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DEMOGRAPHIC VARIABLES AND STUDENT ATTITUDES

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Abstract

This study was an investigation of the relationship between demographic variables and student attitudes toward computer-aided instruction (CAI). The selected demographic variables were mathematics aptitude, level of education, rank, race, gender, age, computer-related experience, computer science experience, and attitude toward computers. Results of this investigation will assist designers, developers, and deliverers of CAI in producing better individualized instruction to meet the needs of culturally diverse populations.

The study looked for group differences with respect to the independent variables and the importance of the independent variable to the prediction of the dependent variable. From the results of group differences, this study constructed profiles of students who do and who do not have good attitudes toward computers and CAI. Using the General Linear Model, results showed that the variables such as average daily exposure to computers, computer science courses, and attitude toward computers were significant at the 0.05 level. Regression models showed that the attitude toward computers, average daily exposure to computers, race and computer science courses respectively served as the best predictors of attitude toward CAI in a single variable model.

Chapter I

Introduction

Overview

Kearsley and Hillelson (1984) report that there has been an extraordinary increase in the use of computers for training applications. This is due largely to advances in microcomputing technology and the growing realization that computer-assisted instruction (CAI) is proving to be a good remedy for tight budgets and the demand for improved training productivity. The authors report that as CAI becomes more widely accepted as a training approach, issues such as cost and the management of self-learning are becoming significant topics in the training community.

Assessing student attitudes so that ways may be found to improve them is a mainstream issue among researchers who study computer-related attitudes. Improving students' computer-related attitudes, including attitudes toward learning through the use of computers, is a key to maximizing the learning process through CAI. To do this in the most effective way, however, requires understanding the effects that different variables may have on learners' attitudes toward CAI.

The necessity of safeguarding our national security heightens the need to stay on the cutting edge of technology. The reductions in the costs of computer-related technologies are making them very affordable for military training organizations, and CAI is becoming an increasingly important application of these technologies in the military. The possibility exists that in numerous situations, CAI may prove to be an effective approach to meeting the training and educational needs of officers and enlisted personnel.

Statement of the Problem

Waugh and Currier (1986) state that research in computer-based education (CBE) includes investigations in the area of student characteristics. Examples of student characteristics include demographic variables such as level of education, socioeconomic status, gender, and age. In discussing adult instruction, Milheim (1993) asserts that awareness of the past experiences and knowledge of the students being taught is important for organizing the content of the students' coursework. An example of related experience for adults who learn through the use of computers is their frequency of computer use for work, education, and recreation. Students' experiences with software should also be explored. Jackson, Fletcher, and Messer (1988), for example, highlight the importance of examining why and which types of software encourage cooperativeness. An understanding of students' familiarity with and attitude toward instructional software is also important.

Waugh and Currier (1986) maintain that to find the most effective ways to individualize instruction, research concerning the instructional design and appeal of CBE needs to be done. Kulik and Kulik (1991) also support this direction for research. They note the ongoing development of new software related to CBE and the importance of investigating whether previous conclusions in the area of CBE remain valid for new software.

Need to Conduct the Study

Developments in Computing Technologies

The need to conduct this research follows from three main considerations: (1) recently, there have been very significant advances in computing technologies; (2) there have been no studies done on a US military academy campus concerning student attitudes toward CAI; and (3) the models used by existing studies to explain attitudes toward CAI are lacking in a balance between psychological and computer science perspectives. Since the development of the first generation of Pentium computer microprocessors, computer-related technologies have evolved at a very rapid rate. This computer evolution and revolution has produced both positive and negative effects. The positive effects of the advancing technologies include the increase in computing capacity that has enabled the development of increasingly sophisticated software. This more sophisticated software has helped to make the computer a much more potentially valuable tool for CAI. The computer is now a more valuable tool because it can handle very complex functions at processing rates never seen before. These advances allow the computer to be customized to meet the needs of culturally diverse populations.

The negative effects of advancing technologies also stem from the increase in the computer's computing capacity and the introduction of more sophisticated software. The increase in computing capacity offers functions and capabilities that are rarely fully employed by the user. Also, as software becomes complex, it can become more difficult to use. As a result, the time and effort required for learners to understand and operate a program can negate advantages that otherwise might be gained. Further, as mentioned by Kulik and Kulik (1991), evolution of technology can causes researchers to question existing conclusions on CAI research.

The rapidly changing pace of the information explosion demands greater insight into the uses of technology in training settings. The lack of research that investigates demographic variables together with computer-related experience as predictors of attitudes toward CAI in a military service academy environment was evidence that the need for such an investigation exists.

Lack of research in this area is a problem because to optimize CAI, educational organizations need to know as much as possible about the factors that affect student attitudes toward CAI. According to Milheim (1993), valid and reliable results from this type of research will contribute greatly to the design, development, and delivery of CAI systems. Such research results will allow CAI implementers to better solve the problems associated with individualizing instruction to better educate a culturally diverse population.

Specific knowledge is needed about student demographics and their relationship to the spectrum of students' computer-related attitudes and their attitudes toward the CAI process of self-directed learning. This new knowledge can make a contribution by helping to guide the design of better processes, products, and services to facilitate self-directedness in student learning. The results from this applied research may also help better prepare students to be computer literate.

Efficient achievement of computer literacy is best attained from work that combines key perspectives. From a cognitive psychological perspective, this research explored the fit between the computer system and the student. Methods in CAI significantly place more of the psychological responsibility of learning on the student. From an occupational psychologist's or a training practitioner's perspective, this study attempted to address CAI effectiveness and the possibility that CAI can be incorporated into a specific organizational environment.

This study was concerned with the attitudes of the respondents and attempted to correlate significant demographic variables with attitude scores. Understanding what affects the spectrum of student computer-related attitudes can provide needed insight to allow researchers to form correlations and conclusions that can be supplied to designers, developers, and deliverers of CAI. These are necessary inputs that are vital to the overall process of making CAI more effective and will be helpful because the process of learning can become more efficient through more suitable learning systems. These suitable learning systems will be more fitting because they will be better individualized to the student. Efforts toward maximizing the effectiveness of the CAI process can result in more efficient and cost-effective ways to reach an individual's and an organization's educational goals.

Another aim of this study was to more accurately identify, prioritize, and account for the factors that contribute to the attitudes of CAI users in the United States Air Force Academy (USAFA) Preparatory School, specifically. The study was unique in sampling members of a USAFA population whose mission is to learn and prepare themselves within the rigors of the Academy's very demanding academic pace. The results may be used to help guide future decisions about the allocation of resources to CAI within such educational organizations, as well as to help determine the best ways to maximize CAI effectiveness. They may also assist educational leaders in finding ways to improve instructional strategies both in military academies and in other educational environments.

Different Context and Environmental Factors

Though the relationship between attitude and CAI has been studied (Waugh & Currier, 1986), there were many differences between the present study and other existing studies. Specifically, no existing studies in this area have surveyed students at the US Air

Force Academy's campus or on any other military service academy campus in the United States. Within this context were important environmental factors that should be understood.

The military has its own distinct culture that is profoundly different from that of a typical college campus culture. Cultural differences in this military academic environment start with the selection process. This process is very strict, and the required standards of conduct are much higher than a typical civilian student population's requirements. The selection process is very competitive and demanding, and thus it is highly unlikely that unmotivated students will survive very long in such an environment. Another cultural distinction exists in the instructor-student relationship. In comparison to a typical college campus, lines of authority and control are much more distinct on the USAFA campus.

For example, the same instructor who provides the students instruction on differential equations, computer programming, and other computer-related subjects might also demand that the students sit up properly in their chairs. The same instructor who instructs students on quadratic equations and the use of software packages might also demand that the students keep pace on a five-mile run or do sit-ups and push-ups in accordance with established standards. The same instructor who instructs students on how to use a computer program to calculate molecular weight might also instruct them on how to march, salute, and wear the uniform, or even in the proper way to clean their rooms. The same military environment that provides a full scholarship with an estimated worth of $75,000 per year also decides when a student will eat, rest, play, or sleep. In summary, from a psychological perspective, there are degrees of control exerted from service academies, through their faculty, that cannot be found in typical academic settings. Since the present study was done at such an academy, this untypical perspective should be recognized in evaluating the results of the research.

Existing CAI Attitude Models

Existing studies have explored various combinations of independent variables in the models that they use to explain student attitudes toward CAI. Studies conducted by Miura and Hess (1983), Snelbeker et al. (1992), and Yaghi (1997) employed, in their models, combinations of independent variables that represented a limited perspective. Adequate CAI models must cover a broad spectrum in order to sufficiently explain the sources of attitudes toward CAI. Adequate CAI models should use independent variables that relate to the field of psychology to address the psychological factors associated with learning. Adequate CAI models should also use independent variables that are from the field of computer science to address the engineering and configuration factors associated with the fit of the learning systems to the organization as well as to the individual. Many of the existing models do not strike the needed balance between these two broad fields.

Milheim (1993) suggests that existing studies should yield useful inputs to the design, development, and delivery stages of CAI. These needed inputs can only be offered by research that is founded on a broad perspective that includes not only psychological, but also computer science perspectives. These key perspectives are needed to provide independent variables that can be used to construct the profiles needed in the different stages of CAI that Milheim refers to, and to improve individualization of CAI.

According to McNeal and Nelson (1991), adequate designs should address instructional content, environmental factors, features of the learning materials, computer-related experiences, and the characteristics of the learner. The present study was unique because it took into account all of these factors. This was considered important because it was thought that one more of those factors might help explain any variations that might be found among groups in student attitudes toward CAI.

Investigating the relationship between student demographics and student attitudes toward CAI was important because of its link to the existing body of contemporary research on student attitudes toward CAI and because understanding the relationships between demographics and attitude is central to solving problems associated with the individualization of instructional methods. In adult education, having adequate student profiles, and thereby understanding better just who the students are, helps in the design, development, and delivery of appropriate learning materials (Milheim, 1993). In particular, for CAI, which should be student-centered, profiling can help make it possible for all students to benefit adequately from instruction. A central concern, however, should be the question of which factors within these student profiles have the most impact on the effectiveness of CAI, as some factors will be more relevant than others.

The relationship between student demographics and student attitude toward CAI deserves inquiry because it taps into the existing gaps in the organized body of knowledge on CAI. The existing gaps in CAI research include the lack of studies aimed at determining the most significant demographic variables that explain attitudes toward CAI. These gaps in CAI research are further widened by the lack of studies aimed at determining the effect of computer-related experiences on attitudes toward CAI. This study sought to determine whether central demographic variables and computer-related experiences were significantly associated with attitudes toward CAI.

The question concerning the relationship between student demographics and student attitudes toward CAI endures partly because of inconsistencies, contradictions, and weaknesses in existing research methods, instruments, and statistical procedures within and between studies. Generally, for many if not most instructional settings, the main factors affecting attitude and achievement are often difficult to specify, and it can be challenging to design studies to isolate main factors and their effects. For example, McNeal and Nelson (1991) note that results of their own study indicate that cognitive achievement was influenced by many variables, including instructional content, environmental factors, instructional methods, features of learning materials, and learner characteristics, but that the affects of these were difficult to pin down.

Research Questions:

The following research questions were addressed in this study:

Question 1. What are the attitudes of the students in the United States Air Force Academy Preparatory School toward CAI?

Question 2. Is there a relationship between student demographics (math aptitude, rank, computer-related experience, race, gender, and age) and student attitude toward CAI?

Significance of the Study

The significance of this study was that it investigated, in a previously unstudied population, factors that may affect attitude toward CAI. By doing so, it adds to the research on factors that may influence the effectiveness of efforts in CAI. Francis and Evans (1995) note the wide range of attitudes expressed by individuals affected by the current expansion and growing availability of computer technology, including "anxiety, stress, feelings of stupidity, fear and dehumanizing effects" (p. 135). Yaghi (1997) points out that students who evade contact with computers have perhaps been affected by attitudes that were constructed on misconceptions. As a result, they may see no value in using computers. Research on the factors that influence attitude toward CAI can assist instructional designers to develop programs that help overcome the obstacle of a negative attitude toward CAI. For example, such research may assist them in being able to create more user-friendly programs for CAI efforts. Also, such research may show that certain students fare better with certain instructional design features, while others derive greater benefits from other design features (Croy, Cook, & Green, 1994).

The attitudes of some demographic groups toward CAI may be more negative than others. Shashaani (1994) contends that the dominant culture reinforces a computing segregation and that there are certain group-related computer attitudes. The present research, in investigating the possible affects of demographic factors on attitude toward CAI, can help in our understanding of such group-related computer attitudes. The study may match Shashaani's call for research "to address the issue of how to break the cycle of the self fulfilling prophecy concerning disadvantaged group-related computer attitudes" (p. 448).

Those individuals and groups who demographically do not fare as well as others with CAI in its present configuration can be categorized as relatively disadvantaged in respect to CAI. Identifying the most significant demographic variables and computer-related experiences affecting student attitudes toward CAI would help to profile members of such disadvantaged groups. Profiling students can allow educators to identify those individuals who might not fare as well as others with these types of learning systems. Highlighting disadvantaged groups and individuals through profiling is an important step in identifying student needs. The next step is to take measures to better meet the needs of students who do not benefit from CAI as well as others.

The results of needs assessments can support future decisions that determine the best modes and configurations to use to maximize the CAI experience for different individuals and groups. The results from this applied research would help to improve instruction through better individualization of CAI. Profiling of students would help to improve CAI designs so that all students may adequately benefit from the newest instructional delivery systems (Milheim, 1993).

Conceptual Framework

Since the development of the newest generations of computer microprocessors, technology has evolved at nearly unimaginable rates. The increases in computing capacity have enabled the development of more sophisticated hardware and software that makes the computer a much more valuable tool. The computer evolution allows CAI to be customized to better meet the needs of a culturally diverse population.

Milheim (1993) notes the increasing utilization of CAI and the importance of the continuing education of adults now and into the next century. He asserts that in the last few years microcomputers have become increasingly viable alternatives for the delivery of instruction to learners in a variety of settings. He adds that computer usage for instruction has become particularly appropriate because of increased computer speed and memory, the use of graphical user interfaces, and the use of multimedia in a variety of forms.

There has been much research in this area on children, but research on adults in nontraditional settings is inadequate. Milheim (1993) maintains that while the employment of computers for instructional purposes has great potential, the majority of past research has concentrated primarily on the use of this technology for educating traditional students in traditional, formalized educational settings such as public schools, colleges, and universities. He adds that although many of these studies contain some material concerning use of instructional computing with adults, their primary focus was generally on younger learners, and the related research thus generally contains strategies appropriate to younger people. He maintains that with so much focus on younger students, it is difficult to obtain information centering on the utilization of CAI with adults either within traditional educational settings or in less formal environments.

The conceptual framework of the present study included adult learning, adult attitudes, the adult learning environment, and adults and CAI. A main focus was on adult learner characteristics and how those characteristics set them apart from others. The student characteristics of interest in this study included math aptitude scores, rank, race, gender, age, and computer-related experience. This study involved identifying student characteristics to profile and group students. These same characteristics may also be used to distinguish the adult learner as an individual with individual needs. This study went further to suggest that student characteristics might be important predictors of the student's attitude toward CAI. In addition, the study highlighted the adult learning environment and its role in shaping the adult learner's attitudes toward CAI.

Adult Learning

Although there are many similarities between children and adults, there are distinct and important differences. One important factor is experience. Knowles (1983), using assumptions from the pedagogical and andragogical models, maintains that adults learn differently from children. The assumptions made by Knowles revolve around a number of elements that may differ between the adult and the child learner, including the role of the learner's experience and the learner's readiness and motivation to learn. Knowles maintains that the adult learning environment should be supportive and collaborative, with a climate of mutual trust and responsibility.

Research shows that satisfied adult learners have predictable characteristics. The goal of educational leaders is to promote these desirable characteristics. Manteuffel (1982) provides a description of a satisfied adult learner. She describes the satisfied learner as being involved and feeling valued, with instruction being appropriately targeted. The adult learner must feel challenged and that the content to be learned is worthwhile and applicable. The learner must be self-directed and believe that the teaching and learning process is somewhat under his or her own control. The learner must also be appropriately rewarded and have a sense of accomplishment and mastery after completion of the instruction. To be most effective, CAI should seek to promote these desirable adult learner characteristics (Manteuffel, 1982).

In order to be satisfied with their educational experience, adults must be recognized for who they are, what they do, and what they have accomplished. Adults bring a wealth of knowledge to the classroom. They must be allowed to actively participate in the various stages of the learning process. Milheim (1993) states that adult-based instruction in continuing education should take into account the learner's past experience and should include learner input and specific applications to the learner's external environment.

Adults and the Environment.

The learning environment plays a very significant role in the quality of the transfer of knowledge in the learning process. Manteuffel (1982) holds that adults do not learn well in a hostile environment or an environment where they do not feel safe. Research shows that the learning environment for the adult can be enhanced and resistance can be reduced if the environment is challenging, supportive, cooperative, and trusting. It is important that the environment be one that facilitates self-directedness, employs active learning methods, and assists students in feeling involved, by choosing relevant subject matter and taking into account the learner's experience (Manteuffel, 1982).

There have been no research studies relating demographic variables with CAI done on the Air Force Academy's campus or on any other US military service academy's campus. This unique context offers important environmental factors, some of which run contrary to the ideal adult learning environment suggested by research. The military has its own distinct culture that is ardently different from a typical traditional college campus culture.

Cultural differences are seen in the strict required standards of conduct and the lack of individualization through standardized appearance. Also, the lines of authority between professors and student are more clearly defined on military than on most campuses. This study seeks to highlight the influence of such a learning environment on the attitudes toward CAI of adult learners.

Adult Attitudes

This study strives to sketch the spectrum of computer-related attitudes such as anxiety, apprehension, resistance, avoidance, caution, appreciating, liking, finding useful and easy, and feeling confident in using. The study sought to show whether certain demographic variables were associated with attitudes toward CAI. Attitude research and psychological theories attempt to explain adult attitudes and clearly distinguish them from children's attitudes toward learning. Adult learning research and andragogical theories may suggest ways to enhance adult attitudes and the adult learning process through manipulation of the learning environment.

Milheim (1993) provides insight into overall strategies concerning effective instruction for adult learners within formal educational settings. He states that effective instructional materials for adults should focus on significant concerns pertinent to the variety of participants involved in the learning experience, and that this instruction should encourage active use and repetition to obtain mastery.

Knox (1988) suggests the use of teaching methods that will help adults apply their learning. He suggests stressing learning topics that participants want to pursue, providing encouragement, reducing resistance, developing active learning methods, and providing evaluation and reinforcement. These are all factors that can be incorporated into CAI.

Kulik and Kulik (1991) report that CAI increased student attitude toward instruction and toward the subject matter. They also reported a reduction in instruction time associated with CAI, with adults typically requiring about one-third less learning time in comparison with conventional methods.

CAI and Adult Education

There are many advantages to using CAI in adult education. Askov, Van Horn, and Carman (1997) mention some of these, including privacy, learner control, cost effectiveness, content organization, practice, feedback, reinforcement, and assessment. Other advantages include open entry and exit, individualization of pacing and content, easier student record keeping, flexibility in scheduling, and ability to provide students with a learning experience quite different from earlier schooling where they might have experienced some difficulty.

Milheim (1993) believes that adults utilizing CAI instruction benefit from the self-pacing that gives them the ability to repeat exercises when desired, as well as from the availability of constant positive feedback. These advantages accommodate adults' need for flexibility and lack the speed requirements often evident in other forms of instruction. Other advantages of CAI mentioned by Milheim include reduced cost, decreased training time, and increased interaction between the learner and the system. The computer system has the ability to adjust to various student levels. Further, the computer is consistent regardless of race, creed, color, sex or age (Milheim, 1993).

One goal of CAI is to produce more efficient learning systems. These learning systems would be better individualized to the student. To do this, vital inputs are needed at all stages of CAI (Milheim, 1993). Studies such as the present one are needed in order to provide those inputs. Further, results of the study may be of use for improving decision making concerning educational resource allocation.

Limitations of the Study

The following were limitations of this study:

1. The population was limited to USAFA Preparatory School students.

2. The students were not randomly selected. The population reflects a selection bias.

3. Data that were presented in this study were based on the participants' perceptions.

4. This research only covers the USAFA Preparatory School approach to CAI, and does not attempt to discuss the aspects of alternative CAI approaches.

Assumptions

1. It was assumed that the respondents honestly reported their computer-related attitudes and attitudes toward CAI and that the instruments elicited the desired responses.

2. It was assumed that the definition of "race" used by society held enough meaning to communicate its intent as a demographic variable.

3. It was assumed that the respondents honestly reported their race to the best of their ability, considering the fact that they might not fully know if they are of mixed racial heritage.

Summary

This chapter looked at the evolution of computing technologies and suggested that the computer-assisted approach to learning is here to stay. It should be the goal of learning institutions to use CAI to make educational gains efficiently. Following adult learning theory, knowledge of the students and the skills and experiences they bring to the learning environment, and knowledge of the learning environment itself were highlighted as being important. Such knowledge can equip designers, developers, and deliverers of CAI to better individualize these learning systems to suit a very diverse population.

This chapter has laid the foundation for this study. Through describing the problem and by discussing the research questions, the need for the study, and the conceptual framework, this chapter showed that the study's goal was to collect student attitude information to profile students in order to provide information that may be useful in improving CAI. This chapter provided the study's link to the existing body of contemporary attitude research and the justification for conducting the study on a previously unsurveyed population and in a new context. It also highlighted the combination of independent variables. The possibility that improving the CAI process may aid in reducing existing disparities in education and employment in technology-related fields was also discussed.

Chapter II

Review of Literature

Overview

The benefits of CAI have been well-documented by leading researchers. The gains in achievement and savings in time among different populations and in different contexts are clear according to Bangert and Kulik (1982), Dalton (1986), Kulik and Kulik (1991), Kulik, Kulik, and Bangert-Downs (1985), and Milheim (1993). According to Kulik (1983), CAI has positively improved learner achievement: research has shown that CAI can benefit learner achievement by about 50 percent and can reduce the time required to accomplish the same learning.

The results from research on achievement and those from research on attitudes are not the same. Kulik (1983) reports that the effect of CAI on attitudes toward computers was strikingly different from its effect on academic attitudes and that in four studies student attitude towards computers were significantly more positive in CAI classes than in non-CAI classes.

Favorable attitudes of learners who participate in CAI programs, according to Dalton (1986), have been attributed to the fact that computers have limitless patience, never show signs of anger and disappointment, and usually leave learners with feelings of having learned better. But CAI does not have the same effect on all people. The attitudes that people have toward CAI depend greatly on who they are. Dalton (1986) supports this statement by reporting that although CAI may be used to efficiently improve student attitudes, if used in a fashion that leads low-ability students to feel degraded, or isolated because of their additional needs, CAI can have harmful effects on learner attitudes.

This study sought to identify what the student attitudes were and then sought to find if correlations existed between the student demographics and their attitudes. Before reviewing research that attempts to answer the question of the relationship of demographics to attitudes toward CAI, it was necessary to look at the definition of the psychological construct of attitude.

CAI Defined

Kulik and Kulik (1991) define CAI through comparison of the many closely related computerized systems. They describe computer-based instruction (CBI) as the larger entity. As subdivisions of CBI, the researchers identify computer-managed instruction (CMI), computer assisted instruction (CAI), computer-enriched instruction (CEI), and computer-based training (CBT). They describe computer-assisted instruction (CAI) as a narrower term that usually refers to simulation, tutorial, or drill-and-practice activities presented either alone or as supplements to conventional, instructor-guided instruction.

Kulik and Kulik (1991) define CEI as educational tasks in which computers (1) create data at the students' demand to explain models of social or physical reality, (2) carry out programs cultivated by the students, or (3) contribute nonspecific augmentation in somewhat unstructured practice that is designed to excite and inspire students. They describe CMI as a management tool that refers either to the employment of computers by faculty to coordinate the administration of student data banks and make managerial and instructional decisions, or to their use to evaluate students' test achievements, direct students to the most suitable educational resources, and maintain and track the histories of their progress.

Kulik and Kulik (1991) have given a number of definitions here, but the lines of these various definitions are very blurred. Researchers do not always agree on the definition of the various configurations that can be used by educational organizations for different purposes because they view them from their own perspective.

Patrick (1980) supports the idea that the definitions related to CAI are not clear by reporting that one should not consider CAI as a unitary concept. Patrick writes that there are a variety of possible configurations in which a computer may be used as a learning delivery system. The computer may be used to present a simulated task such as fault diagnosis in a computer system, may provide tutorial exercises to supplement an academic course, or might assist in managing a faculty educational program. Any element of such a learning delivery system may be computerized, and the problem is to decide in which capacities or functions the computer involvement may be used to increase the overall efficiency of the learning. Through comparison and contrast of CBI, CMI, CEI, CBT, and CAI it is clear that the lines are not distinctly drawn and the definition is dependent upon the user's interpretation of the capacity in which the computer is being used.

Attitude Defined

Shaw and Wright (1967) list several definitions of the psychological construct of personality referred to as "attitude," a relational construct that is distinctly different from those of belief and motive. The authors describe attitude as "an enduring predisposition to behave in a consistent way toward a given class of objects"(p.10). They identify attitude with a system of positive or negative evaluations, emotional feelings, and tendencies to action that can be pro or con toward a social object. They also hold that attitude can be considered a mental or neutral state of readiness, organized through experience, that is able to exert an influence upon an individual's response to situations. In addition, it can be considered to be a drive that produces responses that elicit motives and therefore gives rise to overt behaviors. The social objects that Shaw and Wright refer to can include modes of organized learning, such as CAI; thus, from their characterization of attitude, we can understand attitudes toward CAI as enduring predispositions to behave in certain ways in relation to CAI. The element of experience that they refer to in saying that attitude is organized through experience plays an important role in designing the present study. For example, daily experience with computers was taken into account as a factor that might affect attitude toward CAI.

Shaw and Wright (1967) discuss several distinct characteristics of attitudes. These characteristics include their being based upon evaluative concepts, such as judging an object or practice to be good or bad, useful or useless. Such evaluations made about the objects to which the attitude is directed tend to give rise to motivated behavior. This characteristic of attitudes suggests that they may correlate with specific behaviors and can be used to predict behaviors. In reference to learning, Shaw and Wright point out that the characteristic may be used to determine if a subject will choose to use a certain type of learning device based on some attitude toward it.

A second characteristic of attitudes listed by Shaw and Wright (1967) is that they can vary in quality and intensity along a scale from positive, through neutral, to negative. It is seen from this that attitude has a two-dimensional structure: not only might an attitude fall somewhere along a scale from negative to positive; but also, wherever it falls along that scale, it will have some intensity or other. A weakness in attitude research is the researchers' consistent inability to communicate this two-dimensional nature of attitude.

The third characteristic that Shaw and Wright attribute to attitudes is their being learned rather than innate. This is an important characteristic because if attitudes can be learned, they can be taught, and we thus have reason to believe that they can be changed through teaching.

The fourth characteristic that the authors list is that attitudes have specific social referents or specific classes thereof. This characteristic suggests that central attitudes are more intense than peripheral ones. An attitude toward one's self is an example of this characteristic. A fifth characteristic is that attitudes possess a certain degree of interrelatedness to one another. Shaw and Wright (1967) suggest that related attitudes form clusters.

The final characteristic of attitudes that Shaw and Wright (1967) list is that they are stable and enduring. Whereas the third characteristic suggests that people's attitudes can be changed, this last characteristic suggests that attitudes will not change very quickly unless there is a significant event or experience that causes the change.

The most important element of attitude highlighted in this study is the fact that in many situations, a positive attitude toward CAI is essential if it is to be successful. One of the areas where attitude is paramount is that of CAI program implementation. For if the attitude of the key players, namely the students, is not adequately positive, then the probability for the success of program implementation will be significantly lowered.

Therefore, this research followed that lead and focused on research relating to the attitudes of students. The model that this research used was one that attempted to identify factors that had significant effects on the attitude of students in the CAI process. This knowledge could then be used as a predictor to improve the probability of success of a CAI program. With attitude defined, and its significance to CAI highlighted, it was necessary to explore what the existing research showed with relation to demographics and their effect on computer-related attitudes.

Attitude Research

In order to answer the question, "What are the computer-related attitudes of the students in the USAFA Preparatory School?" this study looked at studies that have compiled findings on the attitudes of students in a similar context. There were no research reports from scholarly journals that present the results of student attitudes toward CAI in a service academy environment. Therefore, it was necessary to look at closely related studies and generalize the findings to this study while taking into account differences, such as the rigid militaristic environment in which this study was undertaken.

Lawton and Gerschner (1982) report a synthesis of findings on the attitudes toward computers and computerized instruction. They report that there is not much agreement on attitudes toward computerized instruction. They add that very few researchers were willing to swear that students would prefer to learn with computers. The authors claim that this was based on the diversity in computer software; the variety in educational programs; the numerous terms used to describe variations of computer-based instruction, projects and languages; and the different methodologies.

These findings may reflect the fact that Lawton and Gerschner's (1982) study is relatively old. Advances in technology have changed many of the hardware features that created problems associated with the findings. Today's more advanced computers and software are more suitable to be individualized to the student. The advances in technology have changed many software features and have thereby made the computer system more adaptable to the needs of the individual. Some of the advances in software reduce the possibility of producing CAI findings today like the ones in the study by these researchers.

These between-study findings of Lawton and Gerschner (1982) also used a method that was very qualitative in nature. This suggests that the research design and framework inherently would make it difficult to make statistical comparisons between studies. There was no mention of effect size (ES) or its importance in across-study comparisons. Nor did this study mention any other reputable meta-analytic method for making comparisons across studies. Therefore, based on the different methodologies, it was impossible to statistically compare the results.

Kulik (1983) did a synthesis of research on CBI. He reported that computer-based teaching produced only small effects on students'academic attitudes. He reviewed 10 studies, with results showing that CBI produced more positive attitudes in 8 of the 10 studies in the classroom. The average ES was only 0.12 standard deviations. Another four studies reported favorable quality of instruction in CBI and conventional classes. The CBI students gave the more favorable ratings in each of these studies. The average ES was only 0.19.

The effect of CBI on attitudes toward computers, according to Kulik (1983), was notably different from its effect on attitudes toward academic subjects. Four studies reported results in this area. In every one of these studies, CBI classes produced more positive student attitudes toward computers, and in three of the studies, attitudes toward computers were significantly more positive among students who used CBI. The average ES was 0.61 (Kulik, 1983).

The meta-analytic study by Kulik and Kulik (1991) examined a total of 254 controlled studies. These studies showed that CBI usually produced positive effects on students. The populations included learners of all ages, from children to adults. The authors report that the CBI programs usually improved student examination scores by 0.30 standard deviations in the average study. This was described as a moderate but significant effect. The authors report that CBI produced small but positive changes in student attitudes toward teaching and computers, and it absolutely reduced the amount of required time for instruction.

Kulik and Kulik (1991) went further to delineate and stratify results of the studies that they examined. For example, of the 254 studies, 19 looked only at student attitude toward computers. The authors reported that use of the computer produced positive changes in attitudes and that 80 percent of the studies reported more positive attitudes for students in CBI classes. The average ES in the 19 studies was 0.34 (SE = 0.1).

Of the 254 studies, Kulik and Kulik (1991) examined 22 that investigated student ratings of the quality of instruction. Sixteen of these 22 found more positive attitudes in the CBI class, two studies found no difference attitudes for CBI and conventionally taught classes, and four studies found more negative attitudes in the CBI class. The average ES in the 22 studies was 0.28.

Of the 254 studies, 34 considered the effects of CBI on student attitudes toward the subject matter that they were being taught. Sixty percent of the studies reported that student attitudes in CBI classes were more positive than in traditional classes. The average ES for attitude toward subject was 0.05 (SE = 0.06) (Kulik & Kulik, 1991)

The researchers report that the results of their study were consistent with the findings of earlier literature reviews. For example Kulik, Bangert, and Williams (1983) and Kulik, Kulik, and Bangert-Downs (1985) report on the effectiveness of computer-based education in elementary schools. Kulik and Kulik (1991) add that results agreed both overall and in detail. With reference to time, the authors report that CBI was especially effective when the duration of treatment was less than or equal to four weeks. The average effect of CBI in such studies was to raise performance by 0.42 standard deviations (Kulik & Kulik, 1991).

In order to more adequately answer the question, "Is there a relationship between student demographics (mathematics aptitude, rank, race, computer-related experience, gender, age, frequency of computer usage, and attitudes towards computers) and student attitude toward CAI?" it was necessary to synthesize the findings of many investigations to attempt to capture the most significant variables from those studies in an effort to produce a better study. Existing research in this area does not use a combination of independent variables that adequately draw from the fields of psychology and computer science. Therefore, it was necessary to select a combination of independent variables to better achieve this needed balance, using mathematics aptitude, rank, race, computer-related experience, gender, age, frequency of computer usage, and attitudes towards computers to form a model to better explain the construct of attitude toward CAI.

Milheim (1993) covers most of the important topics associated with CAI. His study also includes most of the independent variables that were of interest to this study. Milheim includes both the positive and negative sides of CAI. He reports that although

CAI for adults has some disadvantages, the good far outweighs the bad. With the ever-increasing age of the general population, adult-based education and training are important as research topics in a variety of settings. Milheim reports that one of the most important areas of interest concerns the design, development, and delivery of instructional materials that are appropriate for adults. CAI has proven to be an effective medium in educational classrooms and corporate training sites. While some disadvantages have been highlighted, CAI, when used as a supplement to traditional classroom instruction, has been confirmed to be appropriate due to its individualization, achievement gains, cost effectiveness, interactivity, and consistency.

During the last decade, according to Milheim (1993), microcomputers have become increasingly viable alternatives for delivery of instruction to learners in a variety of settings and provides useful information on adult learning theory, giving suggestions on the organization of adult-based education. Milheim points out the importance of instructional program pacing, the use of reinforcement and meaningful feedback, and the use of group discussion and of role playing in simulations. He adds that adults are capable of participating in the planning and implementation of their learning and can scrupulously determine the value of a particular learning activity. The starting point for organizing the content of adult-based instruction, according to Milheim, should be related to the knowledge of the students and their past experiences. The element of past experiences was explored in this study and served as an independent variable to help explain the criterion variable of the study.

Various factors, according to Milheim (1993), can limit the potential effectiveness and efficiency of adult-based instruction. He suggests that some adults may feel insecure, fearful, tense, or pressured. Also, adults may feel awkward, unsure, frustrated, threatened by, or afraid of computers. Some adults may feel the reduction in human interaction or isolation brought about by use of computers. It is important to find ways to minimize student anxieties. With adults, emphasizing accuracy rather than speed and emphasizing retention without emphasis on time limits can make the leaning environment more conducive for learning. The emphasis must simply be on mastery. These approaches will reduce anxiety in the adult learner (Milheim, 1993).

The author adds that environmental conditions must be taken into account. Environmental conditions can have an effect on the student's overall opinion of the instruction. These environmental conditions include factors such as extraneous noise, interruptions, crowded seating, inferior lighting, and inadequate and incompatible tools. More importantly, the psychological climate must also be taken into account. Adults will feel more comfortable within a respectful and supportive climate (Milheim, 1993).

The context of the present study requires the environment be taken into account. The psychological climate was not typical. Very crude but effective methods were used for mental conditioning. The psychological climate that exists in the context of this study does not always fit the conditions that will produce the best results for adult learners. This study took these differences into account. Milheim, (1993) maintains that although the negative factors should be considered when designing and implementing CBI, the overall data suggest that computers can be used as effective instructional tools for adult-based instruction. The author does add that this type of instruction must be mindfully designed with emphasis on adult learning principles.

Computer instruction for adults, according to Milheim (1993), must be designed scrupulously to provide the maximum advantages from the use of this technology. Design elements in this area should reflect specific decisions concerning content organization, learner control, practice, feedback, reinforcement, and assessment. Concern for these factors and overall knowledge affecting adult-based education will support the instructional designers and developers in their production of suitable CAI for adult learners (Milheim, 1993).

The quantitative ex post-facto study by Snelbecker et al. (1992) has many similarities to this study. The similarities were that Snelbecker et al. use previous experience and aptitudes as independent variables. The difference of their study from the present research was that the researchers also used attitude towards computers as an independent variable that was a predictor of success for the research subjects. The population under study was teachers, but they can be viewed as students for all practical purposes because in this situation they served in the capacity as learners. The study started with the hypothesis that even though it was necessary for the instructors to learn more about computers, some people were going to have a more difficult time than others learning about them.

Snelbecker et al. (1992) moved further to hypothesize that gender, math background, and/or previous computer experience would indicate who would be successful learning with computers. The study examined the extent to which these demographic variables may be indicative of a subject's likely success. The first research question of the study was, "Which attributes collectively account for variations in achievement as measured by course projects, course exams and overall course grades?" (p. 4). There was no indication, in the study, of the level of standardization in the course materials; and the study, ironically, gave no indication of the level of standardization of instruction between instructors and course materials. This weakness in design makes it very difficult to generalize these findings to a larger population.

The second research question of the study was, "What portion of the collection variance in achievement was accounted for by the respective collective predictors?"(p. 4). Answering this question required the proper operationalization of the predictors in the conceptual model and an instrument that adequately measured the predictors in the model. Answering the question also required a design that controlled for the extraneous variables affecting measures of the dependent variable. Careful analysis showed that the operationalization of the predictors, an adequate instrument, and a research design with adequate control was lacking in this study. A weakness in one of these components inherently produces weakness in the other components. For example, the value of adequately measuring an independent variable is greatly lessened if the variable cannot be accurately described.

The third research question of the study was, "To what extent are predictors of one type of achievement evident as predictors of other types of achievement within a given course?" (Snelbecker et al., 1992, p. 4). This question asks, for example, if success in computer science courses would lead to success with computers or, more generally, do past experiences with computers lead to success with computers? The research questions require the adequate operationalization of the predictors. If it means success with computer science, then will any course do? Will some programming languages be better predictors than others? Was there a time limit on these courses? Would college courses serve as better predictors than high school courses? This question was answerable in the research so long as the study's design provided sufficient control to allow the researcher to conclude that it was the treatment or predictor, and not extraneous variables, that caused the change in the measures of the dependent variable.

The fourth research question of the study was, "To what extent are predictors for one course likely to be predictive of achievement in other courses?" (Snelbecker et al., 1992, p. 4). This question asks about the reliability of the predictors and relates to the importance of the predictor in the model. The answer to the question relates to the how much of the variance in the measures of the dependent variable can be accounted for by a single predictor or combinations of predictors.

The fifth and final research question of the study was, "To what extent are there similarities and differences in the pattern of predictors for high school vs elementary school teachers?" (Snelbecker et al., 1992, p. 4). This question inquires about the reliability and generalizabilty to larger populations of the predictor variables. If the predictor variables were the same for both the elementary schools and the high schools, then the researchers might conclude that these predictor variables were generalizable to other elementary schools and high schools. This question would also answer whether or not these predictor variables were valid enough to generalize the findings of this study to instructors of colleges and universities.

One immediate observation of Snelbecker et al.'s (1992) study was the fact that there were so many research questions. This creates a weakness in the study's design. The sheer number of questions tends to disallow the researchers from gaining the needed depth on a few of the questions. On the other hand, the advantage to these questions rests in the fact that the majority of the questions were focused on different dimensions of the dependent variable. The questions were directly linked to the criterion variables. However, the first two questions would have been enough for these researchers to conduct a very meaningful study. Adequate answers to the first two research questions of the study could have eliminated the need to answer the last three research questions. It was the inability to limit the scope of the research questions and clearly define the conceptual framework that created weaknesses in the framework and the research design of the study.

In their study, Snelbecker et al. (1992) also never clearly communicate what specific types, or in what ranking order or what graduated amounts of computer experience were desirable in order to be considered successful. The researchers should have communicated more clearly and specifically, with range and magnitude, the characteristics of these experiences. If a certain type of experience was important, then what type was it? Was it computer programming? Was it computer operation, or computer repair? Was it computer usage for work, for education, for play, or for some combination of these? If the answer was that it was experience with computer programming, then was there a hierarchy among the computer programming languages that would represent the best experience? Was there some combination of computer programming languages that represented the best experience? These unanswered questions did add to existing weaknesses in the design of the study.

The researchers did collect self-reported information on computer-related experiences and interest variables. These were submitted in the form of written responses from the participants. Participant responses included typing speed, number of computer-related classes taken, and level of class achievement. Other self-reported responses included use of computer games, computer programs writing experience, mainframe operation, computer repair, computers sales, computer design, computer personnel systems management, and computer program proficiency. Finally, the self-reported information submitted included whether participants were undergraduate majors (math versus non-math) and their undergraduate grade point averages (Snelbecker et al., 1992).

If the type of experiences and the order of those experiences that serve as the best predictors of success was clear, then what were the required amounts for an individual to be considered experienced with computers? Was there a time factor associated with these experiences? This line of questions suggests that a fundamental problem rests with operationalizing the computer-related experience. This study's poor operational definition of the experience variable led to a weak conceptual model and conceptual framework. The research question requires a computer attitude scale (CAS) that has sub-scales that would identify more specifically the domain and range of experiences required as predictors of success. The lack of the necessary CAS makes it impossible to adequately explain the variance in measures of the dependent variable.

The lack of a valid and reliable instrument to adequately measure the subject's experience level led to the inability to adequately measure the experience variable. This created a very weak research design that produced inadequate levels of internal validity. The decrease in internal validity led also to a decrease in external validity for the study.

Snelbecker et al. (1992) derived information from two National Science Foundation (NSF)-funded programs designed to retrain experienced teachers to become K-12 computer science teachers. There could be selection bias since these instructors were selected based on computer experience. Half had very little computer experience.

Since there was no random selection or random assignment, it was not possible to conclude that the extraneous variables, the confounding variables, and the intervening variables were evenly distributed among the population. If this was so, on what basis were there conclusions of some degree of sameness among the population on the variables of interest? This was a prerequisite, if the researchers were to make any conclusions about the effect or relationship of the independent variable of interest to measures of the dependent variable. This weakness decreases both the internal and external validity of the study.

The researchers report that data were collected in various manners from questionnaires constructed by the authors. The report failed to include a description of reliability or validity measures of the questionnaires. The researchers did not describe the number of items on the scale or the questionnaire, or whether or not the CASs or questionnaires were five-point Likert-type scales or continuous scales. The researchers failed to mention the alpha reliability coefficient. They also did not mention for what and for whom specifically the instruments were designed or the various populations that have used the instruments to verify their suitability for use in this context.

The treatment in this study was the series of courses that the instructors took. In these programs, employed teachers, certified in other areas, took a series of courses to become qualified to teach computer science and to serve as computer resource persons at either the elementary or secondary level. Forty-two subjects in the study were high school teachers, and 47 were elementary school teachers. They completed the NSF program and the Computer Attitude Scale; the Computer Aptitude, Literacy, and Interest Profile; and a series of questionnaires. Results indicate that some kind of previous experience with computers was predictive of successful achievement, but which experiences were most important was not clear (Snelbecker et al., 1992).

Through the use of ANOVA and stepwise regression the study attempted to find the best-fit model. ANOVA found the independent variables at the 0.05 significance level that were the best predictors of the dependent variable. The same statistical procedures were run using robust regression to eliminate the distortions associated with outliers. With the stepwise regression, gender showed an effect: males appeared to do better in computer programming and in courses that deal with instructional design. The conclusions show that some kinds of experiences were predictive, but the exact type was not clear. The researchers also report that the undergraduate math major had an effect (Snelbecker, et al., 1992). In order to explore these findings that relate to the experience variable, the present study suggested that the students' mathematics placement score, SAT mathematics score, experience in computer-related subjects, and experience with computers may serve as predictors of attitude toward CAI.

In order to capture findings that explored additional related variables, the study by Hess and Miura (1983) was reviewed. The researchers investigated the relationship between the demographic variables of gender and socioeconomic status (SES), and computer learning. The variable of SES in Hess and Miura's study was comparable to rank in the present study. This was because in the present study most members of the population were all paid at the rank of E-1, which was approximately $700 per month. The population also received housing, meals medical, and dental benefits. This rank communicated clearly the standard of living and economic situation of the population surveyed. There was no better way to capture that information.

This study used a conceptual framework that was based on the assumption that the disparities in computer literacy have a theoretical and a social importance. Social significance, according to Hess and Miura (1983), follows from economic and educational opportunities open to students who have computer knowledge, and the fact that differences in the tendency to acquire programming skills may be expected to increase the gender and socio-ethnic bias that exists in the labor market. They warn that the new technologies may threaten gains in educational and career opportunities for women and minorities that have been achieved at great efforts in the past (Hess & Miura, 1983).

The purpose of Hess and Miura's (1983) quantitative ex post-facto study was to identify the students who voluntarily seek to acquire computer knowledge and programming expertise. This was a report about gender and socioeconomic differences in enrollment in computer camps and summer classes. The researchers used an analysis of gender differences by age, SES, and selected characteristics of classes and camps. They sent out one-page questionnaires to directors of summer camps and classes that offered training in programming for microcomputers. Follow-up data were gathered by phone from directors of computer camps and summer workshops. They reached 23 directors of summer programs by phone. The researchers listed the many difficulties associated with the approach they used. An example includes incorrect and inappropriate procedures used in the selection of the students. The directors served a total population of 5,533 students in approximately 132 instructional groups. Directors furnished data on enrollment and SES of students, type of sponsorship of programs (private, public schools, universities), level of difficulty of classes, cost, and residential versus day use (Hess & Miura, 1983).

Camps were located in various parts of the United States, but about half were in western states. The survey asked for enrollment by age, grade, gender, socioeconomic status (SES), and ethnic origin. The three categories for SES were low income, middle income, and upper income. The five categories of ethnicity were Caucasian, Black, Hispanic, Asian, and Native American (Hess & Miura, 1983).

No mention was made in this study about the validity or reliably of the instrument or for whom it was best suited. The study did not mention any cases where the instrument was used in other populations. One of the weaknesses of the study rests with the manner in which the instrument was used. The researchers relied on the directors to report the information on the students. They were expected to report the student's SES. It was clear from the report that the directors were not well-informed about the social background of the students. The unreliability of the source of the information seriously decreases the internal validity of the study. At a minimum, the contribution of the independent variable to measures of the dependent variable were unreliable. This study did not clearly identify the criterion variable (Hess & Miura 1983).

The analysis of gender and SES enrollment, according to Hess and Miura (1983), was designed to explain questions about gender and SES differences for the total group. They added an additional dimension to the study by adding that data were investigated to determine whether magnitude of gender variance varied by the age of the student, level of difficulty of the programming courses, expense of the residential character of the camp, and type of sponsorship. The differences between proportions of males and females and SES, according to Hess and Miura (1983), were so large that statistical tests were not necessary to establish significance of the results. When appropriate, interactions between gender and other characteristics such as age and cost was examined by the use of the Chi Square test of significance.

Hess and Miura (1983) concluded that Caucasian males from middle SES backgrounds sought computer literacy most often. Sixty-seven percent more males than females were enrolled in the total sample. The enrollment of males exceeded that of females in each of the reporting groups. The disparity between males and females increased with grade, age, cost of program, and level of course difficulty. Ninety-eight percent of those enrolled were from middle class backgrounds, and 91 percent were Caucasians. The camps were from many different states, but this population was not one that was representative of the larger population as a whole. The authors report that while Asians were over-represented, other minorities were under-represented.

To suggest causation, Hess and Miura (1983) maintain that parents appear to be more willing to invest in this type of training for their sons than for their daughters. They were certain that computer literacy must not be left to personal discretion if all segments of the population are to be equally prepared for the future in a technological workplace. The problem requires intervention from leadership that has the knowledge of the needs of disadvantaged groups. The gender and socioeconomic differences found in enrollment in computer camps and classes prove that computer knowledge and skills are not being acquired equitably. Computer literacy has followed the traditional lines of affluence, education, and gender bias. The authors believe that we are at a primary stage in the expansion of computer literacy programs. This suggests that there is still time to intervene. Intervention by educational leaders is needed to prevent these inequities from becoming even more deeply entrenched in our society (Hess & Miura, 1983).

In order to capture more findings that explored more related variables, the study by Miura and Hess (1983) was also reviewed. They extended their research by including two other related studies to form a comprehensive report. Through the use of a more diverse population, these additional studies collectively strengthen the external validity of each of the individual studies. The investigation of Miura and Hess does not capture all of the dimensions required for this study, but it does capture more dimensions than Hess and Miura (1983). They claim that these three studies give evidence to support informal reports of sex differences in computer access, interest, and use in the school-aged population (Miura & Hess, 1983).

The research of Miura and Hess (1983) starts with the conceptual framework that assumes that math and technology have always been looked upon as male domains. The authors claim that recent attempts to battle conventional inequities in access to education and employment have ignited a new awareness of gender differences in these areas. The study compiles data to support the proposition that there is a gender gap and that the gap is widening. They present some of the possible causes and some plans of attack to reverse the trend to create a level playing field for disadvantaged groups.

The first study was the before-mentioned investigation by Hess and Miura (1983), in which data supplied by 23 camp directors on 5,533 students indicated that enrollment in computer classes showed a pattern of three to one in favor of Caucasian males from middle SES backgrounds, where the disparity increased with course difficulty and course cost. The authors report that the results reflect the strong tendency of parents to encourage computer literacy more aggressively with their sons than with their daughters.

In the second study, a survey of 87 middle-and upper-income students in grades five to eight revealed that more males than females owned home microcomputers and that use of the home computer also differed by gender. The authors determined from interviews with the students that the typical owner in this study was a male who was a high academic male achiever and who enjoyed programming and playing games on his computer (Miura & Hess, 1983).

In a third study, 157 middle school students from three school districts located in lower, middle, and upper income areas were surveyed to rate a list of 75 software titles for perceived user interest. Miura and Hess (1983) report results that indicate that a considerably larger number of the randomly selected software titles were perceived as principally suited for male audiences. The authors added that the females generally chose software games that involved writing or music, while males chose competitive action games involving hand-eye coordination. The deficiency in suitable software has been offered as one reason for the differences between computer interest and usage. This idea can be compounded by the idea that the lack of female software engineers complicates the matter. If the males were predominately software engineers and software developers, then they may have been writing and developing programs mainly for male audiences (Miura & Hess, 1983). The notion that, through the random selection of software, the software was more suitable for males, supports a central theme of this literature review, which is that a subject's attitude toward computers and CAI could correlate with some demographic variables.

The most likely plan to break the cycle that exists with a software gender bias is for researchers to produce the evidence showing that the gender gap and other gaps between disadvantaged and advantaged groups exist. Next, the needs of the disadvantaged groups should be assessed and a feedback network created that feeds this information to designers, developers, and deliverers of CAI so that the necessary changes can be made in future software packages. These changes in software will serve to assist in helping to close any gaps that exist in computer access and usage.

Significant differences between males and females in school-aged populations in how software is perceived may have economic and educational impacts and effects on careers of individuals who do not have the requisite technological skills. There is a need to analyze the psychological processes that contribute to these differences in computer literacy to develop effective intervention strategies to minimize the growing gender gap in computer access, interest, and usage (Miura & Hess, 1983).

Gardner, Discenza, and Dukes (1993) explain that the presence of certain attitudes serve as a major factor for the students to use them. Also, students who experience computer anxiety display behaviors such as avoiding contact with computer systems, minimizing their computer time, exercising extreme caution, and making generally negative remarks about them and those who use them. The researchers mention that these obstacles undermine the learning process and that researchers must seek ways to minimize negative attitudes.

Shashaani (1995) designed a study to examine the extent to which experience with, and attitudes towards, math differ between males and females. Her study was also concerned with the association between adolescents' math attitudes and computer attitudes. She found gender differences in math experience and attitudes toward math. She reports that males completed more math courses than females and that females were less interested in math and had less confidence in their ability than males.

Using Pearson correlations, Shashaani (1995) showed that math experiences and attitudes were positively correlated and that math liking and math confidence were positively associated with computer interest and computer confidence. This well-documented positive correlation to computer liking and computer interest and other computer-related attitudes justifies tracking the data associated with mathematics in the present study.

Using MANOVA, Shashaani (1995) showed that on three attitude subscales there was a significant effect for gender: computer interest, computer confidence, and computer stereotype. Males scored higher for computer interest and computer confidence. The Pearson correlations showed that on all three subscales math was significant for males and females.

If having more mathematical skills leads to more positive attitudes toward mathematics, which in turn leads to more positive attitudes toward computers, then the profound question is how to lure more females and minorities to enroll in math courses. Research shows that this problem is social rather than biological. (Shashaani, 1995). If the designers, developers, and deliverers of CAI could tailor, for example, CAI mathematics courses to the individual, the individual might develop a better attitude about the delivery system and the course content. This would create a win-win situation.

Jegede, Okebukola, and Ajewole (1991), with their study in Nigeria, provided contrast to studies done on a predominantly Caucasian population in the most industrious nation in the world. The researchers write of the struggles of a developing nation and the problems that were associated with the use of computer technologies in education. These differences produced a different array of computer-related attitudes. They allege that the cost of purchasing and maintaining computer systems was a major inhibiting factor to the adoption of this high technology.

The economies of many developing nations, according to Jegede et al. (1991), are dormant, rudimentary, and struggling to meet the basic needs of health, rural development, and general education. This analogy can also be used to understand the relationship of people in a lower SES to computer access. The authors determined that the presence of computers in the classroom at that time was a luxury. There was also a problem with the definition of computer literacy and the inappropriateness of software that used western world-view standards. On a microscale, this is one specific form of the general problem that exists when individuals use inappropriate software. When that occurs, there is little or no chance of an efficient transfer of knowledge.

The authors framed their study around three questions. First, what were the attitudes of the students, who operate within a poorly developed computer technology environment, toward the use of the computer in learning biological concepts? Second, would there be an attitude change when the students are engaged in the use of the computer on an individual or a cooperative basis? Third, would students who live in an environment that has a poorly developed computer technology achieve more in biology when learning is undertaken with the use of the computer? (Jegede et al., 1991).

The authors used a method that consisted of a population of only 64 students who were enrolled in a national examination preparatory course in biology in Nigeria. The sample included 43 males and 23 females. The mean age for the population was approximately 16.3 years. The CAS was a 20-item 5-point Likert scale type instrument. The researchers reported that the CAS had a coefficient alpha of 0.84 for a validation sample and 0.96 for the subjects of the study (Jegede et al., 1991).

One of the very strong characteristics of the research by Jegede et al. (1991) was that it used a quasi-experimental design, with random assignment of students to three groups. The pretest and posttest strengthened this design. Although random assignment was a very strong approach to distributing the extraneous variables equally across the population to ensure sameness, the requirement to have a female in every group could have decreased the maximum efficiency of the groups. This research could have gained more depth if the researchers had limited their research questions to only two. One of the weaker environmental factors in their study was the fact that the computers used were very old. The computers used had only 20-megabyte hard drives, with very limited memory. Therefore, it was highly unlikely that the software program that was used, School Software BIO 101, was top-of-the-line software, as the old machines would not have been able to handle the necessary graphics.

The use of cooperative-learning teams, according to Jegede et al. (1991), included individuals for purposes of analysis. This violated the assumption of independence among observations, which reduced within-cell variation and influenced the type 1 error rates above what was reported. They found that at the pretest level, the students did not have a favorable attitude toward computer usage for learning biological concepts, but using the computer resulted in significant attitude changes. The posttest results further indicated that the groups using the computer had more favorable attitudes toward computers than those that did not use the computer.

Limitations of this research were linked to the shortage of computers based on cost concerns. The limited number of computers most likely forced the students into inefficient group sizes that were larger than three students. The researchers do suggest that future research address the problem of the critical group size that can derive maximum benefit from the use of computers on a cooperative basis (Jegede et al., 1991).

From a computer scientist's or engineer's perspective, the systems configurations in the study by Jegede and coworkers (1991) were less than adequate in comparison to what is considered minimum system requirements to handle the educational media that are available today, as the computers used were old and outdated. This was another limitation of the study, one that directly links to the occupational psychologist's or training practitioner's perspective. Such computers would not be able to take advantage of the advances in software technology that could lead to more efficient learning (Patrick, 1980).

The findings from Jegede et al.'s (1991) study support research that makes claims that student attitudes can be improved with computers. The researchers never clarified whether or not the subjects had exposure to CAI alone or to a combination of CAI and an instructor, and to what degree. On the question of whether or not the students learned better, the researchers disclose that their findings were the null hypotheses of no difference. It was very likely that the computer systems and the software were poorly suited for the individuals as well as for the different groups (Jegede et al., 1991).

Very firm conclusions cannot be drawn from the results of this study until studies in similar settings furnish supporting data. There were many variables that were not controlled for, and the researchers were rightfully cautious about making claims of causation. One of the goals of the research was to determine the attitudes of the students. Yet, the researchers did very little to explain what the attitudes were, to whom the attitudes belonged, and the reasons the students had those attitudes (Jegede et al., 1991).

The researchers stated that at the pretest level, the students in the sample did not have positive attitudes toward computer usage for learning biological concepts. They report that in a group by gender analysis of covariance, the data showed an effect for group but not for gender. The researchers should have been very descriptive in communicating the demographics of the group members. There are questions that should be answered about the gender composition of the groups and the aptitudes of the members of the group. The aptitudes should be properly matched, as should genders. The negative gender effects could have been attributed to group composition, or demographics, or aptitudes and dynamics of the group. The researchers could have depended on random assignment to take care of these discrepancies.

Patrick (1980) conducted a study in which he traveled the US in search of ideal CBI systems. Patrick took the approach of finding systems that worked and wrote about them. No experiments were conducted, and no treatments were administered. There were no experimental groups or control groups, nor pretests or posttests. He simply looked for systems that worked, and tried to describe the characteristics of those systems.

The research designs studied by Patrick (1980) did not incorporate the necessary controls to show causation. Therefore the conclusions that may be drawn were largely intuitive. Patrick did not intend for hard generalizations to emerge from his study. The investigation was aimed at examining the philosophy and ideas underpinning the various research projects he investigated. Because of the rapid changes in technology, the past 20 years have rendered most of these systems obsolete, but the adult learner principles used in the projects are still valid. These were the same enduring principles mentioned by

Milheim (1993).

Through a synthesis of relevant CAI research findings, it was clear that CAI offers superior advantages for learning when used in conjunction with classroom instruction. What was not so obvious from these reports was a unified concept of CAI. This means that subdivisions of CBI such as CMI, CEI, CBT, and CAI have roles that are very similar and this leads to unclear definitions among researchers. Without clear lines of distinction there exists a lack of a unified CAI concept.

This lack of a unified concept leads to a situation in which CAI means many different things to different researchers and in which different researchers take very different methodological approaches to answering their research questions. Another clear observation was that the methodological framework being used by the researchers rendered results that were limited to their disciplinary perspective. The range of expertise required for the adequate assessment of CAI requires the synthesis of expertise from many disciplines. This proves to be a major weakness in the research findings from CAI (Patrick, 1980).

The obvious way in which CAI systems differed, according to Patrick (1980), was reflected in the different backgrounds and approaches used by research workers. CAI impinges not only upon a variety of areas within psychology, such as cognitive psychology, artificial intelligence, and occupational psychology, but also on other disciplines such as education and computer science. Researchers may have backgrounds in any, all, or indeed none of these areas. Patrick believes that to some extent the expertise of the researchers affects the flavor or orientation of CAI projects. (Patrick, 1980).

Cognitive psychologists, according to Patrick (1980), are obviously concerned that for example, the dialogue between the tutor and student is sufficiently sophisticated. Occupational psychologists or even training practitioners may be more concerned that CAI is effective and that it can be assimilated within a particular organizational context. On the other hand, computer scientists and engineers may focus on various alternative computer configurations. These different emphases are all-important dimensions to the same problem, all of which need to be considered in CAI research. Patrick (1980)concludes that some projects, which dwell upon some dimensions to the exclusion of others, are delimited as a consequence.

In order to address the weakness presented due to the limiting nature of researchers' philosophical perspective, higher quality CAI research should incorporate an amalgamation of perspectives. First, more superior CAI research should, from an occupational psychologists' or a training practitioner's perspective, address CAI effectiveness and the possibilities that CAI can be assimilated within a particular organizational context. Next, it should also address, from a cognitive psychologist's perspective, the sophistication of the dialogue between the tutor and student. Finally, adequate CAI research addresses, from the computer scientists' or engineer's perspective, various alternative computer configurations. Patrick (1980) believes that these different emphases are all significant dimensions to the same problem. These dimensions must be considered when researchers decide upon a methodological framework to study CAI.

Summary

This review sought to chart the spectrum of computer-related attitudes. Examples of attitudes include anxiety, apprehension, resistance, avoidance, caution, appreciation, liking, finding useful or easy, and feeling confidence in using. The review has shown that the presence of certain attitudes will elicit certain corresponding behaviors from students in the learning process. From existing related studies this study concludes that previous computer experience, math aptitude, gender, computer experience, and attitude toward computers are independent variables that may indicate who will like CAI. Therefore this study examined if a subject's demographic characteristics may be indicative of probable success in learning with CAI. As this review charted the spectrum of computer-related attitudes, it sought to find relationships to demographics and computer-related attitudes.

The variables of experience and how exactly they affect computer-related attitudes and attitudes toward CAI were not clear in the literature. The exact type or amount of experience has not been very well documented. This study presents very strong findings that suggest that adequate levels of experience in mathematics were strong indicators of positive attitudes toward computers and CAI. The reviews showed that the presence of key experiences stimulate certain corresponding positive computer-related attitudes from students. On one hand, people who exhibit negative attitudes tend to avoid contact with computer systems. On the other hand, people who exhibit positive attitudes tend to maximize the amount of time that they operate computer systems.

Disparities in computer literacy, according to Hess and Miura (1983), have an obvious theoretical and social importance. Differences in the tendency to use computers may be expected to increase gender and socio-ethnic inequities that now exist in education and the labor market. Developing technologies may endanger gains in educational and career opportunities for women and minorities that have been achieved at the expense of great efforts in the past.

Computer literacy, according to Hess and Miura (1983), cannot be left to individual discretion if all elements of the population are to be primed equally for the future in a technological workplace. The problem requires intervention from leadership that has the knowledge of the needs of disadvantaged groups. Intervention by educational leaders and other agencies may be needed to prevent these inequities from becoming even more deeply ingrained in our society (Hess and Miura, 1983).

Chapter III

Research Design and Methodology

Overview

This chapter is divided into four sections. The first section describes the population. The second section includes information about the instruments that were used in this study to collect data to answer the research questions. The third section identifies the procedures used to collect the data and outlines the necessary steps that were followed to conduct the study. The fourth section describes the procedures used to analyze the data that were collected.

Population

The population consisted of 217 USAFA Preparatory School students. Their ages ranged from 18 to 22 years, and they had completed 12 to 14 years of school. They were all students of algebra, geometry, physics, chemistry, computer science, and English during their stay at the USAFA Preparatory School. These courses were designed to better prepare the students for the rigorous academic requirements of the Air Force Academy.

Form the total population of 217 students, only 179 participated. Approximately seventeen students had acceptable excuses for not attending. Excuses ranged from being to sick to having to fulfill other responsibilities (e.g. athletic duties). Approximately twenty-one students attended the assembly, accepted surveys, but choose not to give information to render their survey usable (e.g. not signing the consent form).

The students were not randomly selected. The only degree of randomization rested with the fact that the students surveyed were the ones who happened to attend the computer/CAI assembly on the day the study was conducted and chose to give adequate information. Even though all students were asked to come to the theater to participate in the study, the researcher did not insist that they do so. Within the group of students who took the survey, there was representation from most of the states in the US. There was also good representation among the students of various socioeconomic backgrounds. It was assumed that the representation of different geographical locations and different socioeconomic backgrounds was evenly distributed among the demographic variables of interest through the random processes that brought the students to the school. The majority of the students who took the survey were from families occupying the middle to lower middle class income ranges.

The majority of the population (51%) consisted of individuals from minority classes, including African Americans, Hispanic Americans, Native Americans, Asian Americans, and women. The student population consisted of approximately 23 percent African Americans, approximately 21 percent Hispanic Americans, approximately 3 percent Asian Americans, approximately 3 percent Native Americans, and approximately 23 percent women.

Instrumentation

There was some difficulty associated with psychometrics related to the important task of selecting and using an adequate CAS. Bear, Richards, and Lancaster (1987) believe that one reason why most CAI investigators have not assessed student attitudes toward CAI is that few psychometrically sound instruments for measuring such attitudes have been developed. For a number of the existing instruments, there is little or no evidence concerning their external validity. This study sought to highlight the many existing CASs and to show the advantages of an adequate CAS. Choice of instrument was based on evidence that the instrument was suitable within a variety of contexts. Specifically, a CAS was needed that would have proven reliability and validity measures for different populations, cultures, and age groups. Through careful selection of a measurement scale, this study constructed a design that would permit other investigators to replicate the study with comparable levels of reliability and validity.

Many research projects have chosen the reliability and validity of existing attitude scales as a focus of their study. They either compared scales or focused on a particular scale and replicated a study using that same scale in a new context. From these empirical investigations, it was possible to draw conclusions about the reliability and validity of the several attitude scales and the suitability of using a combination of scales. Examples of researchers who have chosen reliability and validity of existing attitude scales as a focus of their study include Francis and Evans (1995); Gardner, Discenza, and Dukes (1993); Katz, Evans, and Francis (1995); Moroz and Nash (1997); and Yaghi (1997).

Gardner et al. (1993) provide a very extensive and most useful CAS comparison study. These researchers empirically compared four measures of attitudes toward computer systems. The researchers' objectives were to determine which, if any, of the measures were superior to the others on statistical criteria of reliability and validity, and to identify items from the measures that would result in reliable scales. They write that one aim of research on computer attitudes has been to classify the greatest psychological obstacles to urging students to learn using computers. In order to explain attitude, Gardner and coworkers highlight the fact that one construct in particular, computer anxiety, is considered to be a major psychological obstacle to learning with computers.

Many factors can affect the degree of acceptance or resistance to the use of computers. Gardner et al. (1993) catalogue a number of obstacles to computer use, including personal characteristics (e.g., age, education, and gender), the meanings which student assign to computers, and prior experience with computers. Gardner et al. report that some researchers have focused on various attitudes toward computers (e.g., liking or disliking to use computers, or thinking them useful or non-useful) as major factors affecting their use.

Reliable attitudinal measures are necessary to ground any claims of explanations of variance in attitudes toward computer delivery systems. Gardner et al. (1993) maintain that one result of research on computer anxiety and other computer attitudes has been the development of self-report scales that claim to measure anxiety and attitudes. They point out weaknesses in the development of attitudinal measures and hold that although there have been many measures developed to assess attitudes in an effort to predict computer-related behaviors, most do not demonstrate evidence of construct validity outside the original studies in which the instruments were developed.

The primary purpose of the study by Gardner et al. (1993) was to investigate the relative psychometric qualities (viz., reliability and construct validity) of four measures of computer attitudes, with emphasis on the central construct of computer anxiety. Construct validation was a prerequisite to their research. The researchers identified and compared four instruments that were developed to measure computer anxiety and other computer-related attitudes: the Computer Anxiety Index (CAIN) (Mauer, 1983), the Computer Attitude Scale (CAS), the Attudes toward Computers scale (ATC) (Raub, 1981), and the Blomber-Erikson-Lowrey Computer Attitude Task (BELCAT) (Erikson, 1987). The researchers concluded that all measures tested were essentially equal in terms of reliability and validity, and they were unable to empirically derive improved scales. They did determine that two of the measures, the CAS and the BELCAT, were superior on a number of other criteria.

The previously mentioned instruments were all predicted to produce reliable and reasonably valid information; however, they have not received the wide-ranging verification across diverse cultures around the world that the Bath County Attitude Scale (BCCAS) has received. Because of its widespread verification, there is substantial evidence that the BCCAS is a superior computer attitude scale in respect to its applicability to diverse groups. The BCCAS is a 26-item questionnaire that uses a 5-point Likert-type scale. According to Bear et al. (1987), the instrument was designed to measure attitudes toward computers of elementary and secondary students in grades 4 to 12; however, the survey has been revised and used in many different contexts with adult populations around the world.

Katz et al. (1995) report on the properties of the BCCAS among 339 undergraduate students in Israel. In spite of some limitations of their study, including the fact that it was conducted for a single course in a single university with a small proportion of men, the researchers maintained that the results of the investigation give evidence of the reliability and validity of the BCCAS both in a cultural context and among a different age group from those in which the instrument was originally developed.

Katz et al. (1995) state that their own study, along with those of Bear et al. (1987) and Francis and Evans (1995), demonstrate the reliability and validity of the BCCAS across a wide age range of students and within the cultural contexts of the United States, the United Kingdom, South Africa, India, and Israel. They also believe that these various findings suggest that the BCCAS "is ideally placed to be used to monitor differences in computer-related attitudes across different cultures"(p. 242). At the same time, they support further studies among various age groups and in different cultures to confirm the wider usefulness of the BCCAS.

Francis and Evans (1995), highlighting the study by Bear et al. (1987), conclude that evidence for the reliability and validity of the BCCAS comes from a broad range of students within cultural contexts of the United States, the United Kingdom, and South Africa. Like Katz et al. (1995), they maintain that the BCCAS is suited for use by researchers to monitor differences in computer-related attitudes across different cultures and wide age ranges. The alpha reliability coefficient for the BCCAS is .95.

On the basis of studies that found the BCCAS to be a valid and reliable instrument to measure computer-related attitudes, the present study employed the BCCAS as one of its main survey instruments. The study also used a variation of another instrument, one developed by Bues (1934), as cited by Shaw and Wright (1967). This instrument is the Attitude toward Any Practice (ATAP) survey instrument, which was modified for this research so that it could be applied to the practice of CAI. This modified version of the ATAP is appropriately referred to in this study as the Attitude toward Computer-Assisted Instruction Scale (ATCAIS). Although it does not have the notoriety of the BCCAS, it was expected that this instrument would correlate closely with the BCCAS. The reason that this modified instrument was chosen was because no such psychometric instrument exists specifically to assess attitude toward CAI. This study applied the instrument in a context different from the ones in which it had previously been applied.

The ATAP was developed using the method of equal-appearing intervals (Shaw & Wright, 1967). There were two 37-item forms that were matched for scale and Q values as closely as possible. The Q values of the instrument range from 0.5 to 2.2 for items in form A and 0.5 to 2.0 for items in form B. This study used form A only. Students were asked to place a mark before questions concerning CAI that they agreed with. Bues (1934), as cited in Shaw and Wright, reported alpha reliability coefficients for the ATAP ranging from .71 to .91. Bues validated the scale by the group method using the activities of drinking and petting, but states that the instrument will remain valid and reliable when other activities are substituted (Shaw & Wright, 1967)

In order to score the ATCAIS, the response from each survey question was assigned a score. The values assigned to each question were added to get a total score. To calculate the final score, the total score was divided by the total number of responses. The highest possible score was 11.0. The lowest possible score was 1.0. The highest score represented the most favorable attitude toward CAI.

The highest possible score that a student could receive on the BCCAS was 130, whereas the lowest possible score was 26. In order to make comparisons between the two scales, the total received from the BCCAS was multiplied by a factor of .08462 to convert it to a scale ranging from approximately 2.2 to 11.0. This conversion allowed the comparison of the BCCAS and the ATCAIS. The scale conversion for the BCCAS was not perfect by one point on the low end because of the difference in the number of questions, but final scores that represented the lowest possible scores that equated to the poorest attitudes were easy to correlate. The conversion factor would have yielded the same response if on the BCCAS the total score were divided by the number of responses and then multiplied by a factor of 2.2 to yield the highest possible score of 11.0. The lowest possible score on the BCCAS would still yield 2.2. Multiplying by the factor of .08462 was acceptable and simpler to accomplish.

Design

In an effort to look at the relationship between demographic variables and attitudes toward CAI, this study chose as its independent variables math aptitude scores, rank, race, gender, age, computer-related experience, and attitude toward computers. The dependent variables were the measures of attitude from the BCCAS and from the ATCAIS. The instruments charted the spectrum of computer-related attitudes from anxiety, apprehension, and avoidance to liking to use and feeling confident in the use of computers. The study sought to find the best predictors of the dependent variable by attempting to determine which independent variables, or combinations of independent variables, were the best predictors of the variance in measures of attitudes toward computers and attitudes toward CAI. These variables or combinations of variables were the ones that formed the best predictive model to account for the majority of the variance in measures of the dependent variable.

This research was concerned with the association between computer-related attitudes and attitudes toward CAI. From the math placement scores it was possible to determine if there were, along the lines of rank, race, gender, age, and computer-related experience, differences in math experience. From responses to the BCCAS, it was possible to determine whether there were variances in attitudes toward computers along the lines of the independent variables of the study. These results showed levels of computer interest and levels of confidence the students have in their ability to use computers. It was possible to determine, from the ATCAIS, if there were variances in attitudes toward CAI along the lines of the independent variables.

Further, this research was designed to examine the extent to which rank and age influenced computer-related attitudes and attitudes toward CAI. This required the use of both CASs. It was possible to determine if there were age or rank differences in students' math aptitudes and computer-related experience. The research was also designed to examine the extent to which race and gender influence computer-related attitudes and attitudes toward CAI, and the study was concerned with the interactions between race and gender and other measures of the independent variable, specifically math aptitude and computer-related experience. From this design it was possible to determine the best predictors of the dependent variable and whether membership in one group or another influenced students' attitudes toward computers and CAI.

Procedures

All 217 USAFA Preparatory School cadet candidates enrolled at the time of this study were the eligible subjects for the study. Of the total 217 eligible students, 179 elected to participate in the study.

The students were surveyed at the same time at the same location. Consent forms and questionnaires were administered by a research assistant. Completing the surveys took about 20 minutes total, with the BCCAS and the ATCAIS each taking approximately 10 minutes to complete. The entire process of passing out the forms, having the students fill out the forms and the questionnaires, and collecting the forms took less than one hour.

The students were not required to give personal information such as their name, squadron, or room number on the surveys. Demographic information was given, but students remained as anonymous as possible. The students were given their SAT, ACT, and math placement scores from an overhead projector. The scores were listed by the last five digits of their social security number. The social security numbers were listed in numerical order to make the process simpler.

Data Analysis

Demographic data were collected from an eight-question demographic questionnaire that was attached to the end of the ATCAIS instrument. This research study investigated the relationship between these demographic variables and attitudes toward CAI. The study investigated whether there were differences based on math aptitude, gender, age, race, education, rank, or computer-related experience and if so, how much.

The investigation examined data using the following statistical procedures: general linear model, Chi Square, analysis of variance (ANOVA), Pearson correlations, *t*-test, and stepwise regression. These tests were used to evaluate differences in measures of the dependent variable.

The general linear model (GLM) was used to determine group mean comparisons. The GLM showed if one group liked to use or had more confidence in using computers than other groups. The GLM showed results along the lines of gender and ethnicity. Chi Square was used to evaluate differences by math aptitude scores, rank, race, gender, age, computer-related experience, and attitude towards computer. The study explored, using ANOVA, the question of whether a significant effect for math aptitude scores, rank, race, gender, age, computer-related experience, and attitude toward computers existed along the lines of gender and ethnicity. ANOVA showed whether one group liked to use or had more confidence in using computers than other groups.

Pearson correlations and R-Square were used to determine associations between math aptitude scores, rank, race, gender, age, computer-related experience, and attitude towards computers on the one hand, and attitude toward CAI on the other. The study also explored, using *t*-tests, group differences along the lines of gender whether Males or females liked to use computers more than the others or had more confidence with computers than others.

Using stepwise regression and R-Square, the study explored the variables or combinations of variables that formed the best predictive model to account for the majority of the variance in measures of the dependent variable. Stepwise regression was used to determine which independent variables, or combinations of independent variables formed the best predictive model for the variance in measures of attitudes toward computers and attitudes toward CAI.

Summary

This chapter has described the procedures used to answer the research questions posed by the study. The chapter began with a description of the population and included a description of the instruments, the BCCAS and ATCAIS, which were selected because of their reliability and validity measures. The chapter also outlined the procedure that was used to collect data.

A description of the methods of analyzing the data gathered from the study completed the discussion in this chapter. Several statistical tests were used to analyze the data. These included the GLM, Chi Square, ANOVA, Pearson correlations, *t*-test, R-Square, and stepwise regression. These tests were used to determine the extent to which attitude toward computers and attitude toward CAI differ along the lines of math aptitude scores, rank, race, gender, age, computer-related experience, and attitude toward computers. The analysis sought to find the best predictors of the dependent variable and to determine which combinations of independent variables are the best predictors of the variance in measures of attitudes toward computers and attitudes toward CAI.

Chapter IV

Analysis

Two research questions guided this study. This chapter's presentation of the data analysis is organized according to those questions. The study examined nine factors related to the attitudes of students in the USAF Preparatory School toward computers and CAI. Student characteristics were addressed by examining mathematics aptitude, level of education, rank, race, gender, age, computer science experience, frequency of computer usage, and student attitudes toward computers. These factors were used to explore if there was a relationship between student demographics and attitude toward CAI.

Research Question 1

The first question, "*What are the attitudes of the students in the United States Air Force Academy Preparatory School toward CAI?*" was addressed by student survey II, which was the ATCAIS. The instrument had 37 questions, each with an assigned Q value. The relationship between the question number and the Q value was such that the lower the question number, the higher the Q value. In order to score the survey, the responses from each survey question were added to get a total score. The total score for a question was divided by the total number of responses to calculate the final score for that question. The highest possible score for a question was 11.0. The lowest possible score was 1.0. The highest score represents the most positive attitude toward CAI, and the lowest score represents the most negative attitude. Using the general linear model, the mean score from the ATCAIS was found to be 7.60, with an F value of 7.78. On the scale from 1.0 to 11.0, this value was approximately 70 percent of the maximum possible score. This value represents a relatively positive attitude toward CAI from the 179 USAFA Preparatory

School students surveyed. Along the spectrum of computer-related attitudes ranging from anxiety, apprehension, resistance, and avoidance to having very positive feelings toward CAI, these values represent attitudes that center around feelings of appreciating CAI and finding it interesting, with varying degrees of confidence. Using the *t*-test sorted by gender and using the GLM, sorted by gender and ethnicity, were used to examine this question. Both approaches found that there were no significant statistical differences among groups. (See Figures 1-5 in Appendix F.)

<u>Research Question 2</u>

The second question was, *"Is there a relationship between student demographics (mathematics aptitude, level of education, rank, race, gender, age, computer science experience, frequency of computer usage, and attitude toward computers) and student attitude toward CAI?"* This research question was addressed by student survey II, the ATCAIS, which was a simple modification of the ATAP, and by a demographic questionnaire attached to survey II that consisted of eight questions asking for demographic information. For those questions on the demographic portion that required a numerical answer, students were asked to state responses rounded to the nearest whole number. The following eight questions plus the results from the BCCAS formed the independent variables of the study.

Item one asked, *"What is your highest level of education (in years)?"* Using the *t*-test, sorting by gender, of the 156 (87 percent) male respondents, the results showed a mean of 12.2 years of school (Std dev = 0.464, Std Error = 0.037, t = -0.107, Df = 27.5). The 23 (13 percent) female respondents also had a mean of 12.2 years of school (Std dev = 0.518, Std Error = 0.108, t = -0.1116, Df = 117). For H0: variances were equal, F' =

1.25, Df = (22,155), and Prob > F' = 0.4358. These results indicate that there was no significant difference in education between surveyed males and females.

Item two asked, "*What is your rank/pay grade?*" Using the *t*-test, sorting by gender, for the 156 male respondents the mean rank was 1.487 (Std Dev = 0.96, Std Error = 0.976, Variances-unequal, *t* = -0.779, Df = 32.8). For the 23 female respondents, the mean rank was 1.347 (Std Dev = 0.775, Std Error = 0.162, Variances-equal, *t* = -0.6642, Df = 177). A value of 1.000 represents a rank of E-1, the lowest enlisted rank. These results suggest that most of the subjects were paid at the grade of E-1 or E-2. Those respondents with the rank of E-1 were most likely civilians when they were brought into the USAFA Preparatory School. The respondents who held the rank of E-2 or above most likely were already in the military as enlisted people before their enrollment in the Preparatory School and had been identified as having the potential to make it in the officer ranks. For H0: variances were equal, F' = 1.54, Df = (155,22), and Prob > F' = 0.2401. This suggests that the average rank of males in the study was a little higher than the average rank for females in the study. The difference, however, was not significant.

Item three asked, "*What is your average daily exposure or experience with computers in hours including work, education, and recreation time?*" For this item the *t*-test was used to examine the results as sorted by gender. ANOVA was used to examine the results as sorted by ethnicity. For the male respondents, the result was a mean of 2.723, and for the females the mean was 3.348. For males, Std Dev = 1.916, Std Error = 0.153, variances were unequal, *t* = -1.02, and Df = 25.0. For females, Std Dev = 2.838, Std Error = 0.592, variances were equal, *t* =- 1.359, and Df = 177. For H0: variances were equal, F' = 2.19, Df = (22,155), and Prob > F' = 0.0059. Though these results show that females spent more time than males on computers, the difference was statistically significant at the 0.05 level. (See Figure 6 in Appendix F.)

Item four asked, "*What is your gender?*" Of the 179 respondents, 156 were male and 23 were female. Male respondents thus totaled 87 percent and female respondents totaled 13 percent of the surveyed students. Females were clearly underrepresented in this population. Even though they reported that they spent, on the average, more time on the computer, they reported lower rank, lower numbers of computer science courses, and lower math scores.

Item five asked, "*What is your age?*" Using the *t*-test, sorting by gender, of the 156 male respondents, the result was a mean of 18.526; of the 23 female respondents, the mean was 18.217. For males, Std Dev = 1.006, Std Error = 0.081, variances were unequal, $t = 2.0722$, and Df = 43. For females, Std Dev = 0.6, Std Error = 0.125, variances were equal, $t = 1.43$, and Df = 177). For H0: variances were equal, F' = 2.81, Df = (155,22), and Prob > F' = 0.0063. These results indicate that males were significantly older than females. Although the *t*-test results show significant group differences, the variable, according to the regression models proved to be a very poor predictor of the dependent variable in this population.

Item six asked, "*What is your race/ethnic origin(s)?*" In order to enable the statistical analysis program (SAS) to read race or ethnic origin, this study assigned each race a value that served as a name for the group within the program: Hispanic American = 1, African American = 2, Asian American = 3, Native American = 4, Caucasian = 6. Hispanic Americans composed 21.23 percent of the student population, African Americans composed 23 percent of the student population, Asian Americans composed

3.35 percent of the student population, Native Americans composed 3.35 percent of the student population, and Caucasians composed 49.72 percent of the student population. The general linear model was used to examine results for this item. Results from regression models showed that race was the third best predict of the dependent variable in a single variable model.

Item seven asked, *"What is your Mathematics placement score?"* For this item, the *t*-test was used to examine the results as sorted by gender. The GLM and ANOVA was used to examine the results as sorted by ethnicity. The mean mathematics placement score for male respondents was 24.615, and for female respondents 22.565. For males, Std Dev = 7.03, Std Error = 0.563, variances were unequal, $t = 1.397$, and Df = 30.1. For females, Std Dev = 6.5, Std Error = 1.355, variances were equal, $t = 1.31$, and Df = 177. For H0: variances were equal, F' = 1.17, Df = (155,22), and Prob > F' = 0.6935. These results indicate that males scored a little higher than females on mathematics placements tests, but not significantly so. Because more than two groups were compared, the GLM and ANOVA were also used for this item. The results did not show significant group differences. (See Figure 7 in Appendix F.)

Item eight asked, *How many computer science or computer programming courses have you taken*? For this item, the *t*-test was used to examine the results as sorted by gender. The GLM and ANOVA were used to examine the results as sorted by ethnicity. For male respondents, the mean was 1.641 courses, and for female respondents the mean was 1.521. For males, Std Dev = 2.709, Std Error = 0.217, variances were unequal, t = 0.36, and Df = 62.4. For females, Std Dev = 1.201, Std Error = 0.25, variances were equal, $t = 0.208$, and Df = 177. For H0: variances were equal, F' = 5.09, Df = (155,22), and Prob > F' = 0.0000. These results indicate that the males in the study had taken more computer science courses than the females, and this difference was statistically significant. It should also be mentioned that the regression models showed this variable to be the fourth best predictor of the dependent variable in a single variable model. (See Figure 11 in Appendix F.)

The next item was the measurement of attitude on the BCCAS. The highest possible score on the BCCAS was 130, and the lowest possible score was 26. In order to make comparisons between the two scales, the total received from the BCCAS was multiplied by a factor of .08462 to convert it to a scale ranging from approximately 2.2 to 11. Conversion allowed the comparison of the BCCAS and the modified Bues ATAP instrument.

Using the *t*-test, sorting by gender, of the 156 male respondents the mean score from the BCCAS was 7.94, while for the 23 female respondents the mean score was 8.02. For males, Std Dev = 1.444, Std Error = 0.116, variances were unequal, $t = -0.31$, and Df = 32.6. For females, Std Dev = 1.175, Std Error = 0.245, variances were equal, $t = -0.266$, and Df = 177. For H0: variances were equal, F' = 1.51, Df = (155,22), and Prob > F' = 0.2598. These results indicate that the females in the study had a more positive attitude towards computers than the males in the study, and this difference was statistically significant. When the GLM and ANOVA, sorted by race and ethnicity, was applied to the results, a significance was found with this variable. (See Figures 8-10 in Appendix F.)

Using stepwise regression, it was possible to determine the best-fit model for determining attitude toward CAI. According to this statistical procedure, scores from the BCCAS were the independent variable that constituted the best predictor of attitude toward CAI. The next best predictor of attitude toward CAI using one independent variable was frequency of computer usage. The remainder of the independent variables were in the following order, going from best to worst predictor: race, computer science courses taken, gender, math aptitude, education level, rank, and age. (See Tables 1-5 in Appendix E.).

Summary

This study explored, using the GLM, ANOVA, Pearson correlations, Chi Square, *t*-tests, R-Square, and stepwise regression, whether any significant effects existed for the independent variables of the study. The independent variables were math aptitude, computer-related experience, rank, race, gender, age, and attitude toward computers. The study explored, using stepwise regression, the independent variables that best explain variance in the dependent variable. Stepwise regression produced the best-fit model.

One hundred seventy-nine students took part in the survey. For research question one, the mean score from the ATCAIS was found to be 7.60, which represents a relatively positive attitude among the subjects toward CAI. For research question two, no significant differences were found between genders for any of the eight demographic items, and no significant differences were found among ethnic groups for those items that were sorted by this variable. For the BCCAS, no significant differences in responses were found among groups. It was found that scores on the BCCAS were the best predictor for attitude toward CAI.

Chapter V

Discussion

This report presumed that adequate CAI models must use findings from both the field of psychology and the field of computer science to provide an adequate picture. Findings from the field of psychology address the psychological factors associated with learning, whereas findings from the field of computer science address the engineering and configuration factors associated with the fit of learning systems to the organization as well as to the individual. Many existing models do not strike the needed balance between the two broad fields. Adequate research designs, according to McNeal and Nelson (1991), would address instructional content, environmental factors, features of the learning materials, computer-related experiences of the learner, and other characteristics of the learner. Further, understanding of the effects of these factors is necessary to explain variations in student computer-related attitudes and attitudes toward CAI.

This report has presented studies that have shown that increases in computing capacity have helped tremendously to enable the production of more sophisticated hardware and software, thereby making the computer an increasingly valuable tool for CAI. The increases in computing capacity that accompany the computer revolution allow CAI to be customized to better meet the needs of a culturally diverse population. Advances in microcomputing technology and substantial increases in the use of computers have enabled CAI to move toward new standards for efficiency and effectiveness in training and education.

One of the keys to increased efficiency in training and education rests with the potential to get the maximum transfer of knowledge from the learning process. This aim can be achieved through the individualization of the learning system to the student. To make the best use of this individualized approach, however, requires understanding student characteristics and their effects on student learning.

In order to study student characteristics, this research investigated the relationship between demographic variables such as mathematics aptitude, level of education, rank, race, gender, age, computer-related experience, computer science experience, and attitude towards computers on the one hand, and student attitudes toward CAI on the other. Knowledge of student characteristics and past experiences serve as an important starting point for organizing the content of instruction. Knowledge of such factors is no less important for adult than for child education.

One important student characteristic is student attitude. A student's having a positive attitude toward CAI is essential to that student's success with CAI. One of the areas where attitude is paramount is that of CAI program implementation. Assessing student attitudes so that ways may be found to improve them is a mainstream issue among researchers who study computer-related attitudes. Improving students' computer-related attitudes and attitudes toward learning through the use of computers is one key to maximizing the learning process with CAI.

This study was concerned with assessing the CAI-related attitudes of USAFA Preparatory School students participating in computer-assisted adult education. In the course of presenting this research, the advantages and disadvantages of CAI have been discussed. Also highlighted were the inequities that exist in education and employment and the potential that CAI has for correcting the inequities. These two points underline the importance of improving this enduring system of feelings called attitude.

The mission of the USAFA Preparatory School is to prepare students for the rigors of the Academy's very demanding academic pace. USAFA has the mission of producing fine military minds. CAI plays a vital role in achieving this national security goal. Through the efficient and effective use of developing computer technologies, the educational and training goals of the USAFA can be achieved much easier. Through the use of CAI for education and training, it will be possible to better communicate and achieve the organization's vision, mission, strategies, purpose, values, culture, priorities, and goals.

The first aim of this study was to determine the attitudes of the students participating in computer-assisted adult education in the USAFA Preparatory School. Another aim of this study was to more accurately identify, prioritize, and account for the attitudes of the participants. This applied research took the questionnaire approach to seeking factors that may affect attitude toward CAI. These results may help support future decisions concerning the allocation of resources to maximize effectiveness with the help of CAI.

The contexts of existing related studies are different from the present study as they do not take place in a US military service academy's academic environment; therefore, the context of this study makes it unique. Within the context of this study were important environmental factors. For example, the military has its own distinct culture that is profoundly different from a typical college campus culture.

This study investigated psychological literature on computer use for learning in order to chart the wide change of negative and positive responses generated by the current growth and accessibility of computer technology. Negative responses include anxiety, stress, feelings of stupidity, fear, and perceptions of dehumanizing effects. Student reactions to the technology can vary with CAI design. Certain students may fare better, depending on the instructional design. Yaghi (1997) proposes that student avoidance of computers may be attributed to attitudes that were built on simple misconceptions or misunderstandings about computers. Students may not comprehend the full potential that the instructional delivery system has to offer. The dominant Anglo-Saxon male culture, according to Shashaani (1994), reinforces an educational and occupational computing segregation. She proclaims that this type of research was needed to assist in breaking the cycle.

Identifying the most significant demographic variables and computer-related experiences affecting student attitudes toward CAI will help to profile members of groups who might not fare as well as others with these types of learning systems. Highlighting demographically these groups and individuals through profiling is an important step in identifying student needs. This was another important step to take to better meet the needs of students who do not benefit from CAI as well as others. From this point intervention can begin to take place.

The first question, *What are the attitudes of the students in the United States Air Force Academy Preparatory School toward CAI?*, was addressed by student survey II. This was the Attitude toward Computer-Assisted Instruction Scale (ATCAIS). The student attitudes among the surveyed population were found to be relatively satisfactory. In that population, results showed that females had a significantly better attitude than males. This was correlated with their significantly higher average daily exposure to computers and their significantly higher attitude towards computers.

Along the spectrum of computer-related attitudes such as anxiety, apprehension, resistance, avoidance, and liking, these results represent attitudes that center around feelings that the respondents like CAI and find CAI interesting and easy with some varying degrees of confidence. These results reflect, to some degree, the approach used here at the USAFA Preparatory School, the subjects being taught, and the quality of the products that the students were using.

These results coincide with results from other studies highlighted in this report. Examples include Bangert and Kulik (1982), Dalton (1986), Jegede, et al. (1991), Kulik, and Kulik (1991), Kulik, Kulik, and Bangert-Downs (1985), and Milheim (1993). Favorable learner attitudes, according to Dalton (1986), have been attributed to the fact that computers have infinite patience, never show signs of anger and frustration, and usually leave learners with feelings of having learned better. It was clear that CAI does not have the same effect on all people. Attitudes toward CAI depend greatly on who the people are. CAI may be used to improve student attitudes, but if used in a manner where low-ability students feel degraded and secluded, CAI can have deleterious effects.

The results of this study coincide with findings by Kulik and Kulik (1991). The use of computers produced positive changes in student attitudes and 88 percent reported more favorable attitudes for students in the CBI classes.

The second question, *Is there a relationship between student demographics (mathematics aptitude, level of education, rank, race, gender, age, computer science experience, frequency of computer usage, and attitudes toward computers) and student attitude toward CAI?* was addressed by the demographic information portion of student survey II. These variables were the amalgamation of the significant variables of the key related studies highlighted in this report.

Item one from student survey II's demographic information asked, *What is your highest level of education (in years)?* Results suggested that the females were slightly more educated than the males, but not significantly. Hess and Miura (1983) listed this variable as significant. Although, on the average, females were slightly more educated than males, males reported higher math aptitude and computer-related experience.

Item two asked, *What is your rank/pay grade?* Results suggest that most of the subjects were paid at the grade of E-1 or E-2. Being paid at the E-1 grade suggests that the subject most likely was a civilian when brought into the USAFA Preparatory School. The respondents who hold the rank of E-2 or above were already in the military as enlisted people and were identified as having the potential to make it in the officer ranks. Results suggest that males held ranks higher than females, but not by a significant amount. There was very little variation in rank among participants, and therefore it was not a significant factor in predicting student attitudes toward CAI. Hess and Miura (1983) and Shashaani, (1994) listed SES as a significant variable.

Item three asked, *What is your average daily exposure or experience with computers in hours including work, education, and recreation time*? Results suggest that females in the surveyed population spent significantly more time on computers than surveyed males. These results give no indication of whether or not the time spent on the computer was efficiently spent. This should be considered a limitation of the study This variable was correlated with females' significantly better attitude toward computers and CAI.

Snelbecker, et. al. (1992) also included the variable of experience as a significant variable. In their study, the researchers never clearly communicated what specific types, or in what ranking order, or what graduated amounts of computer experience were desirable to be considered sufficient. The researchers should have communicated more specifically, with range and magnitude, the characteristics of these experiences. If a certain type of experience was important then what type was it? Was there some combination of experiences that would represent the best experience? The present study has also not answered this question.

Item four asked, *What is your gender?* Most questions were sorted by gender, so this dichotomy was addressed in almost every question. Results from this question clearly showed that females were distinctly underrepresented in this USAFA Preparatory School population. The question, when asked alone, does not offer much additional information, but when asked in conjunction with other questions, it renders results that offer a wealth of information. Even though females reported that they spent, on the average, more time on the computer and were slightly more educated, they also reported holding lower rank, lower numbers of computer science courses taken, and lower math scores. The variable gender was included in the majority of the reports reviewed by this study, including Shashaani (1995), Hess and Miura (1983), and Miura and Hess (1983). The results of this report were consistent with findings of these three studies. Hess and Miura (1983) report that more males than females owned home microcomputers and that the use of the home computer also differed by gender. They report that the typical computer owner was a male, high academic achiever who enjoyed programming and playing games on his computer.

Hess and Miura (1983) claim that these studies give evidence to support reports of sex differences in computer access, interest, and use in the school-aged population. Differences between proportions of males and females and SES, according to Hess & Miura, were so large that statistical tests were not necessary to establish significance of the results. They added that computer classes were sought more often by Caucasian males from middle class backgrounds. Their findings show that three times as many males as females were enrolled in computer classes, and the enrollment of males exceeded that of females in each of the reporting groups.

Item five asked, *What is your age?* Results showed that males were slightly older than females, but not significantly so. Since there was not much variation in the participants' ages, this factor did not add much insight into the explanation of student attitudes toward CAI. The age group of this study typically has a better attitude toward computers and CAI when compared to students twice or three times their age. This might be partly attributed to the fact that this age group was raised on video games so that they were accustomed to the stimulus response interaction that is often a part of educational delivery systems involving computers. Knowles (1983), Knox (1988), and Hess and Miura (1983) highlighted the age factor. The disparity between males and females, according to Hess and Miura, increases with age, was greater in advanced than in beginning classes, and was larger for expensive programs. They suggest that parents seem more willing to invest in science and technology classes for their sons than for their daughters.

Item six asked, *What is your race/ethnic origin(s)?* The five categories of ethnicity were categorized as Hispanic American, African American, Asian American, Native American, and Caucasian. Hispanic Americans and African Americans composed approximately 50 percent of the student population. Neither Asian Americans nor Native Americans had enough representation to yield statistically reliable results for their race or ethnicity. Even though minorities reported that they spent, on the average, more time on the computer and were slightly more educated, they also reported holding lower rank, lower numbers of computer science courses taken, and lower math scores. None of these differences were by significant amounts.

The regression models showed race as the third best predictor of the dependent variable. This is possibly tied to the corresponding higher levels of average daily computer usage and higher attitude toward computers among this group. These results do not explain why the variable race was not included in the majority of the reports reviewed by this study. Existing studies cast minorities with lower scores, on the variables of interest, than the average Caucasian male population.

Unlike females, ethnic minorities were over-represented in this USAFA Preparatory School population. Specifically, Hispanic Americans and African Americans had almost twice as much representation in comparison to the general population. Reasons were social, institutional, and economic. Institutions that make up the American society are dominated by the Anglo-Saxon male culture. Opportunities provided by the dominant culture are limited to young gifted minorities. The military provides a very viable option for minority individual, which explains why the minority representation was so high in the surveyed population.

Item seven asked, *What is your Mathematics placement score?* Results from this question showed that males scored slightly higher than females in mathematics placement tests. This indicates that male prior experience with mathematics was greater. This could be based on the socialization and institutionalization of males into mathematics courses. Snelbecker et al. (1992) highlighted the factor of math aptitude. They hypothesized that gender, math background, or previous experience with computers would indicate who will be successful with computers. Findings in this area from the present study also relate to the findings by Miura and Hess (1983), who report that mathematics and high technology have always been regarded as male domains. These authors show that endeavors to counter conventional inequities in access to education and employment have kindled a new awareness of gender differences in these areas. These reports conclude that the gender gap is widening.

Item eight asked, *How many computer science or computer programming courses have you taken*? Results from this question showed that the males in the surveyed population had taken more computer science courses than the females. Although the difference was not significant, the results suggests that the males' prior experience with computers was more extensive than that of the females. Again, this could be based on the socialization and the institutionalization of males into mathematics and computer science courses.

The next item was the measurement on the BCCAS. Results suggest that females in the study had a more positive attitude toward computers than males. Using stepwise regression it was possible to determine the best-fit model for determining attitude toward CAI. The study showed that the best-fit model using one variable, and thus the best predictor for determining attitude toward CAI, was attitude toward computers. This result is consistent with Kulik's (1983) claim that there exists a high correlation between attitude towards computers and attitude toward CAI.

In the present study, the next best predictor of attitude toward CAI using one independent variable was frequency of computer usage. The question of exactly what type of computer usage respondents had engaged in was unanswered. The remaining independent variables were in the following order: race, computer science courses taken, gender, aptitude, education, rank, and age, with rank and age being the least best predictors of attitude toward CAI.

Conclusion and Recommendation

From a social perspective, this study has attempted to bridge the "digital divide" or the unequal access to computing technologies in our society. Narrowing the gap would insure that a greater portion of a diverse population would have a greater ability to benefit from the latest advances in learning technologies. This could only be achieved if profiles were produced to show who does and does not enjoy learning from these types of learning systems and why not.

Factors contributing to positive attitudes towards these systems should be promoted. Negative factors should be minimized. Promoting the positive factors requires preparing the students to be ready to learn, providing systems that are adaptable to diverse students and producing an environment that is most conducive for the learning process. Maximizing all of these weighted factors will maximize the learning process.

As this review charted the spectrum of computer-related attitudes such as anxiety, apprehension, resistance, avoidance, liking, finding useful or easy, and confidence in using, it sought to find relationships between demographics and computer-related attitudes. The variables of experience and how exactly they affect computer-related attitudes and attitudes toward CAI were not clear in the literature. The exact type or amount of experience has not been very well documented. This study presents findings that suggest that adequate levels of experience in mathematics were indicators for positive attitudes toward computers and CAI. The review shows that the presence of key experiences stimulate certain corresponding positive computer-related attitudes from students. On one hand, people who exhibit negative attitudes tend to avoid contact with the computer systems. On the other hand, people who exhibit positive attitudes tend to maximize the amount of time that they utilize the computer systems. Therefore, researchers seek to find the ways to maximize the positive attitudes. This will assist eliminating some of the existing disparities associated with access to education and employment in high tech related fields.

The benefits of CAI were well-documented by leading researchers. The gains in achievement and savings in time among different populations and in different contexts were clear according to Bangert and Kulik (1982), Dalton (1986), Jegede et al. (1991), Kulik and Kulik (1991), Kulik et al. (1985), and Milheim (1993). Although CAI for adults has some disadvantages, the good outweighs the bad by far. With the increasing age of the general population, according to Milheim (1993), adult-based education and training are worthwhile as research topics in a variety of settings, with design, development, and delivery of appropriate materials for adult learners being an important area of interest. Computer-assisted instruction has proven to be an effective medium in classrooms. While some disadvantages have been highlighted, CAI, when used as a supplement to traditional classroom instruction, has been proven to be suitable due to its individualization, achievement gains, cost effectiveness, interactivity, and consistency.

Millheim (1993) warns that some factors can limit the potential effectiveness of CAI for adults. He suggests that some adults may feel insecure, fearful, tense, or pressured. Adults may feel awkward, unsure, frustrated, threatened by, or afraid of computers. They may feel a reduction in human interaction or isolation. Methods must be found to minimize this anxiety, emphasizing accuracy rather than speed, and retention without an emphasis on time limits. The focus should be on mastery. These approaches will reduce anxiety in the adult learner (Milheim, 1993).

The attitudes that Milheim (1993) mentions are examples from the range of attitudes that this study has explored. Such attitudes manifest themselves within and serve as predictors of student behaviors. These behaviors will determine whether or not the student will participate in CAI (Milheim, 1993).

This study took environmental conditions into account. Environmental conditions will have an effect on the student's overall opinion of the instruction. They include such factors as extraneous noise, crowded seating, interruptions, and poor lighting. More importantly, the psychological climate must also be taken into account. Adults will feel more at ease within a considerate, receptive, and supportive climate. The context of this study required that the environment be taken into account. The psychological climate in this study was not typical. For example, crude but effective methods are often used for mental conditioning in the militaristic environment of US military academies. Moreover, the psychological climate that existed in the context of this study does not always fit the conditions that will produce the best results from adult learners as stated by Milheim

(1993).

The evidence of gender differences in computer literacy will have an economic and educational impact and eventually have effects on the careers of individuals who do not have the requisite technological skills. The theoretical importance suggests the need to analyze the psychological processes that contribute to these differences in computer literacy in an effort to develop effective intervention strategies to minimize the growing gender gap in computer access, interest, and usage (Miura & Hess, 1983).

From the literature review this study expected to find the variable mathematics aptitude with a greater role as a predictor of the dependent variable. It is believed that on this measure the students were the same. This is based on the selection process that brings them here. It is believed that in a more diverse population this variable would have played a more significant role. This research will be useful in that it has shown that certain experiences will contribute to better attitudes toward CAI. Leader can take these results and promote increased time on computers and increased computer science course so that students develop better attitudes toward computers and CAI. This information may be supplied to designers, developers and delivers of CAI so that these types of courses are produced, and produced more efficiently to fulfil the requirement to take more computer science courses. The limitations of this study should include the military environment in which it exists and the sameness that brings the students here.

Future research in the area of attitudes toward CAI should use the most significant variables of this study but should control for the environment and the type and quality of the software being used. Additionally, future research in the area of student attitudes toward CAI should control for the computer hardware being used and the efficiency of the systems network environment that provides this instructional delivery system. They should also control for the influence of parents on student attitudes toward computers and mathematics.

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Appendix A

STUDENT SURVEY

COVER PAGE

The purpose of this survey is to help researchers understand how demographic variables impacts student attitudes towards computer assisted instruction. It should take about 10 to 15 minutes of your time to complete. By completing and returning the enclosed survey, your name will be entered into a drawing to win a $50 gift certificate at the USAFA Main Exchange. Please take a few moments and complete the survey.

Upon entering the theater you were given you math placement score. This number will be entered on the last page of survey 2. After you complete the survey, turn it face down on your desk. When instructed, you will pass the survey and consent form to the ends of your rows. The research assistants will walk up the isles and collect the face down surveys and place them into the plastic bins. To protect your identity, the survey and consent form will be given to the researcher who will separate the signed individual informed consent form from the survey. The researcher assures the confidentiality of the student responses on the surveys. Both the signed informed consent form and the survey will be secured in a locked file cabinet. No attempt will be made to match the consent form with the completed survey. When the collection process is completed, the Education Technician will randomly select one of the signed consent forms. The person selected will receive the $50 gift certificate for the USAFA Main Exchange.

You should find the following items enclosed along with this letter: the survey, two (2) copies of the consent form (sign and return one and keep the other for your records), envelope to the researcher. Thanks for your help. Don't forget to sign your consent form.

This survey is not directly related to any of your courses. You are not required to complete the survey.

The researcher assures confidentiality with all survey responses.

YOU WILL PASS COMPLETED SURVEYS AND THE SIGNED CONSENT FORMS TO THE ENDS OF YOUR ROWS WHEN DIRECTED TO DO SO

Appendix B

Consent Form

AN INDIVIDUAL CONSENT FORM FOR A RESEARCH STUDY BEING CONDUCTED UNDER THE AUSPICES OF THE UNIVERSITY OF OKLAHOMA, NORMAN

My name is Ellick L. Ruffin. I am a doctoral candidate in the Graduate College at the University of Oklahoma, Norman. I am conducting a study entitled "Demographic Variables and Students' Attitudes Toward Computer Assisted Instruction" (CAI) which seeks to study the relationship between demographic variables that affect student attitudes about CAI. Results of this study may provide educational leaders with information that may assist in finding ways to improve design, development and delivery of CAI. Results will therefore assist leaders in making better decisions concerning the allocation of educational resources. The analysis and results of this survey will be submitted in a report to the Commander of the USAFA Preparatory School. Participant confidentiality will be maintained in the final report. Participants may access the report through their chain of command. This study is being conducted under the guidance of Dr. Rosa Cintrón, Assistant Professor of Educational Leadership and Policy Studies, University of Oklahoma, Norman, OK. The researcher assures the confidentiality of your responses to the questions in the survey that you are being asked to complete. Your involvement in the project should be approximately 10-15 minutes. If you have any questions regarding the rights of research participants you may contact the University of Oklahoma's Office of Research Administration at (405) 325-4757. If you have any questions regarding this survey you may contact me at my office, DSN 333-25340 or my home (719) 476-6307.

By signing this informed consent form you agree to the following:

1. Your participation is entirely voluntary. Refusing to participate will not affect your grades or cause penalty or loss of benefits to you.
2. You are free to refuse to answer any question at any time without penalty.
3. You are free to withdraw from completing the survey at any time without penalty.

There will be no risks for those who participate in this project. A possible benefit may be that educational policy makers will gain insight related to your attitude toward CAI and therefore seek resolutions that maximize the learning process.

Consent statement: I hereby agree to participate in the above-mentioned project.

--(signed)

--(printed)

--(dated)

Appendix C

Student Survey I

The Bath County Computer Attitude Scale

USAFA SCN 99-10

Participation is strictly voluntary

Please darken the number that corresponds to your attitude toward the questions asked.

Key: disagree strongly = (1)

disagree = (2)

not certain = (3)

agree = (4)

agree strongly = (5)

1. People who like computers are often odd.	1	2	3	4	5
2. Working math problems on a computer is fun, like solving a puzzle.	1	2	3	4	5
3. It is easy to get tired of using a computer.	1	2	3	4	5
4. Studying computer science in high school would be a good idea.	1	2	3	4	5
5. People who use computers in their jobs are the only people who need to study about computers.	1	2	3	4	5
6. Learning about computers is interesting.	1	2	3	4	5
7. School would be a better place without computers.	1	2	3	4	5
8. I enjoy using a computer.	1	2	3	4	5
9. Computers are boring.	1	2	3	4	5
10. Working on a computer is a good way to spend spare time.	1	2	3	4	5
11. Using a computer becomes boring after about half an hour.	1	2	3	4	5
12. Learning about computers is something I can do without.	1	2	3	4	5

13. Computers are not exciting.	1	2	3	4	5
14. Studying about computers is a waste of time.	1	2	3	4	5
15. It is fun to figure out how computers work.	1	2	3	4	5
16. Computers help people to think.	1	2	3	4	5
17. Classroom discussions about the use of computers in society are a waste of time.	1	2	3	4	5
18. Studying about the history of computers is boring.	1	2	3	4	5
19. Learning about the different uses of computers is interesting.	1	2	3	4	5
20. Reading and talking about how computers might be used in the future is boring.	1	2	3	4	5
21. Learning about the development of computers is interesting.	1	2	3	4	5
22. Learning to program a computer is something I can do without	1	2	3	4	5
23. Learning about computer hardware and software is fun.	1	2	3	4	5
24. I enjoy learning about how computers are used in our daily lives.	1	2	3	4	5
25. Studying about the uses and misuses of computer will help me be a more responsible citizen.	1	2	3	4	5
26. I wish I had more time to use computers in school.	1	2	3	4	5

Student Survey 2

Attitudes toward CAI

Form A

USAFA SCN 99-11

Participation is strictly voluntary

Directions: Following is a list of statements about Computer Assisted Instruction (CAI). Place a plus sign (+) before each statement with which you agree with reference to CAI.

1. CAI is better than anything else.
2. I like CAI better than anything I can think of.
3. CAI is profitable to everyone.
4. CAI is very worth while.
5. CAI has an irresistible attraction for me.
6. I enjoy CAI.
7. CAI is liked by almost everyone.
8. I like CAI too well to give it up.
9. CAI makes for happier living.
10. CAI serves a good purpose.
11. CAI develops cooperation.
12. CAI should be appreciated by more people.
13. CAI is being accepted more and more as time goes on.
14. CAI has advantages.
15. If CAI were used more it would developed into a good practice.
16. There is no reason for stopping CAI.
17. CAI is all right as a pastime.
18. I like CAI a little.

19. CAI is all right in some cases.

20. CAI is all right in a few cases.

USAFA SCN 99-11

21. My likes and dislikes are balanced.

22. I dislike CAI but I do not object to others liking it.

23. CAI isn't so bad but it is very boring.

24. CAI has limitations and defects.

25. I like many practices better than CAI.

26. CAI has several disadvantages.

27. CAI has several undesirable features.

28. CAI is disliked by many people.

29. CAI should not be tolerated when there are so many better ones.

30. CAI is not endorsed by logical-minded persons.

31. Life would be happier without CAI.

32. CAI cannot benefit someone who has common sense.

33. CAI is a waste of time and money.

34. CAI accomplishes nothing worth while either for the individual or society.

35. CAI is sinful.

36. I hate CAI.

37. CAI is the worst thing I know.

USAFA SCN 99-11

Please state responses rounded to the nearest whole number.

1. What is your highest level of education (in years)? ________
2. What is your rank/pay grade? ________
3. What is your average daily exposure (or experience) with computers (in hours)? (Include work, education, and recreation time) ________
4. What is your gender? ________
5. What is your age? ________
6. What is your race/ethnic origin(s)? ________________________
7. What is your Mathematics placement score? ____________________
8. How many computer science or computer programming courses have you taken? ______

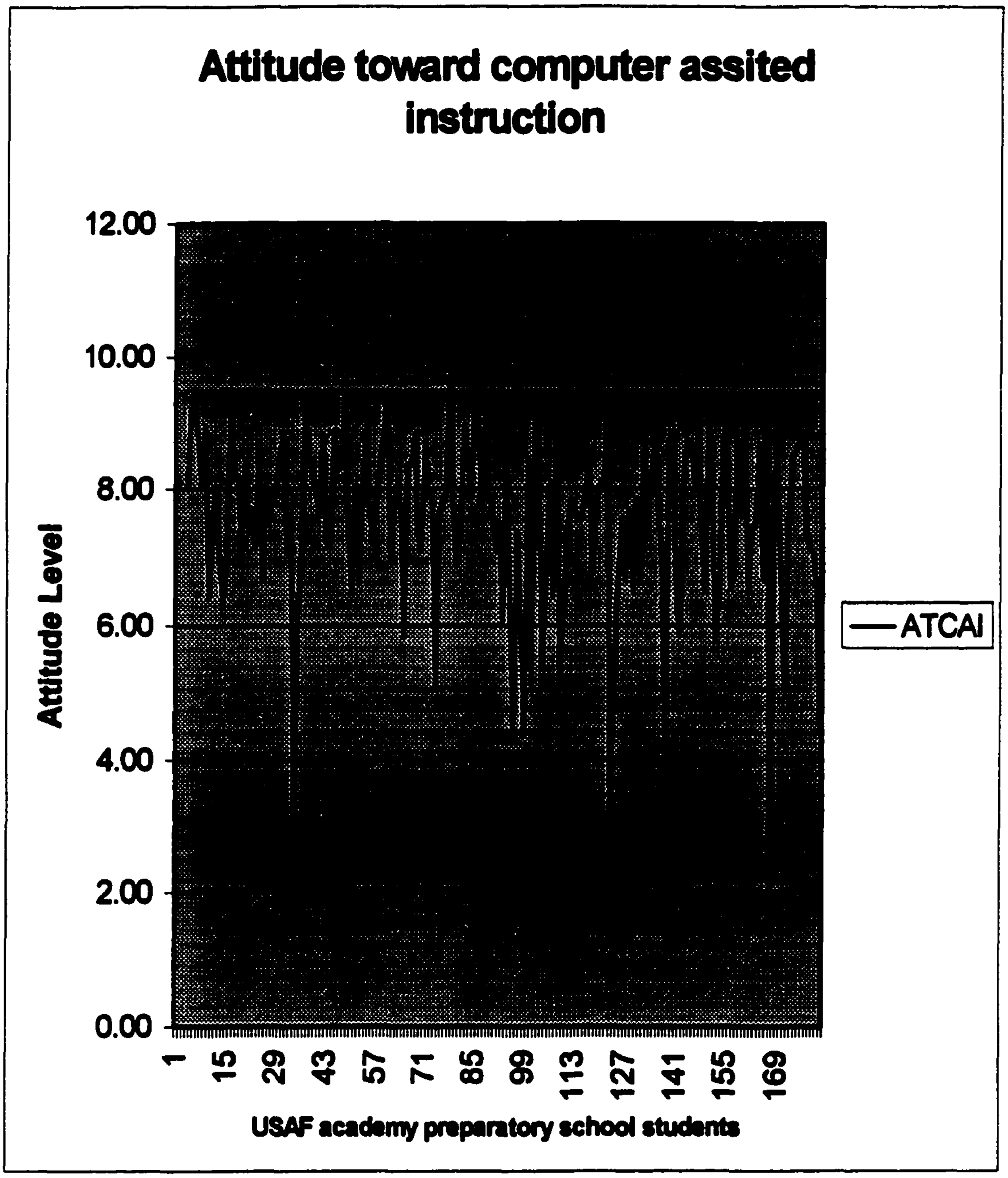

Figure 1 Overall attitude toward computer assisted instruction scores from 179 USAF academy preparatory school students.

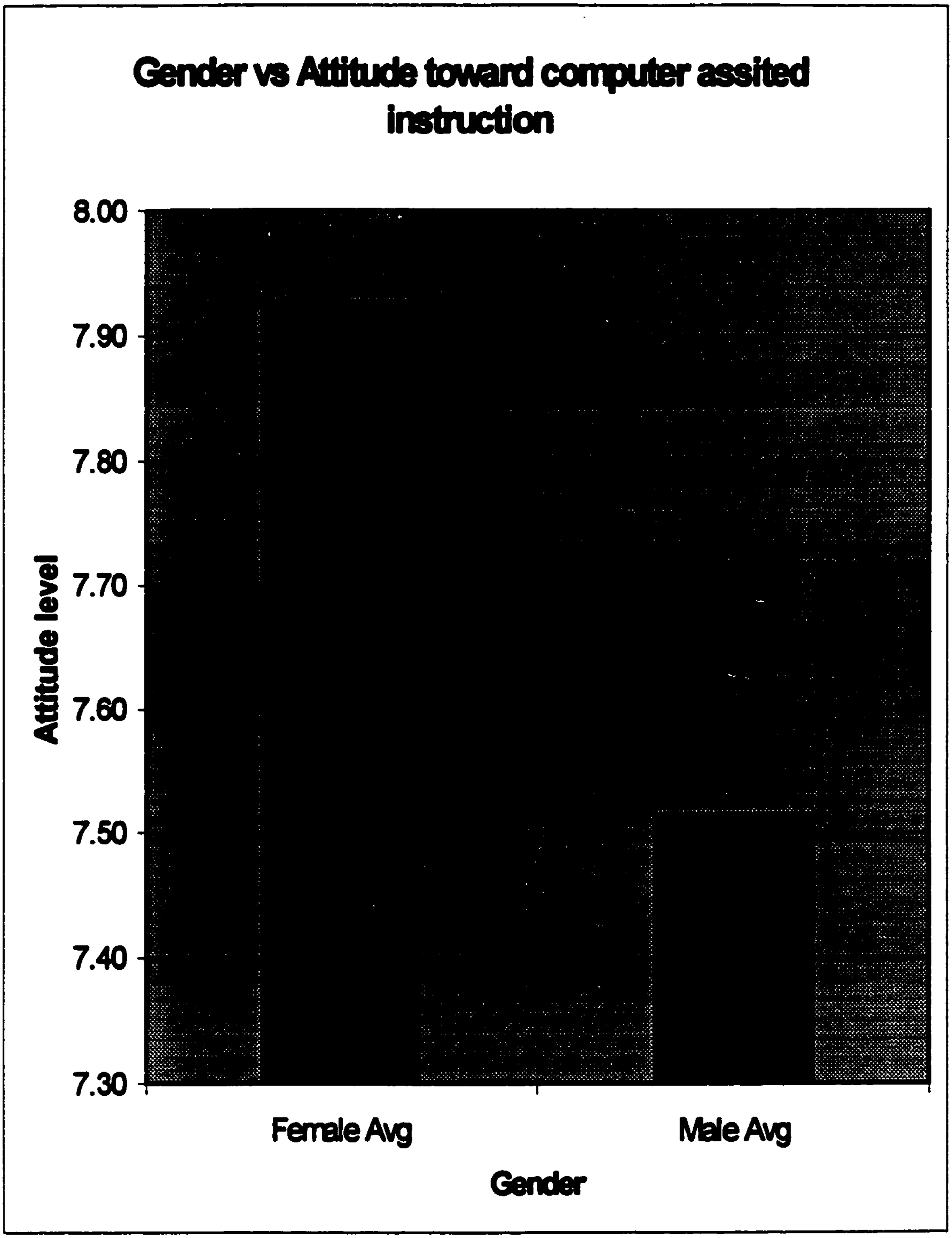

Figure 2 Overall Attitude toward computer assisted instruction scores from 179 USAF academy preparatory school students sorted by gender.

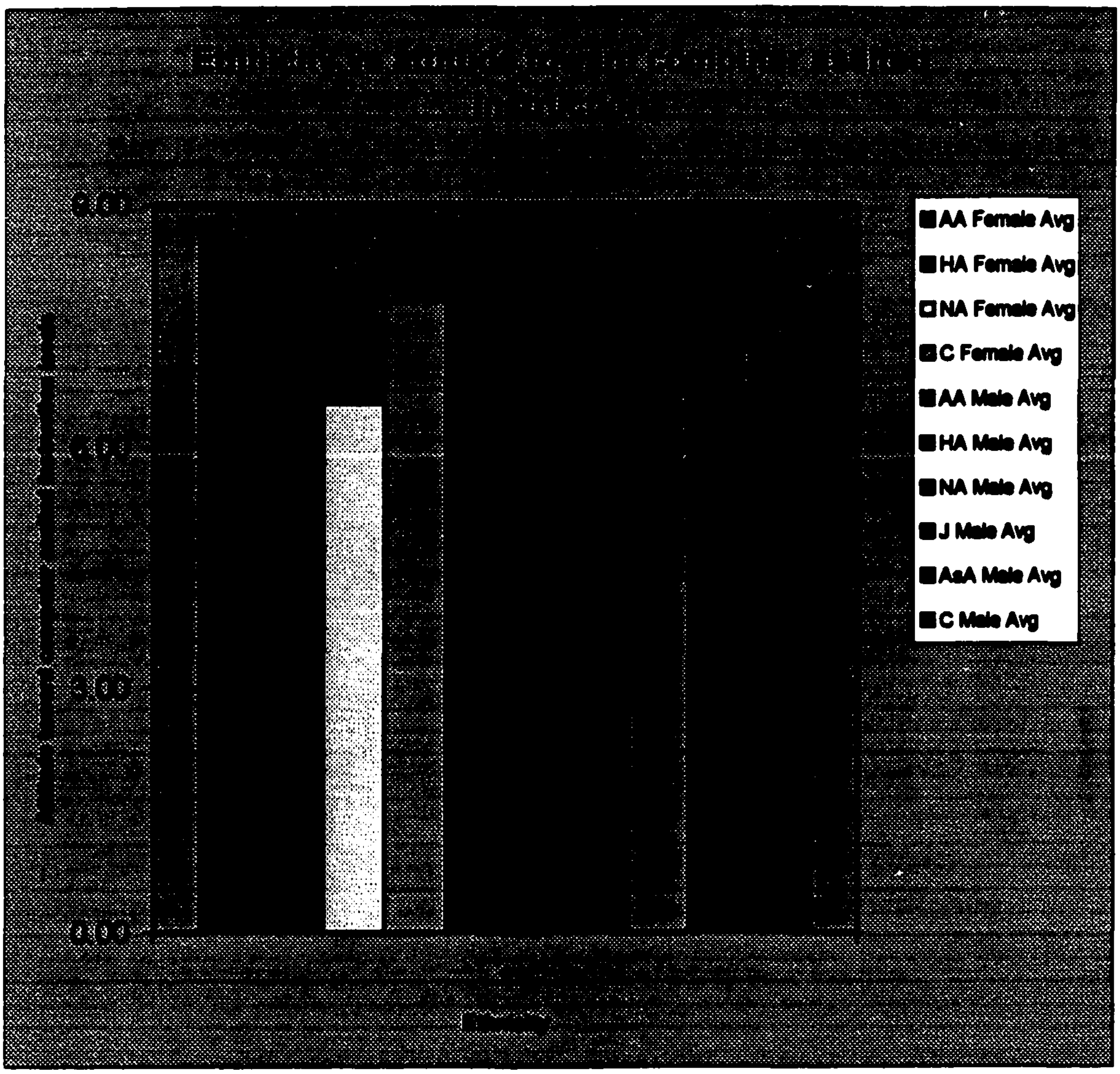

Figure 3 Overall attitude toward computer-assisted instruction scores from 179 USAF academy preparatory school students sorted by ethnicity.

AA – African American

HA- Hispanic American

NA-Native American,

J-Jewish

C-Caucasian

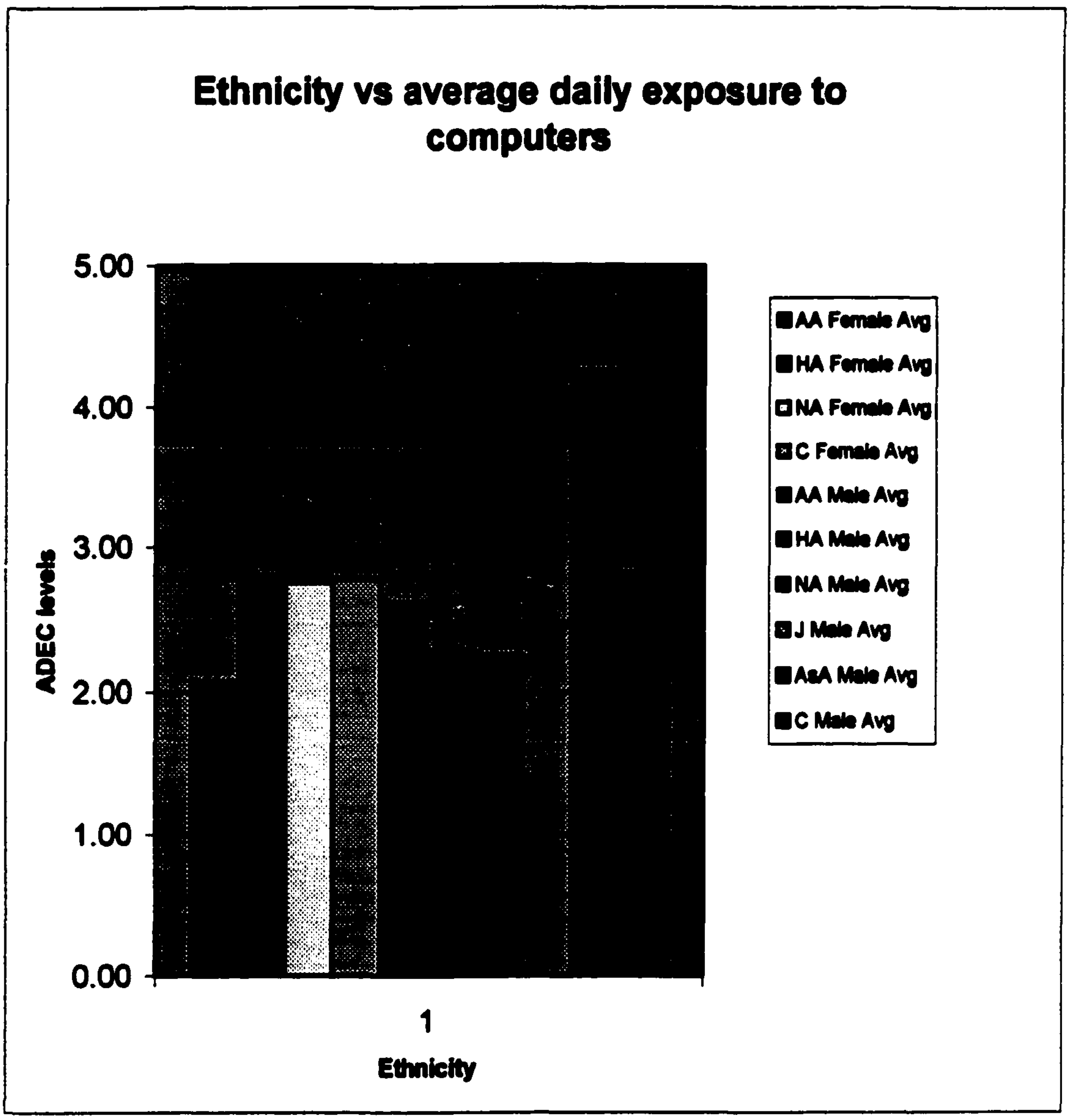

Figure 4 Average daily exposure to computer scores from 179 USAF academy preparatory school students sorted by ethnicity

AA – African American

HA- Hispanic American

NA-Native American,

J-Jewish

C-Caucasian

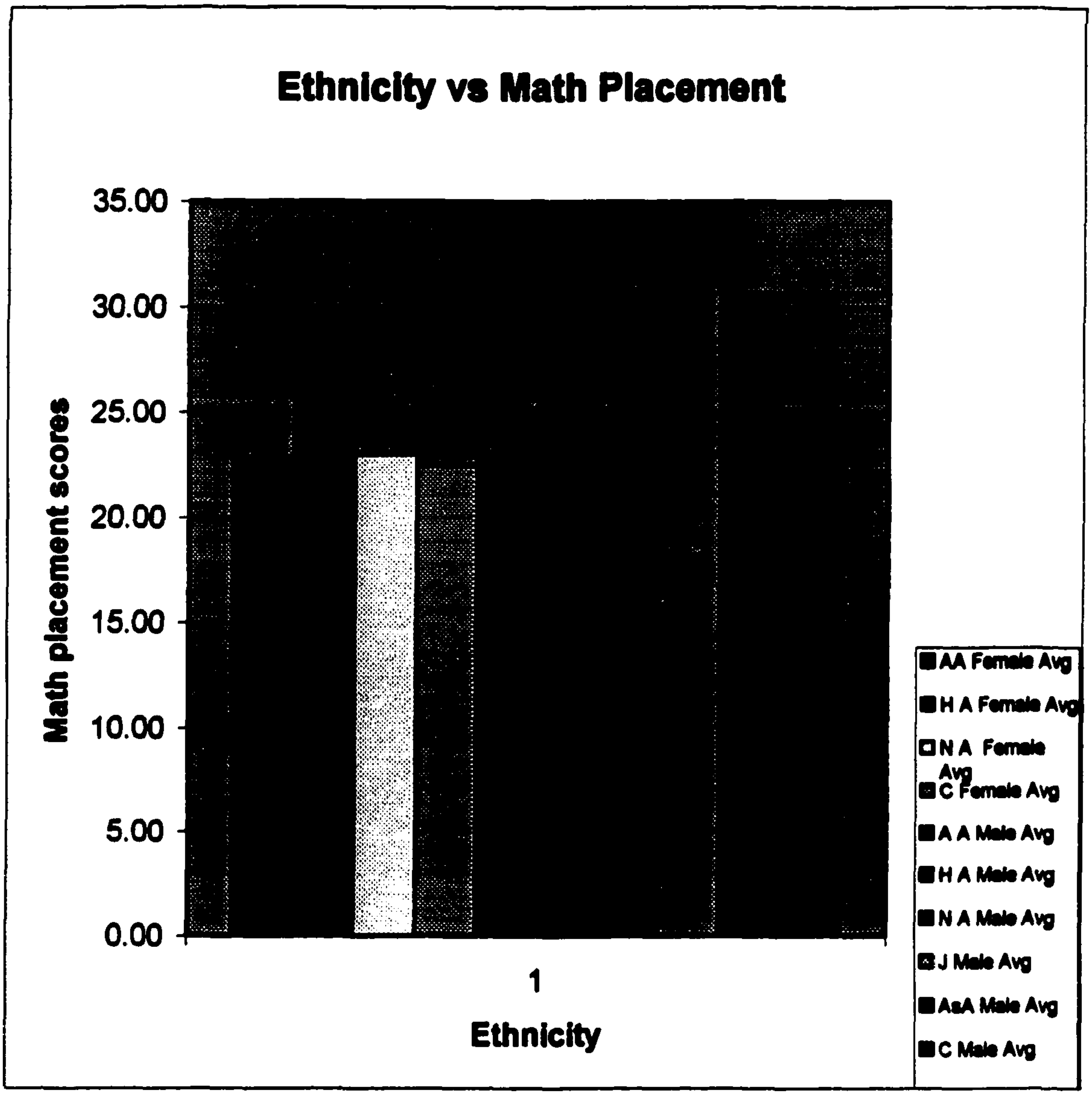

Figure 5 Average daily exposure to computer scores from 179 USAF academy preparatory school students sorted by ethnicity

AA – African American

HA- Hispanic American

NA-Native American,

J-Jewish

C-Caucasian

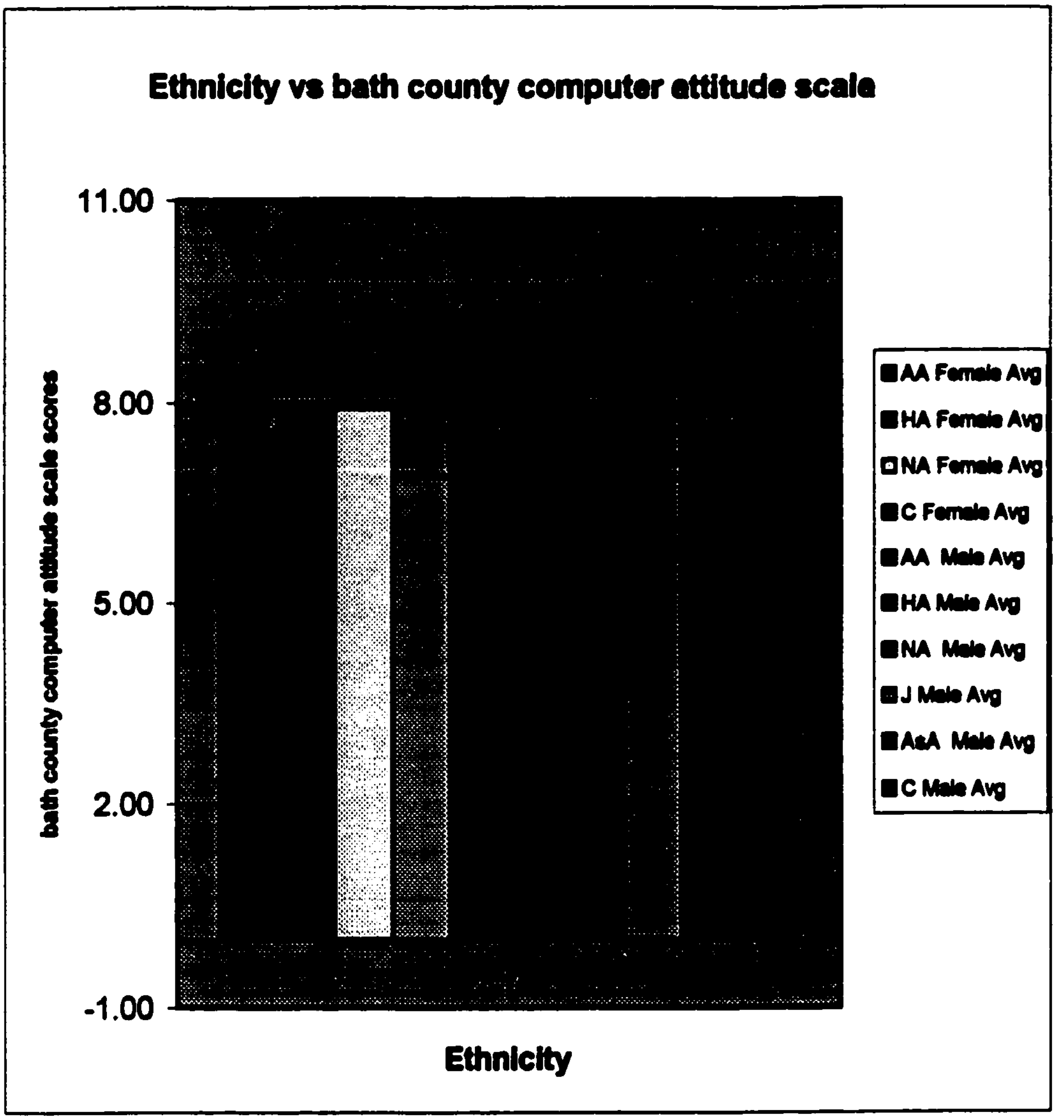

Figure 6 Bath County Computer Attitude Scale scores from 179 USAF academy preparatory school students sorted by ethnicity

AA – African American

HA- Hispanic American

NA-Native American,

J-Jewish

C-Caucasian

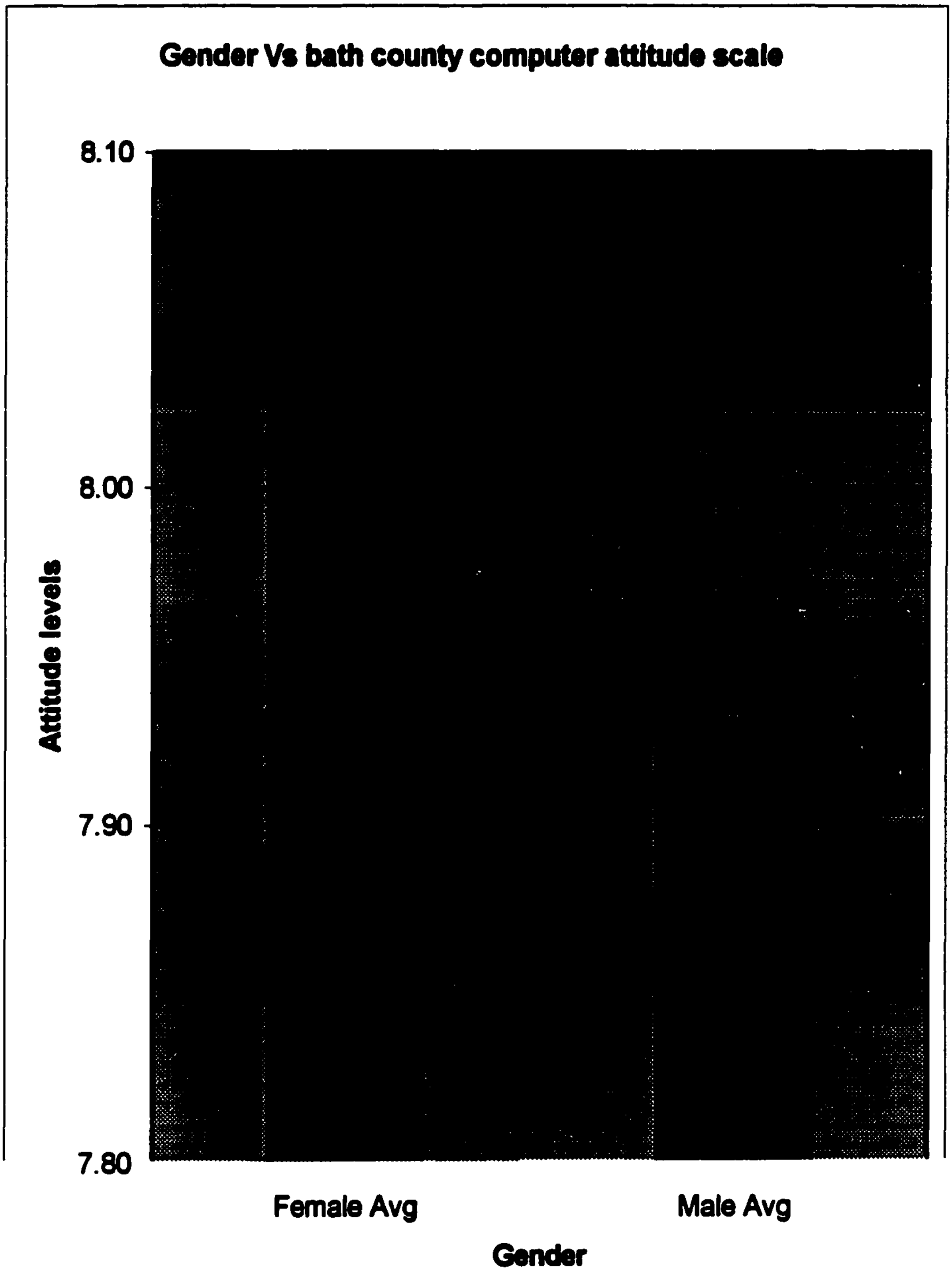

Figure 7 Bath County Computer Attitude Scale scores from 179 USAF academy preparatory school students sorted by gender.

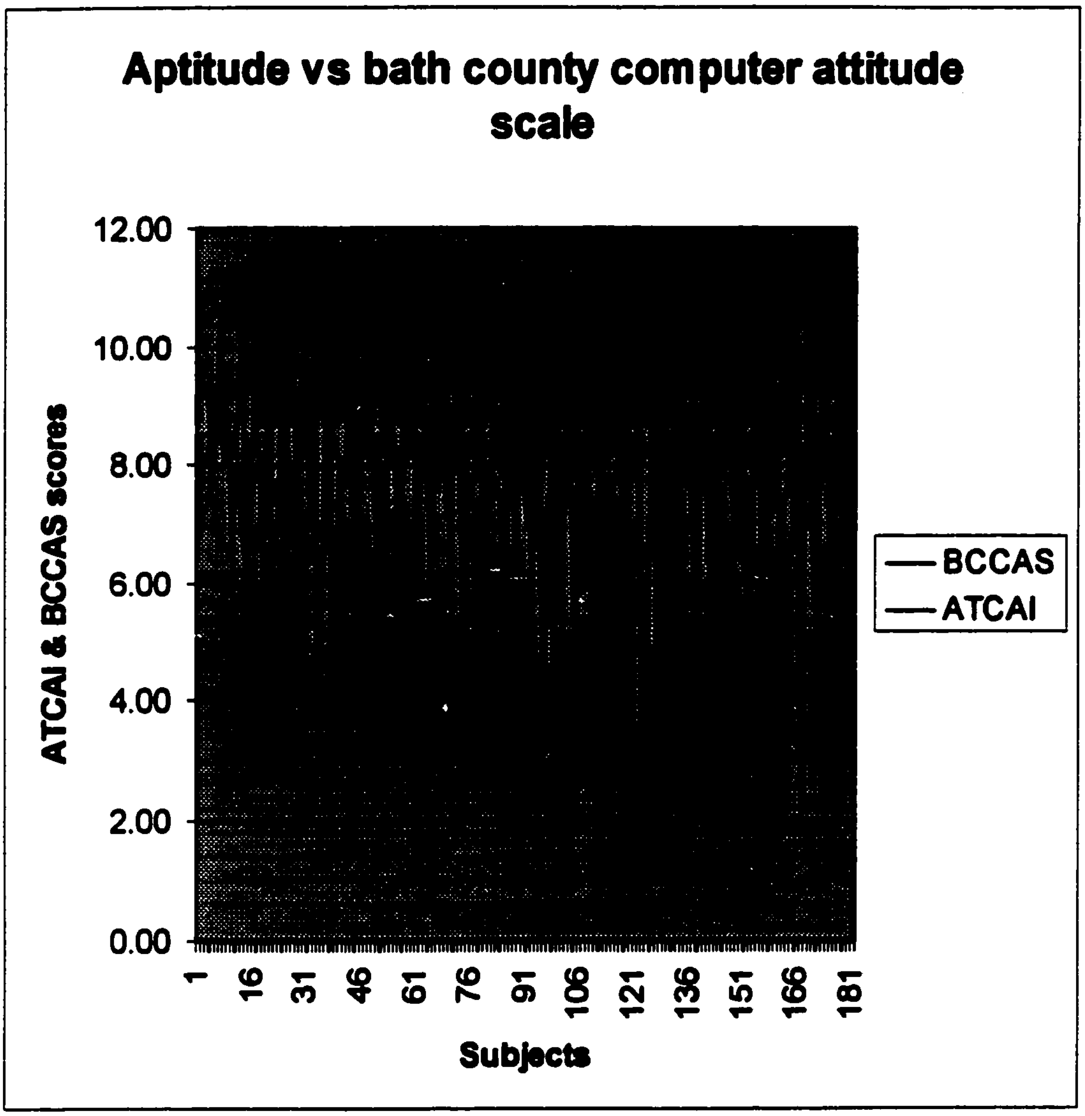

Figure 8 Bath County Computer Attitude Scale scores from 179 students compared to attitude towards computer assisted instruction scores.

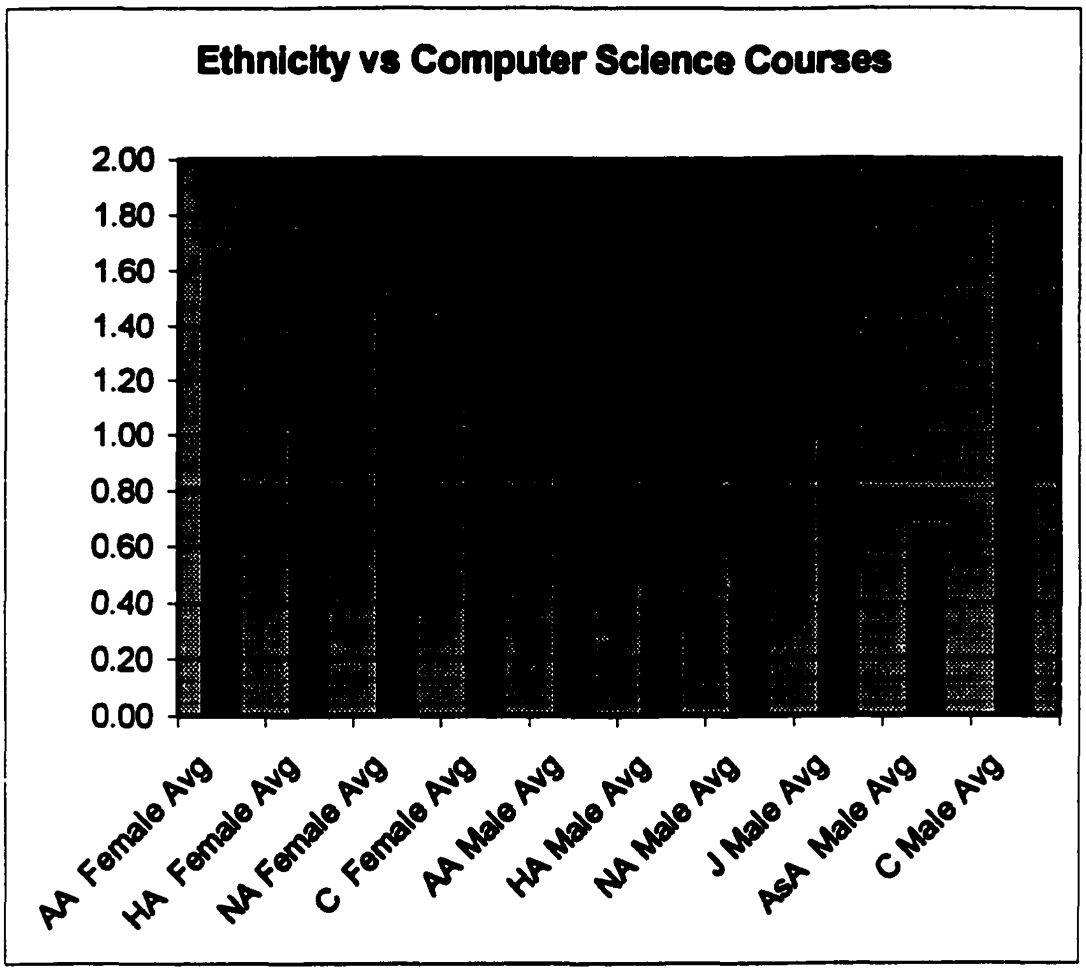

Figure 9 Computer Science Courses taken sorted by Ethnicity Overall Attitude toward computer-assisted instruction scores from 179 USAF academy preparatory school students sorted by ethnicity

AA – African American

HA- Hispanic American

NA-Native American,

J-Jewish

C-Caucasian

Table 1

Regression Models for Dependent variable: ATCAI

Number In Model	R-square	Variables In Model
1	0.26114326	BCCAS
1	0.05041940	ADCE
1	0.02350255	RCE
1	0.01694227	CSC
1	0.00905600	GEN
1	0.00472760	MAPT
1	0.00119669	EDU
1	0.00004849	RNK
1	0.00001595	AGE
2	0.27150338	MAPT BCCAS
2	0.26836031	GEN BCCAS
2	0.26817236	CSC BCCAS
2	0.26531123	RCE BCCAS
2	0.26398095	ADCE BCCAS
2	0.26310377	AGE BCCAS
2	0.26220375	RNK BCCAS
2	0.26124357	EDU BCCAS
2	0.06474806	ADCE RCE
2	0.06346788	ADCE CSC
2	0.05715804	ADCE MAPT
2	0.05570705	ADCE GEN
2	0.05078971	ADCE AGE
2	0.05066304	RNK ADCE
2	0.05051122	EDU ADCE
2	0.04371653	RCE CSC
2	0.03158299	GEN RCE
2	0.03040746	RCE MAPT
2	0.02641879	RNK RCE
2	0.02639151	GEN CSC
2	0.02564990	EDU RCE
2	0.02501327	AGE RCE
2	0.02020949	CSC MAPT
2	0.01727116	RNK CSC
2	0.01698477	AGE CSC
2	0.01694282	EDU CSC

Table 2

Regression Models for Dependent variable: ATCAI

Number In Model	R-square	Variables In Model
3	0.27714995	GEN MAPT BCCAS
3	0.27702083	CSC MAPT BCCAS
3	0.27684545	RCE MAPT BCCAS
3	0.27613805	AGE MAPT BCCAS
3	0.27564341	GEN CSC BCCAS
3	0.27492380	RNK MAPT BCCAS
3	0.27478772	ADCE MAPT BCCAS
3	0.27346126	RCE CSC BCCAS
3	0.27219139	GEN RCE BCCAS
3	0.27150821	EDU MAPT BCCAS
3	0.27063610	ADCE CSC BCCAS
3	0.27056139	RNK CSC BCCAS
3	0.27037883	ADCE GEN BCCAS
3	0.27022561	AGE CSC BCCAS
3	0.26960236	GEN AGE BCCAS
3	0.26915678	RNK GEN BCCAS
3	0.26844779	EDU GEN BCCAS
3	0.26831531	EDU CSC BCCAS
3	0.26750236	ADCE RCE BCCAS
3	0.26615688	ADCE AGE BCCAS
3	0.26602637	AGE RCE BCCAS
3	0.26555462	EDU RCE BCCAS
3	0.26548414	RNK RCE BCCAS
3	0.26534084	RNK ADCE BCCAS
3	0.26400244	EDU ADCE BCCAS
3	0.26338001	EDU AGE BCCAS
3	0.26317995	RNK AGE BCCAS
3	0.26257051	EDU RNK BCCAS
3	0.08044554	ADCE RCE CSC
3	0.07328131	ADCE RCE MAPT
3	0.06970859	ADCE GEN RCE
3	0.06914999	ADCE GEN CSC
3	0.06857985	ADCE CSC MAPT
3	0.06527504	RNK ADCE RCE

Table 3

Regression Models for Dependent variable: ATCAI

Number In Model	R-square	Variables In Model
4	0.28338910	RCE CSC MAPT BCCAS
4	0.28298349	GEN CSC MAPT BCCAS
4	0.28218944	RNK CSC MAPT BCCAS
4	0.28206744	GEN RCE MAPT BCCAS
4	0.28156363	AGE CSC MAPT BCCAS
4	0.28057259	GEN AGE MAPT BCCAS
4	0.28056365	GEN RCE CSC BCCAS
4	0.27993592	RNK GEN MAPT BCCAS
4	0.27991588	ADCE CSC MAPT BCCAS
4	0.27986392	ADCE AGE MAPT BCCAS
4	0.27961641	ADCE GEN MAPT BCCAS
4	0.27936237	ADCE RCE MAPT BCCAS
4	0.27931014	AGE RCE MAPT BCCAS
4	0.27887772	RNK ADCE MAPT BCCAS
4	0.27830885	RNK RCE MAPT BCCAS
4	0.27763973	RNK GEN CSC BCCAS
4	0.27732869	ADCE GEN CSC BCCAS
4	0.27731145	EDU CSC MAPT BCCAS
4	0.27715475	EDU GEN MAPT BCCAS
4	0.27694934	GEN AGE CSC BCCAS
4	0.27691046	EDU RCE MAPT BCCAS
4	0.27626539	EDU AGE MAPT BCCAS
4	0.27614804	RNK AGE MAPT BCCAS
4	0.27581392	EDU GEN CSC BCCAS
4	0.27522527	EDU RNK MAPT BCCAS
4	0.27522360	ADCE RCE CSC BCCAS
4	0.27480239	EDU ADCE MAPT BCCAS
4	0.27426593	RNK RCE CSC BCCAS
4	0.27410368	AGE RCE CSC BCCAS
4	0.27370102	ADCE GEN RCE BCCAS
4	0.27351481	EDU RCE CSC BCCAS
4	0.27340152	RNK ADCE CSC BCCAS
4	0.27289223	ADCE AGE CSC BCCAS

Table 4

Regression Models for Dependent variable: ATCAI

Number In Model	R-square	Variables In Model
5	0.28890073	GEN RCE CSC MAPT BCCAS
5	0.28738243	RNK GEN CSC MAPT BCCAS
5	0.28629155	GEN AGE CSC MAPT BCCAS
5	0.28597148	RNK RCE CSC MAPT BCCAS
5	0.28579697	RNK ADCE CSC MAPT BCCAS
5	0.28558497	AGE RCE CSC MAPT BCCAS
5	0.28546961	ADCE RCE CSC MAPT BCCAS
5	0.28508225	ADCE GEN CSC MAPT BCCAS
5	0.28487341	ADCE AGE CSC MAPT BCCAS
5	0.28391855	ADCE GEN RCE MAPT BCCAS
5	0.28372380	GEN AGE RCE MAPT BCCAS
5	0.28353936	EDU RCE CSC MAPT BCCAS
5	0.28346808	ADCE GEN AGE MAPT BCCAS
5	0.28329359	EDU GEN CSC MAPT BCCAS
5	0.28317866	RNK GEN RCE MAPT BCCAS
5	0.28298435	RNK ADCE GEN MAPT BCCAS
5	0.28233962	RNK AGE CSC MAPT BCCAS
5	0.28229339	ADCE AGE RCE MAPT BCCAS
5	0.28219146	EDU RNK CSC MAPT BCCAS
5	0.28212862	EDU GEN RCE MAPT BCCAS
5	0.28170561	ADCE GEN RCE CSC BCCAS
5	0.28162398	EDU AGE CSC MAPT BCCAS
5	0.28139077	RNK ADCE RCE MAPT BCCAS
5	0.28118081	RNK GEN RCE CSC BCCAS
5	0.28084052	GEN AGE RCE CSC BCCAS
5	0.28067410	EDU GEN AGE MAPT BCCAS
5	0.28063690	EDU GEN RCE CSC BCCAS
5	0.28062615	RNK GEN AGE MAPT BCCAS
5	0.28041375	EDU ADCE CSC MAPT BCCAS
5	0.28018964	EDU RNK GEN MAPT BCCAS
5	0.27993285	RNK ADCE AGE MAPT BCCAS

Table 5

Regression Models for Dependent variable: ATCAI

Number In Model	R-square	Variables In Model
6	0.29101605	RNK GEN RCE CSC MAPT BCCAS
6	0.29035462	ADCE GEN RCE CSC MAPT BCCAS
6	0.29031198	GEN AGE RCE CSC MAPT BCCAS
6	0.29010670	RNK ADCE GEN CSC MAPT BCCAS
6	0.28906897	EDU GEN RCE CSC MAPT BCCAS
6	0.28878436	ADCE GEN AGE CSC MAPT BCCAS
6	0.28868985	RNK ADCE RCE CSC MAPT BCCAS
6	0.28807691	ADCE AGE RCE CSC MAPT BCCAS
6	0.28739243	EDU RNK GEN CSC MAPT BCCAS
6	0.28738885	RNK GEN AGE CSC MAPT BCCAS
6	0.28638356	EDU GEN AGE CSC MAPT BCCAS
6	0.28603824	RNK AGE RCE CSC MAPT BCCAS
6	0.28597416	EDU RNK RCE CSC MAPT BCCAS
6	0.28596431	ADCE GEN AGE RCE MAPT BCCAS
6	0.28590333	RNK ADCE AGE CSC MAPT BCCAS
6	0.28583586	EDU RNK ADCE CSC MAPT BCCAS
6	0.28576037	EDU ADCE RCE CSC MAPT BCCAS
6	0.28562529	EDU AGE RCE CSC MAPT BCCAS
6	0.28557051	EDU ADCE GEN CSC MAPT BCCAS
6	0.28548279	RNK ADCE GEN RCE MAPT BCCAS
6	0.28504153	EDU ADCE AGE CSC MAPT BCCAS
6	0.28392714	EDU ADCE GEN RCE MAPT BCCAS
6	0.28388327	EDU GEN AGE RCE MAPT BCCAS
6	0.28372380	RNK GEN AGE RCE MAPT BCCAS
6	0.28360063	RNK ADCE GEN AGE MAPT BCCAS
6	0.28349169	EDU ADCE GEN AGE MAPT BCCAS
6	0.28344226	EDU RNK GEN RCE MAPT BCCAS
6	0.28311343	EDU RNK ADCE GEN MAPT BCCAS
6	0.28254233	RNK ADCE GEN RCE CSC BCCAS
6	0.28235976	EDU ADCE AGE RCE MAPT BCCAS
6	0.28234592	EDU RNK AGE CSC MAPT BCCAS

Table 6

Regression Models for Dependent variable: ATCAI

Number In Model	R-square	Variables In Model
7	0.29298920	RNK ADCE GEN RCE CSC MAPT BCCAS
7	0.29209343	ADCE GEN AGE RCE CSC MAPT BCCAS
7	0.29102727	EDU RNK GEN RCE CSC MAPT BCCAS
7	0.29101798	RNK GEN AGE RCE CSC MAPT BCCAS
7	0.29015905	EDU RNK ADCE GEN CSC MAPT BCCAS
7	0.29010936	RNK ADCE GEN AGE CSC MAPT BCCAS
7	0.28898006	EDU ADCE GEN AGE CSC MAPT BCCAS
7	0.28873808	RNK ADCE AGE RCE CSC MAPT BCCAS
7	0.28872387	EDU RNK ADCE RCE CSC MAPT BCCAS
7	0.28819884	EDU ADCE AGE RCE CSC MAPT BCCAS
7	0.28740035	EDU RNK GEN AGE CSC MAPT BCCAS
7	0.28604384	EDU RNK AGE RCE CSC MAPT BCCAS
7	0.28602453	EDU ADCE GEN AGE RCE MAPT BCCAS
7	0.28598508	RNK ADCE GEN AGE RCE MAPT BCCAS
7	0.28595441	EDU RNK ADCE AGE CSC MAPT BCCAS
7	0.28563170	EDU RNK ADCE GEN RCE MAPT BCCAS
7	0.28389444	EDU RNK GEN AGE RCE MAPT BCCAS
7	0.28366429	EDU RNK ADCE GEN AGE MAPT BCCAS
7	0.28261272	RNK ADCE GEN AGE RCE CSC BCCAS
7	0.28258018	EDU RNK ADCE GEN RCE CSC BCCAS
7	0.28237189	EDU RNK ADCE AGE RCE MAPT BCCAS
7	0.28218661	EDU ADCE GEN AGE RCE CSC BCCAS
7	0.28124992	EDU RNK GEN AGE RCE CSC BCCAS
7	0.27969598	EDU RNK ADCE GEN AGE CSC BCCAS
7	0.27635359	EDU RNK ADCE AGE RCE CSC BCCAS
7	0.27435666	EDU RNK ADCE GEN AGE RCE BCCAS
7	0.09245854	RNK ADCE GEN AGE RCE CSC MAPT
7	0.09161257	EDU ADCE GEN AGE RCE CSC MAPT
7	0.09154443	EDU RNK ADCE GEN RCE CSC MAPT
7	0.08802061	EDU RNK ADCE AGE RCE CSC MAPT
7	0.08730842	EDU RNK ADCE GEN AGE RCE CSC
7	0.07722410	EDU RNK ADCE GEN AGE RCE MAPT

Table 7

Regression Models for Dependent variable: ATCAI

Number In Model	R-square	Variables In Model
8	0.29303587	EDU RNK ADCE GEN RCE CSC MAPT BCCAS
8	0.29299233	RNK ADCE GEN AGE RCE CSC MAPT BCCAS
8	0.29223858	EDU ADCE GEN AGE RCE CSC MAPT BCCAS
8	0.29102849	EDU RNK GEN AGE RCE CSC MAPT BCCAS
8	0.29016412	EDU RNK ADCE GEN AGE CSC MAPT BCCAS
8	0.28877976	EDU RNK ADCE AGE RCE CSC MAPT BCCAS
8	0.28606875	EDU RNK ADCE GEN AGE RCE MAPT BCCAS
8	0.28264256	EDU RNK ADCE GEN AGE RCE CSC BCCAS
8	0.09255945	EDU RNK ADCE GEN AGE RCE CSC MAPT
9	0.29303728	EDU RNK ADCE GEN AGE RCE CSC MAPT BCCAS

Table 8

TTEST PROCEDURE

Variable: EDU

GEN	N	Mean	Std Dev	Std Error	Variances	T	DF	Prob>|T|
1	156	12.2051	0.46445	0.0372	Unequal	-0.1073	27.5	0.9154
2	23	12.2173	0.51843486	0.10810114	Equal	-0.1164	177.0	0.9074

For H0: Variances are equal, F' = 1.25 DF = (22,155) Prob>F' = 0.4358
****

Variable: RNK

GEN	N	Mean	Std Dev	Std Error	Variances	T	DF	Prob>|T|
1	156	1.4872	0.9604	0.0769	Unequal	0.7786	32.8	0.4418
2	23	1.3478	0.7751	0.1616	Equal	0.6642	177.0	0.5075

For H0: Variances are equal, F' = 1.54 DF = (155,22) Prob>F' = 0.2401

****

Variable: ADCE

GEN	N	Mean	Std Dev	Std Error	Variances	T	DF	Prob>|T|
1	156	2.7244	1.9162	0.1534	Unequal	-1.0198	25.0	0.3176
2	23	3.3478	2.8382	0.5918	Equal	-1.3593	177.0	0.1758

For H0: Variances are equal, F' = 2.19 DF = (22,155) Prob>F' = 0.0059

****

Variable: RCE

GEN	N	Mean	Std Dev	Std Error	Variances	T	DF	Prob>|T|
1	156	3.9231	2.2013	0.1762	Unequal	0.4621	28.9	0.6475
2	23	3.69621	2.2040	0.45965	Equal	0.4625	177.0	0.6443

For H0: Variances are equal, F' = 1.00 DF = (22,155) Prob>F' = 0.9294

Table 9

TTEST PROCEDURE
Variable: CSC

GEN	N	Mean	Std Dev	Std Error	Variances	T	DF	Prob>|T|
1	156	1.6410	2.7095	0.2169	Unequal	0.3600	62.4	0.7201
2	23	1.5217	1.2011	0.2505	Equal	0.2078	177.0	0.8357

For H0: Variances are equal, F' = 5.09 DF = (155,22) Prob>F' = 0.0000
****

Variable: MAPT

GEN	N	Mean	Std Dev	Std Error	Variances	T	DF	Prob>|T|
1	156	24.6159	7.031	0.5629	Unequal	1.3972	30.1	0.1726
2	23	22.5652	6.501	1.3555	Equal	1.3178	177.0	0.1893

For H0: Variances are equal, F' = 1.17 DF = (155,22) Prob>F' = 0.6935

****

Variable: BCCAS

GEN	N	Mean	Std Dev	Std Error	Variances	T	DF	Prob>|T|
1	156	7.9399	1.4435	0.1156	Unequal	-0.3102	32.6	0.7584
2	23	8.0239	1.1751	0.2450	Equal	-0.2663	177.0	0.7903

For H0: Variances are equal, F' = 1.51 DF = (155,22) Prob>F' = 0.2598

Table 10
General Linear Models Procedure

Dependent Variable: ATCAI

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	90.85365777	10.09485086	7.78	0.0001
Error	169	219.18763273	1.29696824		
Corrected Total	178	310.04129050			

R-Square	C.V.	Root MSE	ATCAI Mean
0.293037	14.98326	1.13884513	7.60078212

Source	DF	Type I SS	Mean Square	F Value	Pr > F
EDU	1	0.37102377	0.37102377	0.29	0.5935
RNK	1	0.00151250	0.00151250	0.00	0.9728
ADCE	1	15.39602265	15.39602265	11.87	0.0007
GEN	1	1.59486444	1.59486444	1.23	0.2690
AGE	1	0.00033820	0.00033820	0.00	0.9871
RCE	1	4.55242079	4.55242079	3.51	0.0627
CSC	1	5.15303373	5.15303373	3.97	0.0478
MAPT	1	1.62803568	1.62803568	1.26	0.2641
BCCAS	1	62.15640602	62.15640602	47.92	0.0001

Table 11
Stepwise Regression

Dependent Variable: ATCAI

Forward Selection Procedure for Dependent Variable ATCAI

Step 1 Variable BCCAS Entered R-square = 0.26114326 C(p) = 1.62429192

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	1	80.96519330	80.96519330	62.56	0.0001
Error	177	229.07609721	1.29421524		
Total	178	310.04129050			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob>F
INTERCEP	3.79571285	0.48853610	78.12677400	60.37	0.0001
BCCAS	0.47858471	0.06050801	80.96519330	62.56	0.0001

Bounds on condition number: 1, 1

Step 2 Variable MAPT Entered R-square = 0.27150338 C(p) = 1.14769803

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	2	84.17725691	42.08862846	32.80	0.0001
Error	176	225.86403359	1.28331837		
Total	178	310.04129050			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob>F
INTERCEP	4.21648767	0.55443262	74.22300609	57.84	0.0001
MAPT	-0.01928130	0.01218741	3.21206361	2.50	0.1154
BCCAS	0.48471892	0.06037737	82.71150566	64.45	0.0001

Table 12
Stepwise Regression

Dependent Variable: ATCAI

Bounds on condition number: 1.004141, 4.016564

Step 3 Variable GEN Entered R-square = 0.27714995 C(p) = 1.79787949

	DF	Sum of Squares	Mean Square	F	Prob>F
Regression	3	85.92792869	28.64264290	22.37	0.0001
Error	175	224.11336181	1.28064778		
Total	178	310.04129050			

Variable	Parameter Estimate	Standard Error	Type II Sum of Squares	F	Prob>F
INTERCEP	3.86124338	0.6317	47.84454997	37.36	0.0001
GEN	0.2971	0.2541	1.7507	1.37	0.2439
MAPT	-0.01784948	0.01223616	2.7252	2.13	0.1464