer gender gap affects the performance of females when they test on computers. Because many believe that

relationships between anxiety and performance exist when females test on computers (Kadhiravan & Balasubramanian 1998), it may follow that if females have more computer anxiety than males their tests scores may be lower.

Although clearly an important issue, the low number of females in the sample taken for this study prevented the study of gender issues in this work.

Summary

The research literature has shown that, although much work has been done in the field of computer-based testing, much more needs to be done. For instance, the studies reviewed concerning multiple-choice test administration modes have not shown clear evidence of equivalency between the computer and paper-and-pencil versions. It is also evident that any influence on student achievement during the process of computer-based testing that may have been attributed to computer anxiety and attitudes is not completely understood. It is also uncertain how gender may have influenced student achievement when technology has been utilized.

CHAPTER 3

METHODOLOGY

Research Design

This study employs a quasi-experimental posttest-only design, using two versions of United States Air Force aircraft maintenance craftsman course Block One Tests. The independent variable in this study was the methodology of testing. The treatment, taking the computer-administered Block One Test, was administered to one group and compared to the group that took the same Block One Test in the traditional paper-and-pencil format. The tests were developed by Air Force training development specialists and validated using Air Force validation procedures. The students were assigned by class to take one of the versions of the Block One Test by either computer or paper-based modes. The students normally take these block tests in the computer-based mode; however, for the purposes of this study, testing in the computer-based mode was the treatment. Students declining participation in the study were not required to complete the background questionnaire, the Computer Anxiety Scale-Revised, and were tested in the computer-based mode as normally required by the Air Force for completion of the courses of study.

Identified Population

The identified population includes all Air Force active duty, Air Force National Guard, and Reserve aircraft maintenance craftsmen. These personnel are identified by Air Force Specialty Codes (AFSCs) 2A373A (F-15), 2A373B (F-16/117), 2A373J (A-10/U-2), 2A571 (Heavy aircraft), and 2A572 (H53/60 Helicopter). According to the Headquarters United States Air Force Personnel Center (2001) (AFPC) demographics and statistics data, the total population of all Air Force aircraft maintenance craftsmen numbers approximately 22,250 personnel. A breakdown of the population by AFSC is as follows: 2A373A (F-15)- 4,220, or 19%; 2A373B (F-16/117)- 4,675, or 21%; 2A373J (A-10/U-2)- 1,580, or 7%; 2A571 (Heavy aircraft)- 11,100, or 50%; and 2A572 (H53/60 Helicopter)- 675, or 3%.

Identified Sample

The research sample included 240 students who attended Aircraft Maintenance Craftsman courses between May and July 2001 at Sheppard Air Force Base, Texas. Five training courses were included in the study: J3ACR2A373A 000 F-15 Aircraft Maintenance Craftsman, J3ACR2A373B 000 F-16 Aircraft Maintenance Craftsman, J3ACR2A373J 000 Fighter Aircraft Maintenance Craftsman, J3ACR2A571 000 Heavy Aircraft Maintenance Craftsman, and J3ACR2A572 000 Helicopter Aircraft Maintenance Craftsman.

The students who participated in this study represented a broad cross-section of United States Air Force aircraft maintenance personnel who maintain a wide range of airframes. There were 34 students who maintain F-15s (14% of sample); 50 students who maintain F-16s and F-117s (21%); 20 students who maintain A-10s and U-2s (8%); 125 students who maintain a variety of 23 different heavy aircraft (52%); and 11 students who maintain H-53 and H-60 helicopters (5%). The sample is proportional to the population and represents diverse worldwide Air Force assignments and prerequisite abilities.

The courses utilized in this study were unique in that they shared a common block of instruction, Block One, and a common pair of alternate versions of tests for that block. One of the versions of this block test was administered to each class at end of block one. At that point, the students had completed 26 hours of training on subject matter covering training records, personnel management, resource functions, equipment account management, repairable parts control, incident investigation, and maintenance accountability. Block One covered 26 hours of classroom instruction and was designed to provide a common core of maintenance instruction to all Air Force aircraft maintainers before aircraft-unique troubleshooting skills were introduced in the five specific courses in block two.

The students who participated in this study were highly motivated to complete the respective courses. The courses are considered mandatory for completion by the Air Force as part of overall training requirements for continued retention and eligibility for promotion. The duty statuses of the students were also diverse, as participating students

attended from active duty Air Force units, National Guard, and Reserve components. The classes were taught on two shifts, either S or T. Students assigned to S-shift classes met from 6 a.m. to 3 p.m., and T-shift students met from 3 p.m. to 12 p.m. Students were assigned to shifts by the Sheppard AFB registrar using a method that employed both convenience and current instructor availability.

Instrumentation

Background Questionnaire (BQ)

A student background questionnaire was developed in order to gather specific demographic data on the sample. The data gathered included age, gender, duty status, base of assignment, airframe assigned, course attended, class number, work shift, and computer experience. Personal information such as names and social security numbers were requested only for tracking purposes during research evaluation and were not used in the final report.

Block One Tests

The Block One tests utilized in this study were developed by the 362d Training Squadron, Sheppard Air Force Base, Texas. The instruments were developed and validated following the Department of the Air Force (1993) handbook. Test development specialists and subject matter experts from the aircraft maintenance career field have established the content validity of the block tests. Content validity was further strengthened by comparisons to Air Force Occupational Survey Reports (OSR),

indicating the skills and knowledge considered by all aircraft maintenance personnel to be critical on the job. The test questions were constructed using measurement plans covering all relevant constructs and cross-referenced to Career Field Education and Training Plans developed for aircraft maintenance personnel.

The reliability of the block tests was initially established by administering each of the two versions of the test three times. At that time, the mean scores of each version were compared to ensure agreement to within 5%. Since the period of initial test validation, these block tests have been administered approximately 2,800 times and undergo periodic (quarterly) item analysis to ensure continued reliability. During periodic evaluations of these block tests, high-miss items are noted, all items are scored for ease, and inter-item reliability is calculated. Coefficient alpha reliabilities for the Block One tests versions A and B have been calculated at .96 and .99, respectively. The Block One tests consist of 30 multiple-choice items and have a minimum passing score of 70%. One of the two alternate versions of the tests is administered on the 4th day of the training in the 10-day courses.

Computer Anxiety Scale - Revised

The Computer Anxiety Scale - Revised (CAS-R) was designed in 1990 by Bandalos and Benson. This scale was adapted from Loyd and Gressard's popular computer attitude scale called the Computer Attitude Scale (McCullough, 1997). This 23-item survey was designed to measure computer anxiety in participants and can be administered in about

15 minutes. Studies performed by Gos (1996), Kay (1992), and Rosen and Weil (1995) found the CAS-R to be a reliable and valid instrument.

The CAS-R is constructed with Likert-type questions ranging from Strongly Agree to Strongly Disagree. The examinee is forced to make choices on the scale that can be translated to weights of 0 through 5. The CAS-R includes items that vary between positive and negative statements. The instrument is designed to measure three constructs of computer liking (8 items), computer confidence (9 items), and computer achievement (6 items), as identified by Bandalos and Benson (1990). The authors calculated an estimate of the coefficient alpha reliabilities for the three CAS-R subscales and the total scale at .90, .93, .90, and .96, respectively.

Data Collection Procedures

Ethical Standards

Application to the Human Subjects review board has been sought and granted for this study. Additionally, because this study was conducted in conjunction with official Air Force training courses, approval from of the Commander of the 362 Training Squadron, Sheppard Air Force Base, Texas was obtained. Student participation in this study was voluntary, and the design was such as to provide maximum information with as little intrusion into the normal training schedule as possible. At no time was student personal information such as names or social security numbers used as part of this study's final report. The results will be made available to the United States Air Force in order to

expand the body of knowledge available concerning computer anxiety and its possible role in regard to testing modes utilized during training.

Independent Variable

The independent variable in this study was the mode of testing. Half of the scheduled classes were randomly selected to test by either paper-and-pencil or computer-based modes.

Dependent Variable

The dependent variable in this study was the score achieved.

Testing Procedures

The student background questionnaire and Computer Anxiety Scale - Revised were combined into one package (BQ & CAS-R). This package was administered to the students the 1st day of class during the orientation hour. The course instructor was directed to administer this package prior to informing students of the test mode to which the class had been randomly assigned. This helped to ensure that students assigned to classes that were testing in the computer-based mode were not affected by prior knowledge of required computer interaction during the course.

One of the two alternate versions of the Block One Tests was administered on the 4th day of the training following 26 hours of instruction. The classes were randomly assigned to take the test in either the paper-and-pencil or the computer-based mode. Classes that were assigned to test in the paper-and-pencil mode were administered one of two

versions of the Block One Tests. The instructor administered paper-based tests according to the administration guidance provided with the instrument (see Appendix C). The students bubbled in the selected answers on test answer sheets that were graded by the instructor. The answer sheets were double-checked by the researcher in an effort to reduce human error in the grading process that could affect the research results.

Classes that had been assigned to test in the computer-based mode were administered one of two identical versions of the Block One Tests. The tests were administered on computers using interactive courseware. The testing software allowed for student answer changing, item skipping, review prior to grading, and much of the flexibility of the paper-and-pencil mode of administration. The student computers were equipped with a monitor, a keyboard, and a mouse. To avoid possible differences occurring from uncontrolled variables, all computer-based testing occurred in the same room. The actual tests were not represented in the final work so as not to compromise the tests.

Data Analysis Procedures

Comparisons between groups were performed for the analysis portion of the study. A comparison was performed to determine whether a statistically significant difference exists between the scores of students rated with high computer anxiety and students rated with low computer anxiety taking computer-administered versions of the same Block One Tests. Additionally, the following comparisons were made to determine whether statistically significant differences existed between the following: (a) scores of students

rated with high computer anxiety and students rated with low computer anxiety taking the Block One Tests in the traditional paper-and-pencil form of the same tests; (b) scores of students taking the Block One Tests in the traditional paper-and-pencil form versus the scores of students taking the computer-administered versions of the same test; (c) scores of older students and younger students taking computer-administered versions of the same tests; and (d) scores of older students and younger students taking traditional paper-and-pencil versions of the same tests.

One-way analysis of variance (ANOVA) tests were used to determine whether differences existed between any of the groups examined. Confidence levels of the ANOVA comparisons were set at .95, with the level of significance being .05.

Summary

The primary methodology was a comparison of the variance of mean scores for groups of individuals who displayed either high or low computer anxiety to their respective mean computer-based and paper-based aircraft maintenance knowledge testing scores.

CHAPTER IV

FINDINGS

Introduction

The purpose of this study was to determine whether varying levels of computer anxiety have an effect on computer-based testing scores of United States Air Force technical training students. This chapter is divided into three sections. The first section provides an overview of the participants in the study. The second contains a description of the data and statistical analysis. The last section evaluates the hypotheses against the supporting analysis.

Student Participation

A total of 244 Air Force aircraft maintenance craftsman students participated in this study. However, four of the combination background questionnaires and Computer Anxiety Scales - Revised (BQ & CAS-R) were rendered invalid due to incomplete data. The final analysis used results from 240 participants, 237 men and 3 women. Table 1 contains demographic data for the study participants. These data illustrate the homogeneity of groups across the variables: Proportion E-5 (grade), Proportion male (gender), and Mean CAS-R score (computer anxiety).

Table 1

Grade, Gender, and Computer Anxiety Data for Study Participants

Group	PROPORTION E-5	PROPORTION MALE	MEAN CAS-R SCORE
COMPUTER-BASED VERSION 1A	93.9%	100%	39.6
COMPUTER-BASED VERSION 1B	98.2%	96.4%	37.0
PAPER-BASED VERSION 1A	95.0%	100%	39.7
PAPER-BASED VERSION 1B	93.2%	98.3%	39.3
TOTAL	94.5%	98.8%	38.4

Specifically, the military pay grade of the sample ranged from E-7 to E-5. There were 2 E-7s, 9 E-6s, 227 E-5s, and 2 participants listing their grade as other. There were 237 men and 3 women who participated in the study, and the average mean CAS-R score for the group was 38.4.

Table 2 contains age demographic data for the study participants. The ages of the participants were grouped for ease of study into 10 categories. Similarly, these data illustrate the homogeneity of the groups studied.

Table 2

Age Data for Aircraft Maintenance Craftsman Study Participants

Group	AGE CATEGORY									
	1	2	3	4	5	6	7	8	9	10
	-20	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60+
COMPUTER-BASED VERSION 1A	0	.03	.50	.36	.10	0	.02	0	0	0
COMPUTER-BASED VERSION 1B	0	.04	.47	.36	.09	.04	.02	0	0	0
PAPER-BASED VERSION 1A	0	0	.58	.21	.10	.10	0	0	0	0
PAPER-BASED VERSION 1B	0	0	.47	.28	.15	.07	.02	0	0	0
TOTAL	0	.02	.50	.31	.11	.04	.01	0	0	0

Students in the computer-based version 1a group (n = 66) ranged in age from category 2 (20-24) to 7 (45-49). The sample contained 65 men and 1 woman. Subjects in the computer-based version 1b group (n = 55) ranged in age from category 2 (20-24) to 7 (45-49). The sample contained 53 men and 2 women. Subjects in the paper-based version 1a group (n = 60) ranged in age from category 3 (25-29) to 6 (40-44). The sample contained 60 men and no women. Lastly, the paper-based version 1b group (n = 59) ranged in age from category 3 (25-29) to 7 (45-49). The sample contained 59 men and no women.

Older and younger groups were determined by dividing the sample into upper and lower ranges. Age categories 1-3 (n =126) were considered younger, and age categories 4-7 (n =114) were considered older.

Study Data and Statistical Analysis

The dependent variable in this study was the Block One Test score. The independent variable was the methodology of testing. The treatment, taking the computer-administered Block One Test, was administered to one group and compared to the group that took the same Block One Test in the traditional paper-and-pencil format.

For the purpose of testing the second and third hypotheses ("There will be no significant difference between the scores of students rated with high computer anxiety and students rated with low computer anxiety taking the Block One Tests on the computer-administered versions of the same tests" and "There will be no significant difference between the scores of students rated with high computer anxiety and students rated with low computer anxiety taking the Block One Tests on the traditional paper-and-pencil form of the same tests") groups were determined by the ranking of CAS-R scores. The CAS-R scores of all participants were arranged from highest to lowest. The scores ranged from 115 to 0 (Mean 38.4). The participants' CAS-R scores were then divided into half by the CAS-R score. The top-scoring 120 participants, in the high-anxiety group, scored in the range of 40 to 115 (Mean 54.06). The bottom-scoring 120 participants, in the low-anxiety group, scored in the range 0 to 39 (Mean 20.58).

Table 3 shows the test mode and version of the participants after being grouped by anxiety level.

Table 3

Test Mode and Version of the Participants After Anxiety Level Grouping

Group	High anxiety	Low anxiety	Total
COMPUTER-BASED VERSION 1A	32	34	66
COMPUTER-BASED VERSION 1B	25	30	55
PAPER-BASED VERSION 1A	30	30	60
PAPER-BASED VERSION 1B	33	26	59
TOTAL	120	120	240

This study used a quasi-experimental posttest-only design. The statistical analysis employed was a one-way ANOVA, which was chosen for its ability to distinguish significant differences in the group means and variances.

Table 4 contains data from one-way ANOVA comparisons of demographic variables. They confirm that there was no significant difference between the group means for the variables of age and mean CAS-R score.

Table 4

Summary of ANOVA Comparisons for Age and CAS-R Score

Variable	Source	SS	df	MS	F	Sig
AGE	Between Groups	2.82	3	0.94	1.15	0.33
	Within Groups	191.83	236	0.81		
	Total	194.65	239			
CAS-R SCORE	Between Groups	290.59	3	96.86	0.23	0.88
	Within Groups	101503.75	236	430.1		
	Total	101794.33	239			

Having demonstrated the similarity of the four groups, it is now possible to compare them on the study data, confident that variance is due in large part to the treatment.

Analysis of Hypotheses

Ho_1: There is no significant difference between the scores of students taking the Block One Tests in the traditional paper-and-pencil form versus the scores of students taking the computer-administered versions of the same tests.

The first hypothesis stated that there is no significant difference between the scores of students taking traditional paper-and-pencil and computer-administered tests. The statistical one-way ANOVA test detected no significant difference between the two groups. The differences between the groups do not exceed the critical value at the preset level ($p < .05$)

of 3.92 for the A version test or 3.93 for the B version. Therefore, this study failed to reject the null for the first hypothesis statement.

Table 5 contains the results of a one-way ANOVA for comparisons of computer and paper administered Block One Test scores. These comparisons indicate no statistically significant difference between the groups (paper and computer-based administration) on the Block One Test means.

Table 5

Summary of ANOVA Comparisons for Computer-Based and Paper-Based Administration

Variable	Source	SS	df	MS	F	Sig
MODE OF	Between Groups	34.65	1	34.65	0.62	0.43
ADMINISTRATION	Within Groups	6955.35	124	59.09		
TEST VERSION 1A	Total	6990.00	125			
MODE OF	Between Groups	23.38	1	26.38	0.55	0.46
ADMINISTRATION	Within Groups	5359.48	112	47.85		
TEST VERSION 1B	Total	5385.86	113			

Ho_2: There is no significant difference between the scores of students rated with high computer anxiety and students rated with low computer anxiety taking the Block One Tests on the computer-administered versions of the same tests.

The second hypothesis stated that there is no significant difference between the computer-administered tests of students, regardless of their anxiety level. The statistical one-way ANOVA test detected no significant difference between the two groups. The differences between the groups do not exceed the critical value at the preset level ($p < .05$) of 3.99 for the A version test or 4.02 for the B version. Therefore, this study failed to reject the null for the second hypothesis statement.

Table 6 contains the results of a one-way ANOVA for the dependent variable. These comparisons indicate no statistically significant difference between groups (high and low anxiety levels) on the computer administered Block One Test means.

Table 6

Summary of ANOVA Comparisons for Computer-Based Block One Test Score

Variable	Source	SS	df	MS	F	Sig
ANXIETY LEVEL	Between Groups	3.88	1	3.88	0.06	0.80
VERSION 1A	Within Groups	3956.62	64	61.82		
	Total	3960.50	65			
ANXIETY LEVEL	Between Groups	3.59	1	3.59	0.07	0.79
VERSION 1B	Within Groups	2621.21	53	49.46		
	Total	2624.80	54			

Ho_3: There is no significant difference between the scores of students rated with high computer anxiety and students rated with low computer anxiety taking the Block One Tests on the traditional paper-and-pencil form of the same tests.

The third hypothesis stated that there is no significant difference between the paper-based administered tests of students, regardless of their anxiety level. The statistical one-way ANOVA test detected no significant difference between the two groups. The differences between the groups do not exceed the critical value at the preset level ($p < .05$) of 4.01 for the A version test or 4.01 for the B version. Therefore, this study also failed to reject the null for the third hypothesis statement.

Table 7 contains the results of a one-way ANOVA for comparisons of paper-based Block One Test scores. These comparisons indicate no statistically significant difference between the groups (high and low anxiety levels) on the Block One Test means.

Table 7

Summary of ANOVA Comparisons for Paper-Based Block One Test Score

Variable	Source	SS	df	MS	F	Sig
ANXIETY LEVEL	Between Groups	10.42	1	10.42	0.20	0.65
VERSION 1A	Within Groups	2984.43	58	51.46		
	Total	2994.85	59			
ANXIETY LEVEL	Between Groups	62.59	1	62.59	1.34	0.25
VERSION 1B	Within Groups	2672.09	57	46.88		
	Total	2734.68	58			

H_{O_4}: There is no significant difference between the scores of older students and younger students taking the Block One Tests on the computer-administered versions of the same tests.

The fourth hypothesis stated that there is no significant difference between the scores of older and younger students taking computer-administered tests. The statistical one-way ANOVA test detected no significant difference between the two groups. The differences between the groups do not exceed the critical value at the preset level ($p < .05$) of 3.99 for the A version test or 4.02 for the B version. Therefore, this study also failed to reject the null for the fourth hypothesis statement.

Table 8 contains the results of a one-way ANOVA for comparisons of older and younger students testing with computers. These comparisons indicate no statistically significant difference between the groups (older and younger students) on the Block One Test means.

Table 8

Summary of ANOVA Comparisons for Older and Younger Students Testing With Computers

Variable	Source	SS	df	MS	F	Sig
AGE	Between Groups	46.00	1	46.00	0.75	0.39
TEST VERSION 1A	Within Groups	3914.50	64	61.16		
	Total	3960.50	65			
AGE	Between Groups	92.20	1	92.20	1.93	0.17
TEST VERSION 1B	Within Groups	2532.60	53	47.78		
	Total	2624.80	54			

Ho_5: There is no significant difference between the scores of older students and younger students taking the Block One Tests on the traditional paper-and-pencil form of the same tests.

The final hypothesis stated that there is no significant difference between the scores of older and younger students taking paper-based administered tests. The statistical one-way ANOVA test detected no significant difference between the two groups. The differences between the groups do not exceed the critical value at the preset level ($p < .05$) of 4.01 for the A version test or 4.01 for the B version. Therefore, this study also failed to reject the null for the final hypothesis statement.

Table 9 contains the results of a one-way ANOVA for comparisons for older and younger students testing with traditional paper-and-pencil tests. These comparisons

indicate no statistically significant difference between the groups (older and younger students) on the Block One Test means.

Table 9

Summary of ANOVA Comparisons for Older and Younger Students Testing With Paper and Pencil

Variable	Source	SS	df	MS	F	Sig
AGE	Between Groups	122.40	1	122.40	2.47	0.12
TEST VERSION 1A	Within Groups	2872.45	58	49.52		
	Total	2994.85	59			
AGE	Between Groups	135.48	1	135.48	2.97	0.09
TEST VERSION 1B	Within Groups	2599.20	57	45.60		
	Total	2734.68	58			

In chapter 5 the results of this study are discussed, and conclusions regarding the impact and effects of computer anxiety on the aircraft maintenance craftsmen test scores are proposed.

CHAPTER 5

DISCUSSION, CONCLUSIONS, and RECOMMENDATIONS

Introduction

Computer anxiety and test administration via computers are important topics in the field of training and development. Many organizations have considered developing computer-skills training for individuals who will be using computers in training and testing. The goal of this type of training would be to reduce or eliminate any barriers to the delivery and measurement of trained knowledge and skills. Because additional resources would be required to design and deliver computer skills training, the benefit provided by this additional training must be clear.

Discussion

The purpose of this study was to determine whether varying levels of computer anxiety have an effect on computer-based testing scores of United States Air Force technical training students. Current studies on computer-based measurement have highlighted the need to explore the role of the user's attitude and anxiety when he or she tests on computers. All of the participants' computer anxiety levels were measured prior to their being randomly assigned to test by either the computer-based or paper-and-pencil method. The groups (high and low anxiety) were determined by the ranking of CAS-R scores. Because the mode of testing was randomly selected, two homogenous groups of high and

low computer anxiety level participants were established. Through holding as many factors as possible constant and using identical tests, the results of the study are dependable.

The research sample was 240 students that attended five aircraft maintenance craftsman courses at Sheppard Air Force Base, Texas. The study covered a time frame of 2 months, from May through June 2001. A student background questionnaire and Computer Anxiety Scale - Revised were combined into one survey package (BQ & CAS-R). This package was administered to the students the 1st day of class during the orientation hour. The course instructor administered this package prior to informing students of the test mode to which the class had been randomly assigned. This helped to ensure that students assigned to classes that tested in the computer-based mode were not affected by prior knowledge of required computer interaction during the course.

The Block One Tests were administered at the end of the first block of instruction for each class. The classes were tested at different times as dictated by the completion of the hours of instruction in the Block One lesson plan. The lesson plan required a minimum of 26 hours of instruction from the time each of the classes started until the Block One Test was administered. Since the research groups were determined by the participant's computer anxiety level, the students were considered individually rather than by class. This also helped to ensure a large enough sample for a robust test.

Ho_1: There is no significant difference between the scores of students taking the Block One Tests in the traditional paper-and-pencil form versus the scores of students taking the computer-administered versions of the same tests.

The statistical one-way ANOVA test detected no significant difference between the two groups. This finding shows that there is balance between the two modes of testing used in aircraft maintenance technical training. It also shows that fair testing practices have been employed for all students since the mode of testing had no effect on test scores. The results of testing this hypothesis support earlier research on multiple-choice tests conducted by Bunderson et al. (1989), which suggested that the mode of test administration does not significantly affect the test taker's performance. Bergstrom (1992), Mead and Drasgow (1993), Neuman and Baydoun (1998) Vansickle et al. (1989), have also reported similar conclusions.

Ho_2: There is no significant difference between the scores of students rated with high computer anxiety and students rated with low computer anxiety taking the Block One Tests on the computer-administered versions of the same tests.

The statistical one-way ANOVA test detected no significant difference between the two groups. This finding shows that varying levels of computer anxiety have no effect on computer-based test scores of aircraft maintenance craftsman students. This conclusion is contradictory to previous work in the field of computer anxiety by Llabre et al. (1987) and Igbaria and Parasuraman (1989), which indicated that test administration mode could affect test performance.

The results of this study most closely support early theories on anxiety in works by Gaudry and Spielberger (1971). These authors have suggested that a moderate level of

anxiety can be healthy in most students because it indicates an interest in what they are doing.

Ho_3: There is no significant difference between the scores of students rated with high computer anxiety and students rated with low computer anxiety taking the Block One Tests on the traditional paper-and-pencil form of the same tests.

The statistical one-way ANOVA test detected no significant difference between the two groups. Although the testing of this third hypothesis showed no statistical difference between the groups, the results are important in that they are similar to the second hypothesis. Because the participants did not have knowledge as to the mode of testing required when the computer anxiety scale was administered, the results serve as a control for the second hypothesis.

Ho_4: There is no significant difference between the scores of older students and younger students taking the Block One Tests on the computer-administered versions of the same tests.

Ho_5: There is no significant difference between the scores of older students and younger students taking the Block One Tests on the traditional paper-and-pencil form of the same tests.

The fourth and fifth hypotheses failed to detect any significant differences between the test scores of older and younger students when they tested on both computers and paper-and-pencil. These findings are important in that they show that the age of the participants was not a factor contributing to any significant differences in test scores while being tested in either mode.

Conclusions

No significant difference was found between groups rated with high and low computer anxiety while testing on computers. The conclusion drawn from this study is that the construction of additional training designed to lessen computer anxiety among trainees while testing should be avoided. There would seem to be no clear benefits to the students in terms of improvement in test scores based upon lower computer anxiety levels. Therefore, additional training in this situation would not be advantageous.

The results of this study are noteworthy in that many of the current views on the effects of computer anxiety suggest performance differences. These results show that computer anxiety is a variable that can be discarded as having no effect on measurement in Air Force technical training. There may also be further implications for the entire field of training and education.

These results show that, during testing, the computer is simply the medium by which a question is posed to a student and differs in no significant way from paper and pencil. The level of anxiety caused by the particular mode of testing has no influence on the outcome. As a student reads from either the computer screen or a sheet of paper the student's focus moves to the question being asked. Since the student has either learned or failed to learn the testing item being measured, the results of both of these testing modes are similar.

Additionally, since both of the testing modes examined in this study are visual in nature, further analysis is recommended to determine whether anxiety caused by the mode of testing affects the time required for a student to recall the correct response.

Although the results of this study are striking, they are not be totally unexpected. These results may indicate population characteristic changes due to the increasing availability of computers in society and an overall increase in the rate of interaction with technology in the course of daily life.

Because this study focused on differences between groups rated with high and low computer anxiety while testing on computers, further research is suggested to determine whether consistent results could be gathered from measurements of achievement of complete courses of instruction delivered by computer. The results of research in this area would help to distinguish between the possible effects of computer anxiety on learning and student recall during testing through a computer-based medium not used in previous instruction.

This study, although important, has some limitations. The sample was taken from a very specific and homogeneous population. Specific inference can be made only to the aircraft maintenance craftsman training program. Additionally, the findings would be more powerful if the sample size was larger. In a broad application, this study raises questions concerning the value of training computer skills aimed at reducing the computer anxiety. Although this study addressed only the issue of the effects of computer anxiety during computer-based testing, the larger issue concerning the effects of computer anxiety while using computers during all aspects of instruction needs to be explored.

There was also no significant difference found between groups rated with high and low computer anxiety while testing on the traditional paper-and-pencil form of the same tests.

This finding is also important in that it supports the contention that computer anxiety has no effect on the student's test score, regardless of the testing mode. Additionally, no significant difference was noted between the scores of students taking the Block One Tests in the traditional paper-and-pencil form and students taking the computer-administered versions of the same tests. This finding is similarly important to the study because it represents the reliability of the Block One Test scores across both modes of testing. Additionally, the ages of the participants had no statistically significant bearing on the participant's test scores in either the paper-and-pencil or computer-based modes.

Recommendations

Several issues regarding computer-administered testing and computer anxiety should be explored through additional research. The following items are recommended as topics for further study:

1. Study the effect of altering the design of this study to measure computer anxiety after participants have knowledge as to their selected mode of testing.
2. Alter the research to include multiple-choice or short-answer types of tests.
3. Explore technology that measures skills as well as knowledge and comprehension.
4. Research the performance of test instruments that utilize pictures, graphics, and sound in addition to usual text questions.
5. Explore the possible effects that testing through technology may have on long-term retention.
6. Study the possible effects of computer anxiety on computer-based instruction.

APPENDIX A

RESEARCH PROJECT QUESTIONNAIRE

Research Project Questionnaire

Privacy Act Statement

In accordance with AFI 37-132, the following information is provided as required by the Privacy Act of 1974.

AUTHORITY: 10 USC 8013, Secretary of the Air Force; power and duties; delegation by Executive Order 9397, 22 November 1943; implemented by AFI 36-2623, Occupational Analysis. AFI 40-402, Using Human Subjects in Research, Development, Test and Evaluation.

ROUTINE USES: The information collected with this questionnaire supports a research project into the evaluation of Aircraft Maintenance Craftsman Courses (J3ACR2A373A 000, J3ACR2A373B 000, J3ACR2A373J 000, J3ACR2A571 000 and J3ACR2A572 000). The information you are providing will be used for training course evaluation and training research purposes only. Reporting of findings will be at the group, not individual, level; responses from individual participants will not be released.

Informed Consent

DISCLOSURE/PARTICIPATION: Completion of this questionnaire is voluntary. The information provided in this questionnaire is required for the evaluation of the Aircraft Maintenance Craftsman training program.

PURPOSE: The purpose of this questionnaire is to obtain a measure of your computer anxiety for use in a comparison to course examinations administered by paper-based and computer-based modes. This information will be used only for an evaluation of Aircraft Maintenance Craftsman courses and for training research. No data will be reported by name.

STUDY PROCEDURES: This study employs a quasi experimental post-test only design using two versions of United States Air Force aircraft maintenance craftsman course Block One Tests. The independent variable in this study will be the methodology of testing. The treatment, taking the computer-administered Block One Test, will be administered to one group and compared to the group that took the same Block One Test in the traditional paper-and-pencil format. The students will be assigned by class to take one of the versions of the Block One Test by either computer or paper-based modes.

BENEFITS TO SUBJECTS: The intent of this research is to use the data collected to determine if differences between computer-based and paper-based modes of testing exist and if varying levels of computer anxiety effect student performance. There are no direct benefits to the individuals participating in the study. Prospective long-term benefits to future students and the Air Force include improvements in the selection of appropriate measurement modes and possible training development efforts designed to improve student performance during test administration.

POTENTIAL RISKS: The potential participant risks associated with this study are minimal and can be overcome with protection of participant data in the final report.

CONFIDENTIALITY SAFEGUARDS: Participants will not be individually identified in the final report. The tests and questionnaires will be maintained in a secure facility and compiled data will be placed in a secure computer file and will meet Privacy Act of 1974 standards.

CONTACT INFORMATION: If you have questions or comments regarding this questionnaire or this study, E-mail MSgt. Richard McVay at richard.mcvay@sheppard.af.mil, or call him at DSN 736-3498 or commercial (940) 676-3498, or write him at 362 TRS/RFT 613 10th Avenue, Sheppard AFB, Texas 76311-2529. MSgt McVay is a doctoral student at the University of North Texas, College of Education, Department of Technology and Cognition. The university faculty sponsor for this research project is Dr. Jeff Allen. Dr Allen can be reached at (940) 565-4918.

Thank you for participating in this effort.

APPENDIX B

BACKGROUND INFORMATION QUESTIONNAIRE

Background Information Questionnaire

1) Name: _____ Today's date: Day ____ Mon ____ Yr ____

2) Base where you are currently permanently assigned: _____

3) I am (circle one): Active Duty Guard Reserve Other

4) Military pay grade (circle one):

E-5 E-6 E-7 E-8 E-9 Other

5) I am (circle one): Female Male

6) Age (circle one): under 20 20-24 25-29 30-34 35-39

40-44 45-49 50-54 55-59 over 60

7) I am attending course (circle one):

J3ACR2A373A 000 (F-15) J3ACR2A373B 000 (F-16/117)

J3ACR2A373J 000 (A10/U-2) J3ACR2A571 000 (Heavy)

J3ACR2A572 000 (Helicopter)

8) I am attending class during (circle one): Dayshift Nightshift

9) Class Number: _____

10) Instructor (Block One) _____

11) Describe your computer experience: High Medium Low

APPENDIX C

BLOCK ONE PAPER-BASED TEST ADMINISTRATION GUIDANCE

362d Training Squadron J3ACR2AXXX 000 1-B

Sheppard Air Force Base, Texas

DO NOT START UNTIL TOLD TO DO SO

IF ANYONE FEELS THAT THEY ARE TOO SICK TO TEST AT THIS TIME PLEASE NOTIFY THE TEST ADMINISTRATOR PRIOR TO STARTING THE TEST.

INSTRUCTIONS:

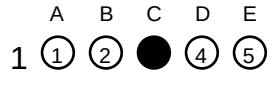
THE MINIMUM PASSING SCORE FOR THIS TEST IS **70 PERCENT**. THIS TEST CONTAINS 30 QUESTIONS, 7 PAGES. EACH QUESTION REPRESENTS A STATEMENT EXTRACTED FROM COURSE MATERIAL AND IS FOLLOWED BY FOUR ANSWERS FROM WHICH TO CHOOSE. READ EACH QUESTION AND **ALL** OF THE ALTERNATIVES CAREFULLY. THEN SELECT THE **1 BEST** ANSWER AND MARK IT ON YOUR ANSWER SHEET.

EXAMPLE:

1. Which of the following is the name given to the F-16 aircraft?

A. Thunderbolt II
B. Phantom
C. Falcon*****
D. Eagle

THE CORRECT ANSWER IS **(C)**, SO **(C)** WOULD HAVE BEEN DARKENED IN ON YOUR ANSWER SHEET. **DO NOT** MARK THIS ON **YOUR** ANSWER SHEET.



DARKEN THE CIRCLE AS SHOWN.

COMPLETELY DARKEN IN THE CIRCLE. DO NOT STRAY OUTSIDE OF THE CIRCLE. IF YOU DARKEN IN THE WRONG ANSWER OR WANT TO CHANGE YOUR ANSWER, **COMPLETELY ERASE THE MARK** AND DARKEN IN THE CORRECT ANSWER.

THE TIME LIMIT FOR THIS TEST IS **60 MINUTES**. THIS IS AMPLE TIME FOR YOU TO COMPLETE THE TEST. IF YOU GET STUCK ON A QUESTION, PLACE A LIGHT MARK BY THE QUESTION ON YOUR ANSWER SHEET. WRITE THE QUESTION NUMBER ON THE SCRATCH PAPER PROVIDED AND SKIP IT, **MAKE SURE YOU GO BACK** TO THAT QUESTION AND ANSWER IT AFTER YOU HAVE ANSWERED THE REMAINING QUESTIONS.

IF YOU DO NOT UNDERSTAND A QUESTION OR WORD, RAISE YOUR HAND AND THE TEST ADMINISTRATOR WILL ASSIST YOU.

DO NOT WRITE OR MAKE ANY MARKS IN THIS TEST BOOKLET. PLEASE **DO NOT** PUT YOUR TEST ANSWER SHEET ON TOP OF THE TEST WHILE YOU ARE TAKING THE TEST.

TALKING IS NOT ALLOWED DURING TESTING.

CHEATING IS PUNISHABLE UNDER ARTICLE 134 OF THE UCMJ.

TURN TO PAGE ONE AND BEGIN

APPENDIX D

RESEARCH CONSENT

APPLICATION FOR APPROVAL OF INVESTIGATION INVOLVING THE USE OF HUMAN SUBJECTS

University of North Texas Institutional Review Board
For the Protection of Human Subjects in Research (IRB)

This application should be submitted to the Office of Research Services, Room 160, Administration Building.

1. **Principal Investigator's Name:** Richard B. McVay

   Department & Campus Address: Applied Technology Training and Development, 1300 Highland Ave. Matthews Hall, Room 304, Bldg # 20

   Campus Phone No: (940) 565-2093 **Home No:** (940) 696-9459 **Email address:** MacVR@aol.com

2. If you are a student, provide the following:

   Home Address of Student: 2558 Shepherds Glen Wichita Falls, TX 76308

   Name of Faculty Sponsor: Dr. Jeff Allen **Phone Ext:** (940) 565-4918

   Email address of Sponsor: JAllen@tac.coe.unt.edu

3. **Title of Project:** An Examination of Computer Anxiety Related to Achievement on Paper-And-Pencil and Computer-Based Aircraft Maintenance Knowledge Testing of United States Air Force Technical Training Students

4. **Total Project Period:** **From:** 19 March 2001 **To:** 31 July 2001

5. **Is a proposal for external support being submitted? Yes __ No X**

   Funding agency:_____

If "Yes," you must submit one complete copy of that proposal as soon as it is available and complete the following:

Is this a renewal application? Yes__ No__

6. In making this application, I certify that I have read and understand the UNT guidelines and procedures for the protection of human subjects in research. I will comply with the

letter and spirit of the University policy and 45 CFR 46. I further acknowledge that I will inform the IRB of any significant changes in the protocol and will refrain from applying any protocol changes until I receive approval for said changes. **I understand that I cannot initiate any contact with human subjects before I have received UNT IRB approval.**

Signature of Principal Investigator Date

_____ _____

7. **Approval by Faculty Sponsor (required for all students): I affirm the accuracy of this application, and I accept the responsibility for the conduct of this research as approved by the UNT IRB.**

Signature of Faculty Sponsor Date

_____ _____

8. **Applicable Documentation:** I have included copies of all pertinent attachments including, but not limited to: Questionnaire/survey instruments, informed consent, letters of approval from cooperating institutions, copy of external support if applicable.

Yes _X_ No ___.

9. **Subjects:** The research sample will include approximately 250 students that are scheduled to attend Aircraft Maintenance Craftsman courses between March and July 2001 at Sheppard Air Force Base, Texas. The students who will participate in this study should represent a broad ethnic cross-section of United States Air Force aircraft maintenance personnel that maintain a wide range of airframes. Student ages are expected to range from 20-55 with a majority being males. The students will be assumed to be in excellent health since all physical requirements for consideration for active duty status in the United States armed forces have been met. Participation will focus upon subject volunteer status. There will be no children, institutionalized mentally disabled, prisoners or subjects whose ability to competently give voluntary informed consent utilized in the study.

10. **Study Procedures:** This study will employ a quasi-experimental posttest-only design using two versions of United States Air Force aircraft maintenance craftsmen course Block One Tests. The independent variable in this study will be the methodology of testing. The treatment, taking the computer-administered Block One Test, will be administered to one group and compared to the group that took the same Block One Test in the traditional paper-and-pencil format. The tests were developed by Air Force training development specialists and validated using Air Force validation procedures. The students will be assigned by class to take one of the versions of the Block One Test by either computer or paper-based modes. The students normally take these block tests in the computer-based mode, however for the purposes of this study testing in the computer based mode will be considered the treatment. Students declining participation in the study will not be required to complete the background questionnaire, the Computer Anxiety Scale-Revised, and will test in the computer-based mode as normally required by the Air Force for completion of the courses of study.

The subjects will be administered a background questionnaire and Computer Anxiety Scale-Revised (CAS-R) during the first day of class. Students will not be provided with their results or any type of interpretation of the CAS-R. The results of the questionnaire and CAS-R will be used for post experimental classification of subjects and comparisons. Students will be classified as either high or low in computer anxiety only after all participating subjects scores on the CAS-R have been compiled in descending order of score and broken into halves at the conclusion of the study.

Ho_1: There will be no statistically significant difference between the scores of students rated with high computer anxiety and students rated with low computer anxiety taking the Block One Tests on the computer-administered versions of the same tests.

Ho_2: There will be no statistically significant difference between the scores of students rated with high computer anxiety and students rated with low computer anxiety taking the Block One Tests on the traditional paper-and-pencil form of the same tests.

11. **Research Consent:** I have gained approval to conduct this research from Lieutenant Colonel Scott A. Miller, Commander of the 362 Training Squadron, Sheppard Air Force Base, Texas. This study is an official Air Force approved endeavor. Subjects for this study will be recruited during the first day of aircraft maintenance craftsman classes held at Sheppard AFB, TX. The Instructor will solicit students by explaining the study's purpose and passing out the combination Informed Consent cover letter and Background questionnaire to all willing subjects.

A waiver of the requirement that requires the subject's signature for Informed Consent is sought from the IRB for this study.

Rationale: Written consent from the subjects is not to be obtained since the probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests. A copy of the written informed consent cover letter will be given to all subjects.

12. **Confidentiality Safeguards:** Participants will not be individually identified in the final report. MSgt Richard McVay will maintain the results of the tests and questionnaires in a secure file cabinet facility located in the Training Development Element office of the Fighter Training flight. The compiled data will be placed in a secure computer file on 3 ½" floppy disc and will meet Privacy Act of 1974 standards. Upon completion of the study all data will be destroyed.

13. **Benefits to Subjects:** The intent of this research is to use the data collected to determine if differences between computer-based and paper-based modes of testing exist and if varying levels of computer anxiety effect student performance. There are no direct benefits to the individuals participating in the study. Prospective long-term benefits to future students and the Air Force include improvements in the selection of appropriate measurement modes and possible training development efforts designed to improve student performance during test administration.

14. **Potential Risks:** The potential participant risks associated with this study are minimal and can be overcome with protection of participant data in the final report. These issues were discussed in Paragraph 12. The benefits of the proposed study are outlined in Paragraph 13, and it is my belief and that of the Air Force that the subjects can only be helped by this study.

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