CHAPTER I

OVERVIEW OF THE STUDY

In the last half of the 20th century, technology has revolutionized life and work in industrialized countries. Schools, community agencies, workplaces, learning institutions, and the marketplace have been incorporating the use of technology in the form of the personal computer (PC). The growing uses of PCs have changed how people work, communicate, and function within society and within their families. PCs have also increased individuals' access to information, have given users new ways to store, organize and produce data, and have made it possible for users to shop, conduct business, and access entertainment on a daily basis.

Few places exist in the United States where information and computer technology (IT) has not played a major role. Young people as early as age five have been trained to use computer technology. Senior citizens have also participated in computer technology classes in senior centers, local schools, and training institutions. Eberts and Gisler (1993) reminded us how in 1982, Time magazine named the computer the "Man of the Year" and proclaimed that the computer would "continue to make waves in the job market in the twenty-first century" (p. 115). Now the year 2000 has arrived and the prediction of Time magazine has come true, the computer has not only made significant waves, but also created a tsunami in the field of IT. This "sea change" (Steingraber, 1996) has also created vast deserts of needed workers and over-representation in the computer world for the "men of the years" since the revolution began (Brosnan, 1998, Melamed, 1996).

Technology and Need for IT Trained Male and Female Workers

Steingraber (1996) chronicled the change in computer technology by noting the changes computers have made in education, medicine, materials, and the entire marketplace, and listed the following as examples:

> (a) Interactive media products such as CD ROMS and video game software, which reshaped education, communication, and entertainment; (b) Interactive and on-line newspapers and journals, which are on the Internet and have changed the way information is accessed; (c) The joining of forces of entire industries to create vast media, business and entertainment corporations to meet the needs of all consumers; (d) Information-related industries, which are united into a single market that enables any information to be available in any form to anyone, anywhere, and at any time; and (e) Technology convergence, which has produced the creation of a virtual world allowing companies to sell products in cyberspace without buildings, documents or money, as well as to design new products, such as the Boeing 777 airplane, which was designed completely on the computer in a virtual world (p. 2).

Dixon (1997) described this new tomorrow as the "genie out of the bottle" in terms of the massive database processes and sophisticated shareware now available and in use (p. 6). Hutchins (1998) too, reminded us that computers are everywhere, "omniscient, omnipresent, and omnipotent and basically they are all around us, like HAL in 2001: A Space Odyssey, they are taking over" (p. 18). As we move to a computer-driven society, Muhammad (1996) pointed out how imperative it was to stay abreast of the technological advancements to best prepare for the demands of the future job market.

Despite the growing importance of IT, the number of young people choosing to study in this field has been small in number compared to the number of jobs available (Brown, 1999; Lord, 1995; Melamed, 1996; O'Malley, 1997; Prickett, 1998). Freeman and Aspray (1999) reported that since 1986 the number of bachelor's degrees in computer science had declined by 40%. They also noted that a Department of Commerce Report projected that between 1994 and 2005, the number of IT jobs in the United States would increase annually by 95,000 per year. Additionally, Muhammad (1996) noted that the U. S. Bureau of Labor Statistics predicted that by the year 2005, the number of jobs in computer-related fields would grow by 90%, and that there will be no occupation untouched by this ongoing technological revolution. With these tremendous changes, the question that comes to mind is will there be an adequate supply of trained workers to fill these jobs.

In Florida, Luis Rojas, Chairman of the Florida House Telecommunications and Utilities Committee, reported that there was a shortage of adequately trained workers throughout the high-tech field. Rojas (1999) said that “for high-technology industries, education really does matter a great deal” and he recommended an educational plan that would support K-12 technology training as well as “undergraduate and Ph.D. level studies aimed at cutting edge high-tech applications and theory” (p. 5L). The shortage of adequately trained IT workers was related directly to the preparation pipeline and training patterns of young people according to Freeman and Aspray (1999). In the recent Department of Commerce Report, ‘America’s New Deficit: The Shortage of Information Technology Workers,’ 1997, Fall issue, Freeman and Aspray noted that “only 25,000 bachelor’s degrees in computer science are produced annually in the United States. These numbers have been steadily decreasing from a high of 42,000 in 1986” (p. 17). Although the number of computer science degrees have been decreasing over the years, more males than females appear to be more interested in the field of IT.

Davidson (1999) reported that the shortage of IT workers and unfilled IT jobs in the United States was 350,000. He also said that since there were not enough IT workers to fill these jobs in the United States, a computer programming provider company, Indusa, was currently training workers in Jamaica to be computer programmers. At the Caribbean Institute of Technology (CIT), Indusa hoped to train 2,000 programmers in the next decade to help fill some of these computer technology needs, and other companies have been going to India, the Philippines, and South Africa to get or train new computer technology workers. Davidson projected that since the U.S. overseas market has swelled by 400% for the past two years, it could reach at least three million by 2001, bringing in more foreign nationals to fill the technical jobs needed here in the United States.

The need for IT training has touched every facet of the business and communication world. Freeman and Aspray (1999) assigned a broad classification to IT workers, which included: Office Systems (OS) Developers, Technology Call Consultants, Network Installers, System Administrators, Software (SW) project Managers, Chief Technology Officers, Applications Developers, Entrepreneurs, and Chief Information Officers; and IT-Enabled Workers as: Bank Tellers, Accountants, Business Project Managers, Product Developers, Marketing Vice-Presidents, and Chief Financial Officers.

Noting other factors in this shortage, Melamed (1996) pointed out that the most prosperous industries in the United States were male-dominated, while women congregated in service industries such as social welfare and education. Since IT has become a major business and career area of interest and employment for young people, there has been a large difference both in the number of women in IT and the promotions of women managers in the field (Brosnan, 1999; Flowers, 1998; Freeman & Aspray, 1998, Harrington, 1990; Melamed, 1996).

Women and IT

Throughout the history of this country, the roles, education, and programs both for women and for technology have changed dramatically. At the beginning of the 20th century the role of women in society and the workforce seemed clear and unquestionable. Women were to be homemakers and mothers and their work was centered on the family. The few women who ventured into the workforce were thought to be unusual and even eccentric. Education, religion, and politics usually excluded women. It was not until the end of the second decade of the 20^{th} century that women had the right to vote. Universal education for women in the United States did not become a reality until late in this century. This historical background has set the stage for women to be in the background of work, technology, and learning.

Because many careers tended to exclude women, laws were passed to ensure gender equity in the United States. The Vocational Education Amendments of 1976 mandated gender equity in vocational education. The Carl D. Perkins Vocational Education Act of 1984 provided increased funding for marketable skills and support services, as well as programs to eliminate gender bias and stereotyping in vocational education. Additional funds were provided in the Carl Perkins Vocational and Applied Technology Act of 1990. Finally, on the state level, The Virginia Department of Education's Vocational Gender Equity Office gave technical assistance to educational institutions for gender equity projects ("Vocational Gender," 1995).

These important pieces of legislation were meant to help young women gain the education and training to enable them to enter any career. However, this equal access has not always been achieved. Issacson and Brown (1997) reported that a number of factors have influenced women's career paths. They cited Keer's (1983) findings that women "have had lower career aspirations than men….a more restricted ranged of careers….and tended to put family concerns before career issues" (p. 390).

Women's perceptions that they had lower abilities than men, despite the high grades they earned in school subjects, especially in math and science, were emphasized by Silver-Miller

(1992). Gysbers et al. (1998) indicated that women not only had lower career aspirations, but low expectations for success and lower self-efficacy beliefs about non-traditional careers. These stereotypic attitudes seemed to have placed women at a disadvantage, and this lack of confidence may have hindered them from following more non-traditional career paths.

The lower representation of women in IT and other technical fields has not just occurred in the United States. Roger, Cronin, and Dufield (1999) found that the proportion of women in all engineering careers in the United States was currently 15% to 16% of those enrolled in higher education, compared to only 7% to 8 % in the United Kingdom. Melamed (1996) also reported that in the United Kingdom, computer science and information technology majors were mostly men, and total female admissions to computer studies, engineering, and physics courses only ranged from 14% to 18 % of all female majors. Even today, Freeman and Aspray (1999) indicated that many young women have avoided more difficult math classes required for careers in professions like science, math, and engineering.

Equal Access to IT Training

The goals of equal access legislation have been to open computer use to many populations including females and to help students become more comfortable with technology. To achieve these goals, several high schools have used the support of federal funds and laws to offer lower level or applied School to Work and Tech Prep classes to prepare all students for the work force. However, Flowers (1998) found that few females participate in these technology education classes. Technology courses generally have not been considered college preparatory courses and therefore, have not met the needs of students, especially young women who wanted to enter four-year college programs (Suggs, 1999).

Advanced classes, such as the Advanced Placement classes in computer and information technology, have been limited in enrollment and therefore, have not been available to all students in local high schools (Mathews, 1997). When advanced computer technology classes have been available, they have usually been computer science classes, which often have restricted young women, minorities, and those from lower socioeconomic groups from participating, according to Erickson (1987). He indicated that these restrictions seemed to be dependent upon the completion of Algebra II as a prerequisite to participate. Also, as Gustafson and Magnusson (1991) discussed, because these courses tended to be structured, linear and more popular with male students, they often have not appealed to young women.

Undoubtedly, both men and women will be needed in increasing numbers in this burgeoning field. However, since more men than women study and plan careers in IT, education and counseling programs may offer important information to help rectify this unequal situation (Solnick, 1995). Freeman & Aspray (1999) were concerned that many high schools did not have the required courses and training for employment positions in the field of IT. The authors also mentioned concerns that counselors were either unaware of or did not fully understand the rapidly growing field of IT and the opportunities for both men and women. As counselors become more aware of the gender gap in IT, they may develop programs that will advance the importance of IT.

Technophobia and Computer Anxiety

DeLoughry (1993, April 28) said that technophobia may affect millions of students. Although statistics have varied, Brosnan indicated that anywhere from 20 to 50% of the population suffered from technophobia, and women constitute the largest portion of these percentages. Technophobia has been the subject of a number of studies (Bedore, 1991; Bronsan, 1998, p. 26; Canera, 1996; Jay, 1981, 1985, Meier, 1985). These studies and others have not only suggested, but have demonstrated that computer anxiety was an authentic and measurable construct (Heinssen et al., 1987; Meier, 1998; Miller & Rainer, 1995; Rosen, Sears, & Weil, 1993).

Heinssen et al. (1987) found that women often have seen computers as somewhat intimidating tools, and many women have had fears that they could actually ruin a computer or a program if they touched the wrong key. This attitude toward computers has produced both anxiety and avoidance (Bowers & Bowers, 1996; Chu, 1990; Heinsen et al., 1987; Meier, 1988; Parish & Necessary, 1996; Pope-Davis, 1989). Statistics have differed as to the amount of computer anxiety or technophobia in the workforce, from a few individuals (LaLomia & Sidowski, 1993), to 30% of the U. S. workforce (Henderson, Dean & Ward, 1995), and finally to 50% (Brosnan, 1998). Even though the estimates of numbers has varied, computer anxiety has been a problem for many people and has caused resistance to using computers in certain segments of the population.

Computer anxiety, which has been a popular subject for research, has been defined generally as stress or anxiousness due to contact with computers (Crable & Brodzunske, 1994; Dyck & Smither, 1994; Henderson et al., 1995; Igbaria & Chakrabarti, 1990; Mauer, 1994; Torkzadeh & Angulo, 1992). This resistance to technology has been problematic because of the growing use of computers in the workplace and the classroom. Pope-Davis & Vispoel (1993) reported that many individuals defined themselves as computer-anxious and often resisted using the computers that were perceived to be the cause of such anxiety. Brosnan (1998) cited the behavioral aspect of computer anxiety, which included: (a) “avoidance of computers and the general areas where computers are located; (b) excessive caution with computers; (c) negative remarks about computers; and (d) attempts to cut short the necessary use of computers" (p. 16). This anxiety that people seem to experience leads one to wonder whether or not anything has been done to mediate this computer anxiety.

Self-Efficacy, Social Learning and Cognitive Behavioral Theory

A feeling of self-efficacy or confidence was one of the important variables for Heinssen, Glass and Knight (1987) in their study. They found that the lack of self-efficacy or confidence had an effect on women's views of their abilities and especially their abilities to work with computers. Bandura and Adams (1977) had found that self-perceptions were influential in determining people's perceptions of their ability to perform a task. The authors stated that when people are confident of their capabilities, they are able to utilize their talents, however, when they doubt their abilities, they in turn behave ineffectually. Cognitive behavioral theory (Ellis, 1985), stressed that cognitions or how people think about their world determined their actions. Bandura's (1986) social learning theory also stressed that attitudes and society role models and messages preceded behaviors and influenced self-efficacy or the confidence that one could complete a task successfully.

Brosnan (1998) reported gender differences in self-efficacy between males, who seemed to have more confidence in their computing ability, and females, who seemed to have less confidence in their computing ability. In her study of young girls and computer use, Hanor (1998) listened to girls' reactions to computers, indicating that they often have been pushed aside and harassed by the boys, ignored by teachers, and not given equal time to work on computers. Because of Hanor's findings and Brosnan's work on technophobia, the results appear to be that not all of our young people, especially young women, have been comfortable using computers.

Educational and Societal Gender Bias

In November of 1998, the American Association of University Women's (AAUW) Educational Foundation instituted a new technology commission to study just such issues of computer-resistance and equal access for women to computer technology. This commission held an 18-month long series of meetings to consider the differences in the ways that girls and boys have used computer-based technologies. The commission was composed of technology experts and leaders in the fields of education, science, mathematics, and research. The outcome of this research was a report entitled "Tech-Savvy: Educating Girls in the New Computer Age (2000)" and pointed out that "girls are critical of the computer culture . . .and instead of trying to make girls fit into the existing computer culture, the computer culture must become more inviting for girls" (p. 1). The major findings were that:

> (1) Girls represent 17% of the Computer Science "AP" test takers, and less than one in 10 of the higher level Computer Science "AB" test takers. (2) Women are roughly 20% of IT professionals. (3) Women receive less than 28% of the computer science bachelor's degrees, down from a high of 37% in 1984. Computer science is the only field in which women's participation has actually decreased over time. (4) Women make up just 9% of the recipients of engineering-related bachelor's degrees. (5) Girls find programming classes tedious and dull, computer games too boring, redundant, and violent, and computer career options uninspiring. (6) When women, who make up half the workforce, account for only 20% of those with information technology credentials, it is a clear sign that we have to make computers and technology relevant across the job market to nontraditional users (Executive Summary available online @ http://www.aauw.org/2000techsavvybd.html, p. 2).

The AAUW has long been an advocate of gender equity according to Weinman and Haag (1999). This new commission was founded on the belief that gender must become a crucial feature of social equity concerns about technology in U.S. public schools.

Before this study, the AAUW Educational Foundation had issued an alarming technological report, “Gender Gaps: Where Schools Still Fail Our Children” (1998, as cited in Weinman and Haag, 1999). This report described the deepening technological divide between girls and boys in the public schools in the United States. The report also stated that very few girls had taken the more advanced computer and computer application courses in graphic arts, computer-aided design, and computer programming and computer science. The girls were more likely to enroll in low level keyboarding and data-entry classes much like the standard typing classes of previous decades.

The schools have not been the only place where gender is unequally represented. The marketplace also has shown the differences in perceptions of what boys like to do and the toys they choose, compared to what girls like to do and the toys they choose. Ivinski (1997) indicated that for many years, computer games have been marketed to appeal mostly to males. She also found that many of these computer games focused on the importance of competition, incorporated negative behavior (e.g. hurting or destroying opponents) and, overall, were not particularly appealing to girls, who tended to prefer games involving creativity, design and cooperation (p. 16). Now that the home computer has replaced the arcade, which was popular during the l980s, boys have become enamored with the more violent computer games such as, “Doom,” “Postal,” “Armageddon,” “Resident Evil,” and “Quake”.

Computer materials for classrooms also may heighten the gender imbalance occurring around computers. Durham & Brownlow (1997) reported that in the elementary mathematics software only 12% of the characters, out of the 40% that were gender-identifiable, were female. They indicated that many of these female figures were passive or stereotypical, portraying mothers and princesses, compared to the male characters, which were for the most part action figures, such as hang glider pilots, mountain climbers, and heavy equipment operators. Games and toys have not been the only gender stereotyping influences on the attitudes of young people.

The Internet has opened up vast resources to both men and women, but as Tarlin (1997) noted in a Harvard Education Letter, the users of the newer, more powerful areas of the Net, like the World Wide Web, are still 85% men. Masayoshi Son, Chairman of Softbank, and owner of many net-properties summed up the feelings of many of Time digital's top 50 leaders in computer technology, when he said: "For the next 10 years, we do nothing but Internet. That's where the whole society is going to have a big revolution," (Quittner, 1999, October 4, p. 41). If women are not prepared for the Web and the new technologies, they again will be left behind.

Roles of Men and Women in IT

The career paths of men and women in IT have been moving in somewhat different directions for many years. Currently, Freeman and Aspray (1999) found that women used IT as tools (e.g., E-mail, word processing and data management), but fewer women have considered IT, computer science, and computer programming as career options (Melamed, 1996; Harrington, 1990; Summers, 1997). Vehvilainen (1997) found that the computing professions had inherited strict gender hierarchies beginning with the punched card systems of the 1950s, where women were in basic data entry positions. Females may have been able to advance to middle management and sales, but a fraternity of men seemed to dominate the computer programming and executive ranks of IT.

Statement of the Problem

In the past two decades there has been extensive literature concerning the increasing importance that computing technology has had and will continue to have in modern society. Postman (1993) saw the need to understand the impact that the pervasive use of new technologies has on the individuals using them. The use of computers and the corresponding computer-mediated communication has continued to multiply, however, the use of such technology has not occurred without resistance. Both Pope-Davis and Vispoel (1993) and Brosnan (1998) pointed out that many individuals defined themselves as computer-anxious and often resisted using computers. Other studies also showed the prevalence of computer anxiety (Heinssen et al., 1987; Jay, 1985; Miller & Rainer, 1995; Rosen, Sears & Weil, 1993).

Despite the introduction of computers into homes and schools, the equal access legislation and school programs, and the significant increase of available and high paying jobs in IT, there has been a gap in the number of females, who have had an interest, have studied, planned careers and have actually worked in IT. Even though more females are now in the work force, these females do not seem to be participating in the technology revolution; while this has been demonstrated in general, would such differences also exist in an elite high school located in a technologically sophisticated area? It would seem reasonable that a school that emphasized technology and computer use would produce students with positive computer attitudes who would tend to enter computer related fields. It would also seem reasonable that the gap between males and females would be lessened. The results could challenge high schools and counselors to create more opportunities for equal access to technology preparation programs and classes so that gender bias and inequality in the IT workforce may be lessened.

Purpose of the Study

The purpose of this case study was to determine if there were gender differences in the current 11th and 12th grade classes at an elite high school, which was named the second best public high school in America by Newsweek Magazine (2000, March 13, pp. 51-54) This elite high school was also named the most challenging public high school in the metropolitan Washington, D.C. area two years in a row (Mathews, 1998, 1999). A number of academic and personal variables were considered, using both school records and a student questionnaire.

Research Questions

The following research questions guided the case study in order to describe and investigate the demographic and academic characteristics and computer attitudes and usage of the juniors and seniors at an elite high school in Northern Virginia. The main question was the extent to which there were gender differences in the 11th and 12th grade students in the following:

1. Demographic and academic characteristics.
2. Extent of use of computers by the participants and their fathers and mothers.
3. Extent of use and the number of math, computer science, and computer technology classes 11th and 12th graders have taken during high school.
4. Strong Interest Inventory General Occupational Themes, Basic Interest Scale Activities and Personal Style Scales.
5. Participants' use of career resources including:
    a) People such as counselors, teachers and other human sources of information.
    b) Printed materials such as books, magazines, newspapers, and journals.
    c) Electronic media including Internet resources, commercial database programs such as

Choices, ExPAN and College View.

d) Experiences such as shadowing and internships.

6. Participants' choice of college majors.
7. Likelihood of participants' advanced computer use in college and careers.
8. Computer attitudes, anxiety, and self-efficacy of 11th and 12th graders.

Significance of the Study

The information from this study will (1) aid educators, counselors, and other researchers in understanding some of the factors involved in the under-representation of young women in IT classes, career preparation programs, and ultimately in careers in the field of IT (Harrington, 1990; Flowers, 1998; Freeman & Aspray, 1999, Melamed, 1996). (2) help to point out ways to provide these women the needed support, education, and guidance and counseling to help alleviate some of the barriers to IT study and careers. (3) increase counselor understanding of the different options for women in IT fields as well as the barriers for young women in the field, and by having this insight, counselors may be able to act as the advocates for these young women to help remove or overcome some of the obstacles. (4) help counselors understand their roles, so that they can assist through counseling interventions. (5) help educators, counselors, and the young women themselves see more clearly what the problem is; where it is coming from; how pervasive it is; and finally, how we as a society can help turn around this alarming situation. (6) help the High School become an even more effective public high school by understanding what the gender differences are in computer attitudes and computer use. This information will help the administrators, counselors, and teachers plan more effective ways of presenting computer technology to the students at the high school, the primary, elementary, and middle schools.

Organization

Five chapters are presented. Chapter I contains the introduction, rationale for the study, purpose of the study, the problem statement, research questions, and the significance of the study. Chapter II contains the literature review of the relevant topics associated with IT, gender, and computer attitudes and self-efficacy. Chapter III contains a complete description of the case study, the methods used in the study, the population, the site, the research design, the instruments, as well as the procedures and data analysis. Chapter IV presents the results of the study and Chapter V contains the summary of the study.

CHAPTER II

REVIEW OF THE LITERATURE

The aim of this chapter is to present a review of the current and past literature concerning the state of computer and information technology, and occupational interest and outlook relating to gender. This chapter discusses literature on attitudes toward computers with emphasis on gender differences in computer anxiety and self-efficacy and previous computer experience and influences of the media, the Internet, computer games, parents, socioeconomic status, peers, role models, schools, counselors, teachers, and high school classes. The theoretical basis for the study, including cognitive behavior theory and social learning theory, were also discussed to establish the framework for the survey research case study. This chapter concludes with a discussion regarding the Strong Interest Inventory and survey research methods.

Computers and Information Technology

Technology has become one of the most important tools for survival among mankind. Technology actually began with tool making in the stone age, when humans made tools of stone, first to find food, then to build shelter, and finally for war. Throughout the ages man has used science and technology to build better and better tools. Both the Scientific Revolution of the 1600's and the Industrial Revolution of the 1700's were necessary to join science and technology, leading to the creation of better tools. Freedson (1993) chronicled the start of industrial technology, which began when power-driven machines caused the growth of the factory system and mass production and paved the way toward a new age, or the "Second Industrial Revolution". As a result of this growth, we now live in a world where science and technology have become essentially linked together. As man first made tools to improve his life, to make his work easier, and wage war, a new tool has emerged to carry out many of these functions. This new tool is called the computer.

Computers

Freedson (1993) portrayed the development of the modern computer as owing its origins to many different countries and individuals. However, the first invention leading to the computer is believed to have been developed by Blaise Pascal in 1642, who built the first digital calculating machine that could count. The next step in computer development occurred from 1671 through 1694 when Gottfried Wilhelm Leibniz, a German mathematician, was developing the "Stepped Reckoner", which counted, and also multiplied, divided, and extracted square roots. Two Englishmen, Charles Babbage and George Boole, made significant inventions and discoveries from 1835 to 1859, which were also important to the development of the computer. Charles Babbage drew up the plans for the world's first computer called the "analytical engine" and George Boole developed symbolic logic, which was the basis of what is now called Boolian algebra and binary switching, upon which modern computing has been based. At about the same time, Herman Hollerith, an American statistician, invented the punched card and a tabulating machine to classify and count the data for the U.S. census (Freedson, 1993).

In the 1930's and 1940's in the United States, an electromechanical analog computer was developed, which was followed by the development of the first automatic calculator (Freedson, 1993). Herman Aiken of Harvard collaborated with IBM engineers to produce the automatic calculator, while in 1942 John Atanasoff and Clifford Berry of Iowa State University constructed the first electronic digital calculator. These inventions led to what has been called the "first computer" designed to use binary numbers by John von Neumann in 1942 at Princeton (Freedman, 1995). Von Neuman's 1947 stored programming computer paved the way for computers in warfare and eventually in business, industry, education, and personal use.

According to Freedson (1993), the first computer was a huge machine consisting of vacuum tubes, which took up a large amount of space and could not be moved. During the 1950s, transistors replaced the vacuum tubes in computers making it possible to build computers that were smaller, more reliable, and less expensive. The computers were later stored with a set of instructions, called programs for processing data. Computers executed these instructions when users requested them. These systems consisted of hardware or the physical components of the system and software, which were the instructions or programs the machine was to follow. The Central Processing Unit (CPU) read the instructions and determined how to execute them. The CPU could store data for later retrieval in the memory of the program. The CPU also contained devices for input or where the computer obtained information from the outside world, such as the keyboard, and output where the computer presented information to the outside world through the monitors or cathode ray tube (CRT) screens and the printers. Some devices were used for both input and output, such as the disk drives and cassette tape units (Freedson, 1993).

Eberts and Gisler (1993) described four generations of computers moving from the mainframes, through minicomputers, to microcomputers and indicated that the fifth generation was nearly upon us. This fifth generation would be where computers learn how to learn, which means that computers will be programmed to go through the same processes that occur in human learning to produce even more sophisticated computer driven applications.

Today, computers can transmit and receive data from other computers by sending signals over telephone lines, through a device called a modem. The computer can also retrieve information from various sources through a connection known as the Internet. The Internet is a 30-year old loosely organized group of computer networks, which was started at MIT by Leonard Kleinrock, the first father of the Internet, in the late sixties (Waterhouse, 1999). The

Internet was designed to enable computers to talk to each other, primarily as a response to the Soviet Union's launch of the Sputnik satellite. Waterhouse credited Vint Cerf, the second father of the Internet, with being one of the primary developers of the communications language (TCP/IP) used by most computers to communicate on the Internet. Now the Internet (World Wide Web) is characterized as a system that is made up of hypertext and allows individuals to communicate on-line to this expanding giant web of information through an Internet access provider (Freedman, 1995).

With the development of integrated circuits, consisting of many electronic components on a single silicon chip, computers are moveable, smaller and less expensive and open up computer use to large segments of the population in developed countries. With the advent of this technology, computers have changed dramatically, so that in the 1990's there are networks of fast microcomputers that are the equal of the fastest of the largest computers (Freedson, 1993).

Turkle (1995) raised the level of computer use describing the computer as not just a large calculator, but as something interactive so that users can begin "communicating with simulated people on our screens, agents who will help organize our personal and professional lives" (p. 19). Turkle also reminded us that 15 years ago, most computer users were limited to typing commands, while today they could use "off-the-shelf products to manipulate simulated desktops, draw with simulated paints and brushes, and fly in simulated airplane cockpits" (p. 19).

Information Technology

Freeman and Aspray (1999) defined Information Technology (IT) as involvement with computer-based systems, including computer hardware and software, as well as the peripheral devices most closely associated with computer-based systems. The authors suggested how this involvement could be acquired through various educational programs such as, computer engineering, computer science and engineering, computer science, software engineering, computer information science, information systems, management information systems, and information science. In addition to having this required academic training, the authors added that IT workers must also have certain abilities and skills. These skills were primarily the skills of organization and communication, management and analysis, knowledge of statistics, and the ability to work on a team, to identify and report problems early, and to work with deadlines (Freeman and Aspray, 1999).

Occupational Outlook

Technological progress has had a tremendous effect on occupations. Older companies and corporations are expanding, while new ones are converging because of the new technology. Issacson and Brown (1996) credited high technology or “high tech” with causing a radical change in the kind of workers needed. The authors emphasized that high tech has created openings for individuals to process the information that has made the machines work automatically, displacing the workers who had originally made them work. Technology, with the use of computerized control and worldwide communications systems, has also enabled the manufacturing plants to relocate to where labor was cheap and available. Thus, technology actually has created a never-ending number and diversity of jobs for trained and computer-literate men and women (Issacson & Brown).

IT has become so prevalent in the modern world, in part, because the processing power and storage capacities of semiconductor devices has been doubling every 18 months for the past 30 years, while prices have continued to decrease (Freeman & Aspray, 1999). Since this technology has become so ingrained in business, industry, education, and government, increasingly IT workers will be needed in the future.

Because of the growth in computer technology, Issacson and Brown (1996) explained that the outlook for occupations in the 21st century up to 2005 would show an increase in professional and specialty occupations. They reported that these professional occupations would grow by 37% in the beginning of the 21st century, followed by service occupations, technicians, and related support occupations. Computer engineers and scientists were also expected to be one of the fastest growing occupations, while word processors were believed to decline significantly (Occupational Outlook Quarterly, Fall, 1993) as cited in Issacson and Brown, 1996, p. 41).

According to Freeman and Aspray (1999) the Monthly Labor Review (Bureau of Labor Statistics, November 1997) listed the anticipated IT occupations with high job growth from 1996-2006, which included database administrators, computer support specialists, and all other computer sciences projecting a 118% rise in the year 2006. Computer engineers and systems analysts had a 109% and a 103% expected growth rate each in 2006. Desktop publishing specialists, data processing equipment repairers, and engineering, science, and computer systems managers were expected to grow at the rates of 74%, 52% and 45% respectively (Freeman & Aspray, p. 60).

Other industry findings and studies have also shown that there has been a serious lack of qualified workers in the field. Freeman and Aspray (1999) summarized these studies into several categories including:

(a) The Olsten Corporation, a large staffing services company, surveyed North American businesses' staffing requirements, and in 1997 found that the high-tech sector had a 57% higher percentage of companies reporting a shortage of workers than any other for-profit sector; (b) Microsoft Corporation found that there were

> more than twice as many job openings in their technical support program than there were software workers in all of Ireland [the country that exported the world's second largest amount of software after the United States]; (c) The insurance, automotive, computer software and hardware, telecommunications, and pharmaceutical industries all had annual turnover rates of between 15 % and 19% for software workers.

Both the need for more IT workers as well as the salaries in IT companies have been rising according to Freeman and Aspray (1999). They reported that starting salaries for computer engineers with a new bachelor's degree increased by 5.8 % to $39,722 from 1996 to 1997, which was well above the national inflation rate. Computerworld's 1997 salary survey showed annual salary increases of more than 10 % in 42 % of the 26 occupations tracked, but if either a male or female went to Washington State that average salary rose to nearly $70,000 according to Freeman & Aspray. Additionally, the authors pointed out that the state of Washington led all the other states in the growth and salaries of computer and information technology with an average software wage of $66,752, the highest of any state in the nation. The growth projections for the state of Washington, too, were the highest in the country with a rate from 1990 to 1996 of 17.8 % compared with the national growth rate of 9.8 %. The State of Washington currently reported a serious worker shortage because of the 7,300 current vacancies and 64,000 total desired hires in the next 3 to 4 years. Three-quarters of all of these jobs required a bachelor's degree or higher, but the most desired positions required a BS or MS in computer science or computer engineering (Freeman & Aspray).

Shortage of Computer Science Majors

Reisberg (1999) chronicled how IT companies were increasingly hiring and training students from almost any field, because the shortage of computer-science majors had been so severe. Researchers and career placement officials said that this was a good labor market for everyone as long as they had some competency with technology, because the demand for college graduates with degrees in computer science, electrical engineering and other technical fields was outpacing the supply of graduates. An example of this was the story Reisberg chronicled about how a typical Class of 1999 graduate with computer training landed a $32,000 IT position in one day over the Internet at (http://www.dice.com).

According to "Technology" USA Today (1999, April 16, http://www.usatoday.com) fewer college students have been seeking high-tech degrees, despite the need for graduates in these fields. The article further stated that the American Electronics Association had found that high–tech degrees decreased 5 % between 1990 and 1996, and of the degrees awarded, a significant portion had gone to foreign nationals. In light of this demand for IT workers, there appears to be a decline in the number of computer science majors in this country and abroad (Brosnan, 1998; Freeman & Aspray, 1999; Melamed, 1996). Freeman and Aspray noted that fewer men and women were studying or going into the field of computer science, especially when compared to the 1980s.

Not only has there been a decline in computer science degrees, but Solnick (1995) indicated that in coeducational schools women's final majors tended to be education and social work, the biological sciences, then the languages, arts and literature, and social sciences. Mathematics, engineering and computer science, cultural studies, and the physical sciences were the least preferred majors by women, which essentially limited their technical job options (Solnick).

Women in IT

Stereotyping of roles and bias toward females may be somewhat to blame for the lack of women in IT fields. For example, in the Weekly Standard, Gelernter (1999, May), a professor of computer science at Yale University, seemed to portray such a biased and stereotyped role attitude. Gelernter wrote that universities could not hire more female professors in science and engineering, because they were just not available. He further stated that women were less drawn to science and engineering than men were. Although women are not being forced out of the sciences, Gelernter believes that they have chosen not to enter them, either because they did not like the fields or did not tend to excel in them. Gelernter then drew the analogy that forcing women into the computer science profession was like forcing weak players into the National Football League (NFL) purely for ideological reasons (http://www.weeklystandard.com).

With this type of opinion apparently alive and well at one of the leading universities in the United States, the concern will continue to be that women are still considered second class citizens. Women continually have not been seen to be as capable, talented or fit to pursue scientific or computer science fields of study as men have been.

In addition to stereotypical roles, Freeman and Aspray (1999) stated that there has been an under-representation not only of women but also of Hispanics, African Americans, and Native Americans in the field. The authors also stated that: "If these groups were represented in the IT workforce in proportion to their representation in the U.S. population, this country would have more than an adequate supply of workers to fill even the most dire estimates of a shortage" (p.111). Since the greatest number of underrepresented workers in all of these categories have been women, gender attitudes, bias, and access for women in IT seem to be some of the major issues in the lack of female workers in the field of IT.

Although the number of women in the workforce has been steadily advancing, this growth among women is expected to continue to increase, while men in the workforce are expected to decline according to Vacc, DeVaney, and Wittmer (1995). This feminization of the work force will also create a need for new legislation and protection for women in the areas of discrimination, safety, training, and equal access. As Blankeship, 1991, in Vacc et al. indicated, almost one-half of all women work in jobs that are 80% female. Thus, women have tended to follow more traditional paths both in education and in career choice, despite the availability of jobs with lucrative salaries offered in technology fields. As women move more into non-traditional jobs the fear of harassment, discrimination, and unequal treatment may hamper their progress and satisfaction in these new jobs.

Computer Attitudes, Anxiety, and Self-Efficacy

The past 15 years has witnessed a growing concern about computer attitudes and computer anxiety. Since computer technology and PCs have radically changed the way we educate, sell, and communicate, the concern has been that certain populations will be left out of this computer revolution. A number of issues have emerged surrounding the attitudes of computer users, the presence of technophobia or computer anxiety in large segments of the population, and the general acceptance and training in processing, handling and using information and technology. Computer attitudes have been the most widely researched of these issues.

Definition of Attitudes

Attitude as a construct has been widely defined, discussed and studied. In the literature on attitudes there have been differences in both the definitions and the interpretations of this important construct. At the end of the 1800s, early studies in psychology discussed the relationships of attitudes, behaviors, and perceptions with researchers studying attitudes as both one-dimensional and multi-dimensional. This review explored the literature related to the construct and measurement of attitudes especially as attitudes related to computers and computer anxiety.

One of the major authorities in attitude research was Gordon Allport. From the historical perspective of attitude, Allport's 1935 definition (as cited in Lemon, 1973) was a classical one in the field. Allport stated that attitude was "a mental and neural state of readiness, organized through experience exerting a directive or dynamic influence upon the individual's response to all objects or situations with which it is associated" (Lemon, p. 8). After many years of research on attitudes, Allport (1954) later described attitude as the "dynamic influence upon the individual's response to all objects and situations with which it is related" (p. 63). Allport believed that directionality was an important part of attitude when he explained that attitude was a "state of mind of the individual toward a value" (p. 62). In providing an overview of the concept of attitude, he proclaimed that attitude was "probably the most distinctive and indispensable concept in contemporary American social psychology" (p. 59).

Many of the definitions of attitude have been complex and multifaceted, but more definitions that are concise have also been helpful. Daniel O'Keefe (1980, as cited in Cushman and McPhee, 1980) provided a short summary of the concept of attitude as it related to behavior. He described the concept of attitude as a "recurrent theme" and "a person's general evaluation of an object (entity, person, policy, etc.)" (p. 118). Kubiszyn and Borich (1993) defined attitudes simply as "descriptions of how people typically feel about or react to other people, places, things, or ideas" (p. 170). Fishbein and Ajzen (1975) described attitude as a "learned predisposition to respond in a consistently favorably or unfavorable manner with respect to a given object" (p.6). Cushman and McPhee (1980) also defined attitude as "a function of a network of propositions or beliefs in memory" (p.24). Currently, Alreck and Settle (1995) have described attitude as the "relatively durable, psychological predisposition's of people to respond toward or against an object, person, place, idea, or symbol, consisting of three components; their knowledge or beliefs, their feelings or evaluations, and their tendency toward action or passivity" (p. 442). In summary, attitude is simply a mental position, feeling, opinion, interest or purpose involving the expectancy of a certain kind of experience and a readiness to respond in a characteristic way.

<u>Assessment and Measurement of Attitudes</u>

Aiken (1980), Lemon (1973), and Cushman and McPhee (1980) linked behavior to attitude measurement. Aiken described attitudes as learned predispositions to respond positively or negatively to certain objects, situations, concepts, or persons" (p. 2) and as such could be measured. Lemon classified attitudes as both measurable and "almost universally conceptualized in terms of some predisposition to respond in a defined way to some object or class of objects with which it is associated…thus the sample of behavior defines the attitude and distinguishes it from others" (p. 117). Cushman and McPhee described behavior "as a general evaluation of an object, measurable by questionnaire" (p. 3).

Researchers have also indicated that attitude has been difficult to measure. For example, Henerson, Morris and Fitz-Gibbon (1978) explained that the "task of measuring attitudes is not a simple one" (p. 11). Anastasi (1976) also commented that "the measurement of attitudes is both difficult and controversial" (p. 545).

According to Shaw and Wright (1967), these opinions seemed to be due to the belief that attitude was considered a construct and as such should be measured indirectly. They also stated that "the most frequently used methods of measuring attitude require subjects to indicate their agreement or disagreement with a set of statements about the attitude object" (p.13). Thus, for Shaw and Wright to achieve a measurement of attitudes, these statements would have to be structured to assess a positive or a negative opinion from the individual. Then from the combination of such statements a measurement "scale" could be created.

Another component of attitude measurement involved intensity. Oppenheim (1966) suggested that in addition to positive or negative direction, attitudes also possessed intensity. The intensity of an attitude was measured in terms of how strong or weak the attitude was. Thus, attitude measurement scales must be constructed in such a manner to determine both the direction of the attitude (positive versus negative) and the intensity of the attitude (strong versus weak). Anastasi (1976) cautioned that while an attitude scale could measure direction and intensity it should be developed only to assess one rather than numerous attitudes.

Shaw and Wright (1967) and Oppenheim (1966) supported this assessment of one rather than numerous attitudes. They identified this one attitude factor in the five factors that were important characteristics of all measurement scales. The five factors included: (1) the unidimensionability or homogeneity of the attitude to be measured, (2) the linearity and equal intervals or equal-appearing intervals of the measurement scale, (3) the reliability of the attitude scale, (4) the validity of the attitude measurement scale, and (5) the reproducibility of the measurement process (Oppenheim, p. 121).

Self-Efficacy as an Attitude

When Aiken (1980) described attitudes as "learned predispositions to respond positively or negatively to certain objects situations, concepts, or persons" (p. 2), this meant that attitudes toward computers were related to other attributes. Delcourt and Kinzie (1993) and Zubrow

(1987) found that self-efficacy was associated with attitudes toward computer technologies. Hill, Smith, and Mann (1987) and Miura (1987) found that the role of self-efficacy was a factor in determining individual recognition of the importance of the computer in the future. Kinzie, Delcourt, and Powers (1994) investigated the predictive effects of self-efficacy on computer applications and found that attitudes of comfort/anxiety and usefulness contributed significantly predictive effects on self-efficacy of computer technologies.

Computer Attitudes

Several authors have conducted studies on attitudes and their effects on computer usage (Bear, Richards & Lancaster, 1987; Brosnan, 1998; Chen, 1986; Chu, 1990; Colley, Gale & Harris, 1994; Connell, 1991; Delcourt & Kinzie, 1993; Devlin, 1991; Fishbein & Ajzen, 1975; Francis, 1993; Gardner, Discenza & Dukes, 1993; Garrett & Bullock, 1997; Glass & Knight, 1988; Gottleber, 1992; Gressard & Loyd, 1987; Grogan, 1991; Gustafson & Magnusson, 1991; Halpern 1995; Hanor, 1998; Harrington, 1990; Igbaria & Chakrabarti, 1990; Katz, Evans & Francis, 1993; Kay, 1990; Kinzie & Delcourt, 1991; Klueva, Lam, Hoffman & Green, 1994; Koslowsky, Lazar & Hoffman, 1988; Lim, 1996; Liu, 1998; Loyd & Gressard, 1984; Loyd & Loyd, 1985; Mahmood & Medewitz, 1990; Massoud, 1992; McHaney, 1998; Melamed, 1996; Miyashita, 1991; Nash & Moroz, 1997; Necessary & Parish, 1996; Nickle & Pinto, 1987; O’Lander, 1994; Otom, 1998; 1992; Parish & Necessary, 1996; Persichitte, 1993; Pope-Davis & Vispoel, 1993; Roger et al., 1999; Sariya, 1991; Scallin, 1991; Schmid, 1989; Shashanni, 1993; Siann, Macleod, Glissov & Durndall, 1990; Sigurdsson, 1991; Smith, 1995; Toppin, 1998; Wallace & Necessary, 1996; Woodrow; 1991; Yin, 1984; Zhang & Espinoza 1998). These studies found that variables such as computer experience, gender, anxiety, socioeconomic levels, mothers and father’s use of computers, and computer training have had significant influences on computer attitudes and computer use.

Since computer usage has become a way of life, researchers have been concerned about the factors that influenced individual attitudes toward computers and the relationships between these factors (Siann et al., 1990). Gardner et al. (1993) indicated that an individual's attitude toward computers has been not only an important topic in schools but also in the workplace. According to Gressard and Loyd (1987) "the success of computer instruction and/or computer-based projects can be largely dependent upon the attitudes toward computers of its participants--both teachers and students" (p. 3). Woodrow (1991) also cited research indicating that "attitudes toward computers are thought to influence not only the acceptance of computers, but also future behaviors, such as using a computer as a professional tool or introducing computer applications into the classroom" (p.165).

Computer Anxiety

Computer anxiety has been defined as a separate construct (Heinssen et al., 1987). Heinssen pointed out that computer anxiety should be distinguished form negative attitudes towards computers and involved a "more affective response, such that resistance to and avoidance of computer technology is a function of fear and apprehension, intimidation, hostility and worries that one will be embarrassed, look stupid or even damage the equipment" (Brosnan, 1998, p. 33).

Research on human/computer interface has reported that many humans have felt a similar sense of anxiety associated with computers as Heinssen portrayed. Fear and anxiety have been identified as emotions that can cause people to either perform or avoid activities and objects that are done without thought or concern by others.

Among the researchers who studied computer attitudes many found that computer anxiety has been just such a factor in computer use (Bandalos & Benson, 1990, Bozionelos, 1997; Brooke, 1989; Canera, 1996; Charlton & Burkett, 1995; Chu & Spires, 1991; Edelbrock, 1990; Farina, Arce, Sorbal & Carames, 1991; Gillon, 1997; Glass & Knight, 1988; Glass, Knight & Baggett, 1985; Gos, 1996; Harris, 1989; Heinssen et al., 1987; Henderson, Deane & Ward, 1995; Howard, 1986; Howard, Murphy & Thomas, 1987; Igbaria & Chadrabarti, 1990; Jay, 1981.1985; Jordan & Stroup, 1982; Keller, 1996; Kernan & Howard, 1990; King, 1995; Koohang, 1989; Leso & Peck, 1992; Loyd & Gressard, 1984; Marcoulides, Rosen & Sears, 1988; Martocchio, 1994; Massoud, 1999, 1989, 1991; McInerney, McInerney & Sinclair, 1994; Meier, 1988; Miller & Rainer, 1995; Morahan-Martin, Olinsky & Schumacher, (1992) Mouzes, 1995; Rameriz, 1997; Raub, 1981; Sigurdsson, 1991; Rosen et al., 1987, 1993; Rosen & Weil, 1990; Rosen & Weil, 1995; Todman & Monaghan, 1994; Torkzadeh & Angula, 1992; Tseng, Tiplady, Macleod & Wright, 1998; Turkle, 1988; Weil & Rosen, 1995; Weil, Rosen & Wugalter, 1990; Weinberg & English, 1981; Wilson, 1996). These studies looked at the various factors involved in computer anxiety such as gender, computer experience, parental and peer influences, self-efficacy, and other variables. However, in these studies there was little agreement as to the specific factors that caused computer anxiety.

Brosnan (1998) called computer anxiety “technophobia”. Other terms such as “cyberphobia” and “computer anxiety” also came into common usage to describe individuals who are frightened by the use of computing hardware and software. Rosen and Weil (1990) defined technophobia or computer anxiety as evidence of one or more of the following: (a) “anxiety about present or future interactions with computers or computer-related technology; (b) negative global attitudes about computers, their operation or their societal impact; and/or (c) specific negative cognitions or self-critical internal dialogues during present computer interactions or when contemplating future computer interaction" (p. 276).

Gardner et al. (1993) explained that "computer anxiety is considered to be a major cause of resistance to using computers" (p. 487). Sigurdsson (1991) stated that "computers have elicited a variety of reactions in people, from negative attitudes and anxious feelings to extreme reactions such as fear and overuse" (p. 617). Heinssen et al. (1987) reported that computer anxiety was a viable construct and was related to individual's gender, computer experience, mechanical interests and even SAT scores. Morahan-Martin et al. (1992) added that the "existence of negative attitudes toward computers could be expected to lead to avoidance of the use of computers" (p. 1).

Math/Science Anxiety

Fears and aversions to technology classes and activities have not just occurred in computer use. Kinzie and Delcourt (1991) cited the 1989 American Association for the Advancement of Science report, which stated that "many students are emerging from school with an aversion to science, mathematics and technology" (p. 3). The AAUW (1994) study also found that young women were not taking as many math and science classes as their male counterparts.

Fear of math was a subject discussed by Tobias (1987) for the College Board in order to deal with the anxiety young women felt over math performance. She presented simple explanations and provided understandable methods for the young women to use when confronted with difficult math problems and helped the young women with tips on how to study, take tests, and prepare for math and science classes. Fear of statistics was another common fear expressed by women. Several tests and studies by Wise measured these fears (Wise, 1985, 1987).

Computer Self-Efficacy

Several studies have indicated that computer self-efficacy tended to have an inverse relationship with computer anxiety; as self-efficacy increased, computer anxiety tended to decrease (Henderson, Dean & Ward, 1995; Martocchio, 1992, 1994). In a study by Henderson et al. (1995), computer self-efficacy was found to be the most important variable in predicting computer anxiety. Delcourt and Kinzie (1993) defined computer self-efficacy as a measure of how confident computer users have been with their ability to understand, use, and apply computer knowledge and skills.

A number of other studies (Barling & Beattie, 1983; Betz & Hackett, 1981, Betz, Harmon & Borgone, 1996; Busch, 1995; Dawes, 1998; Dugnan, 1992; Howard, Murphy & Thomas, 1987; Lewis, 1985; Locke, Fredrick, Bobka & Lee, 1984; Lynch, 1990; Monge, Bachman, Dillard & Eisenberg, 1982; Schunk, 1981; Shauareb, 1993; Stumpf, Brief & Hartman, 1989) have been conducted concerning self-efficacy and computer attitudes and computer anxiety. A summary of the research indicated that higher computer self-efficacy or feeling competent to use computer technology related to lower computer anxiety. These findings suggested a possible link between the general construct of self-efficacy and computer anxiety.

Zhang and Espinoza (1998) examined the relationships among computer self-efficacy and attitudes and anxiety toward computers. The authors used the Kinzie, Delcourt, and Power's (1994) definition of self-efficacy, which stated that "self-efficacy reflects an individual's confidence in his/her ability to perform the behavior required to produce specific outcomes and is thought to directly impact the choice to engage in a task, as well as the effort that will be expended and the persistence that will be exhibited (p. 747).

How competent individuals feel about their computer ability tended to be a variable in self-efficacy. A number of factors also have been found to be of concern to computer users. Lynch (1990) described the medium used by the computer user, as significantly affecting the message sent over it. He also pointed out that the software accessed by computer users could not avoid carrying some of the personality of the creator. Earlier, Howard et al. (1987) reported that the programming language intimidated students in an introductory computer course, more than the actual computer they were assigned to use. The authors explained that the type and style of written language could be a determining factor in users' computer anxiety, and if software writers have not consciously considered the mindsets of users, who are not part of their paradigmatic worldview, the result could enhance miscommunication. Thus, those who design and write software may be ignorant of what is involved in analyzing an audience when designing a communication strategy such as a manual or help screen (Howard et al.).

A study by Monge et al. (1982) also seemed to support this contention. Subjects in their study, who were found highly computer competent, were also found low in interpersonal communication competent. Therefore, users of computers, not familiar with the inside language and culture of software writers often might be confused by their use of jargon, and this might tend to lessen their self-efficacy.

Computer Attitude, Anxiety, and Self-Efficacy Measures

Computer Attitude Scales

Woodrow (1991) reported that "if the utilization of the computer as a learning and teaching tool is to be maximized, attitudes toward computers must be continuously monitored" (p. 165). During the 1980s a number of computer attitude and anxiety scales were developed to measure attitudes and avoidance of computers. Four of these attitude and anxiety measures were the Computer Attitude Scale (CAS) in 1984, the Computer Anxiety Index (CAIN) in 1983, the Blomberg-Erikson-Lowrey Computer Attitude Task (BELCAT) in 1987, and the Attitudes toward Computers (ACT) in 1981.

The Computer Attitude Scale (CAS @ http://ericae.net/tc2TC019544.htm) is believed to be one of the most popular measures of attitudes toward computers because of its extensive use in a large number of studies (Chu, 1990; Colley et al., 1994; Connell, 1991; Devlin, 1991; Grogan, 1991; Koslowsky, M., Lazar, A., & Hoffman, M., 1988; Liu et al., 1998; Miyashita & Knezek 1991; Nickle & Pinto, 1987; Parrish & Necessary; Sariya, 1991; Schmid, 1989; Shauareb, 1993; Smith, 1995; Toppin, 1998; Yin, 1989). The CAS is a 29-item instrument designed to measure high school and college students' attitudes toward computers and computer use. The CAS is a Likert-type scale, and students are asked to respond to statements representing three types of attitudes: anxiety or fear of computers; liking of computers or enjoying working with computers; and confidence in their ability to use or learn about computers. The CAS measures confidence, and computer liking and anxiety. The CAS can be administered in approximately ten minutes.

The Attitudes toward Computers (ATC) developed by Raub (1981) is a 25-item Likert-type scale that assesses three factors: computer usage, computer appreciation, and societal impact. Raub defined computer anxiety as a multidimensional construct that consisted of 1) computer usage anxiety, 2) lack of appreciation for computers, and 3) anxiety concerning the negative impact of computers on society.

The Blomberg-Lowery Computer Attitude Task (BELCAT) by Erickson (1987, as cited in Gardner et al., 1993), @ http://ericae.net/tc2/TC019542.htm is a 36-item Likert-type self-report measure of attitudes toward learning about computers and toward computers themselves. The BELCAT appears to be a composite of the CAS, CAIN and ACT and was based on Fennema and

Sherman's Mathematics Attitude Scales (Gardner et al.). The instrument has five subscales: computer liking, comfort with computers, usefulness of computers, attitude toward success with computers, and computers as a male domain. The BELCAT is based on a model developed by Eccles (1985, as cited in Gardner et al., 1993), who predicted an index of choice to study and use computers by students. Erickson (1987) and Gardner et al. (1993) indicated that an index of value of computers was the best predictor of the index of choice to study and use computers.

Other important and widely used computer attitude surveys included the Bath County Computer Attitudes Survey (BCCAS) developed in 1987; the Attitudes toward Computers (ATC) developed in 1982; and the Young Children's Computer Inventory (YCCI) developed in 1992.

The Bath County Computer Attitudes Survey (BCCAS) developed by Bear, Richards, & Lancaster (1987), @ http://ericae.net/tc2/TC016027 is a 26-item Likert-type scale that measured subjects' attitudes toward computers. The internal reliability of the survey has been estimated as r = .94. The BCCAS scores were predictably related to computer experience and usage, educational and career plans, choice of favorite school subject, and attitudes toward school subjects, and were thus seen to be a valid measure of computer attitudes. This scale has been used to assess the attitudes and anxiety of the students in grades four through twelve toward computers and computer-based instruction (CBI), (Katz et al.).

An earlier attitude scale, Attitudes toward Computers (ATC) by Reece & Gable (1982, as cited in http://ericae.net/tc2/TC018294.htm), is a 10-item Likert-type scale designed for students in grades seven to twelve and in college. The ATC assesses student's eagerness to use computers and the probability that they would select courses that made use of computers.

The Young Children's Computer Inventory (YCCI) by Miyashita & Knezek (1992) @

http://ericae.net/tc2/TC018469.htm is a Likert-type survey instrument designed for use by first grade students. The YCCI consists of four subscales, which included attitudes toward computers, motivation to study, empathy, study habits, and creativity. This scale measured young children's attitudes, motivation and study habits to determine how the introduction of microcomputers into the primary grades would be assessed. Factor analysis was used to affirm construct validity of the factors. The reliability for attitudes toward computers was .75; motivation to study, .66; empathy, .50; study habits, .65; and creativity, .66.

Many other computer attitude scales were found and cited in the Educational Testing Service, ERIC Clearinghouse on Assessment and Evaluation available @ http://ericae.net/tc2. These included the following scales: Beliefs About Computers Scale (Ellsworth & Bowman, 1982) @ http://ericae.net/tc2/TC014568.htm; Personal Computer Survey (PCS), (Festervand, 1994) @ http://ericae.net/tc2/TC019651.tcm; Attitudes Toward Computers Scale (Francis, 1993) @ http://ericae.net/tc2/TC017413; Computer Appreciator-Critic Attitude Scales (Mathews & Wolf, 1983) @ http://ericae.net/tc2/TC012616.htm; Attitudes Toward Writing with the Computer Scale (Shaver, 1990) @ http://eric.net/tc2/TC017505.htm; Career Attitude Scale (CAS), (Stickel & Bonett, 1992) @ http://ericae.net/tc2/TC018908; Attitudes Toward Increased Participation by Women Questionnaire (Storrs, 1973) @ http://ericae.net/tc2/TC013627; Attitudes Toward Computer-Usage Scale (Popovich, 1987) @ http://ericae.net/tc2/TC015780.htm; How Do You Feel About Computers (Todman & File, 1990) @ http://ericae.net/tc2/TC810821.htm; Computer Anxiety Questionnaire (Toris, 1984) @ http://ericae.net/tc2/TC014724.htm; Computer Attitudes Questionnaire (CAQ), (Zoltan & Chapanis, 1982) @ http://ericae.net/tc2TC016030.htm; Computer Orientation Scale (Morris, 1988) @ http://ericae.net/tc2TC016926.htm; Beliefs About Computers Scale (Ellsworth & Bowman, 1982) @ http://ericae.net/tc2/TC014568.htm; and the Computer Attitude Scale (Dambrot, et al., 1985) @ http://ericae.net/tc2/TC016780.htm.

Because of the number and different attitude scales and types of measurements, some authors (Francis, 1993; Kay, 1993; Kinzie & Delcourt, 1991) have expressed concern and dissatisfaction about the lack of adequate measures and theoretical justification to assess student attitudes about computers. This was especially found to be true in the area of computer anxiety.

Computer Anxiety Scales

Francis (1993) argued that the measurement of attitudes was quite a different matter than the measurement of anxiety. Francis believed that since attitudes did not necessarily cause anxiety; a computer attitude survey might not be the appropriate measure for computer anxiety. As computer anxiety has come to be considered technophobia (Brosnan, 1998), a more adequate means to assess this phenomenon has been needed. Researchers and practitioners have also been concerned not only with assessment of computer anxiety, but with treatment programs designed to help individuals in overcoming fear of computers, so that they would be more likely to utilize computers in their education, work, and personal and professional lives.

To deal more adequately with computer anxiety, Rosen & Weil (1990) refined scales that they had developed specifically to measure the level of technophobia an individual may exhibit. The Computer Anxiety Rating Scale (CARS) by Rosen, Sears & Weil (1987) is one of three measures refined by Rosen, Sears & Weil, 1993, and Rosen and Weil (1990, 1995) to measure technophobia. The other two measures are the Computer Thoughts Survey (CTS, Weil et al., 1990) and the General Attitudes toward Computers Scale (GATCS, Rosen & Weil, 1987). All three scales, the CARS, the CTS, and the GATCS contain 20 items each on five-point Likert-like scales. The Rosen, Sears & Weil (1987) CARS is designed to measure a variety of aspects and features of technological anxiety. These include "anxiety about the machines themselves, their role in society, computer programming, computer use, consumer uses of technology, problems with computers and technology and technology in the media" (Rosen & Weil, 1990, p. 9). The CTS is used as part of the set of three instruments to measure the "technophobics' cognitions and feelings about their abilities with technology rather than on their anxieties about computers and technological devices" (Rosen & Weil, 1990, p. 9). The GATCS is used to assess "features and aspects of attitudes toward computers and technology" (Rosen & Weil, 1990, p. 10).

Another scale, the Computer Anxiety Index (CAIN) by Maurer (1983) @ http://ericae.net/tc/TC019543.htm is a 26-item Likert-like scale that measures subjects' anxiety toward computers by examining avoidance of, negative attitudes, anxiety, and computer comfort. Currently, Gos (1996) has used the CAIN to point out the seriousness of the problems caused by computer anxiety.

The Computer Anxiety Rating Scale (CARS) by Heinssen, Glass & Knight (1987) @ http://ericae.net/tc2/TC018171.htm is another popular computer anxiety rating scale, as evidenced by the large number of citations it has in the literature. Heinssen's et al. CARS is a self-report inventory designed to assess individuals' levels of computer anxiety. The 19-item questionnaire is based on a five-point, Likert-type scale, and individuals respond to items covering technical capability, appeal of learning about and using computers, being controlled by computers, learning computer skills, and traits to overcome anxiety. This instrument has been found reliable and valid. The CARS may also be used to identify individuals who would benefit from counseling to overcome their anxiety of using computers (http://ericae.net). The CARS also includes information on the relationship between computer anxiety and math and test anxiety, the amount of computer experience, cognitive styles, mechanical interests, and SAT scores.

Another scale, the Computer Aversion Scale (CAVS) by Meier (1988) @ http://ericae.net/tc2/TC016925.htm is a 31-item, true-false scale producing four scores: (a) efficacy expectations for computers; (b) outcome expectations for computers; (c) reinforcement expectations for computers; and (d) total score of the cumulative effects of reinforcement, outcome, and efficacy expectations for computers. The scale was developed for use with mental health clients, high school age, and older and mental health workers. Concurrent validity was assessed by administering the Attitudes toward Computers Scale (ATCS, Rosen et al., 1987). A Pearson product-moment correlation calculated for the two scale's total scores was significant ($r = -.53$, $p < .001$) indicating that higher computer aversion was associated with more negative attitudes toward computers. The reliability studies yielded alpha coefficients of .89 for Total Score, .80 for Efficacy Expectations for Computers and .74 for Reinforcement Expectations for Computers. This scale, however, was limited to use by mental health professionals because of the number (five) of questions that applied only to that population.

Other computer anxiety scales were found in the Educational Testing Service ERIC Clearinghouse on Assessment and Evaluation. These included the Computer Orientation Scale (Morris, 1988 @ http://ericae.net/tc2/TC00.htm16926.htm); the Computer Anxiety and Computer Attitudes (Kernan & Howard, 1990 @ http://ericae.net/tc2/TC017280.htm); the Computer Anxiety Scale-Revised (Bandalos & Benson 1990 @ http://ericae.net/tc2/TC017413.htm); and the Competitive State Anxiety Inventory – 2 (Martens et al, 1990 @ http://ericae.net/tc2TC017151.htm).

Several attitude and anxiety scales involving mathematics, science, career beliefs and self-reports were also found in the literature. These scales were very similar to the computer attitude and anxiety scales, which measured some of the same variables. These included the Mathematics Anxiety Rating Scale, Abbreviated Version (Alexander & Martray, 1989 @

http://ericae.net/tc2/TC0181872.htm); the Mathematics Anxiety Scale (Betz, 1978 @ http://ericae.net/tc2/TC018842.htm); the Self Report Inventory (Brown, 1958 @ http://ericae.net/tc2/TC017932.htm); the Indiana Mathematical Belief Scales (Koosterman & Stage, 1992 @ http://ericae.net/tc2/TC018610.htm); the Career Beliefs Inventory (Krumboltz, 1991 @ http://ericae.net/tc2TC017880.htm); the Mathematics Anxiety Scale for Children (Lian-Hwang & Henry, 1990 @ http://ericae.net/tc2TC018154.htm); the Students' Beliefs about Mathematics (Sprangler, 1992 @ http://ericae.net/tc2/TC018850); the Attitudes Toward Statistics (Wise, 1985 @ http://ericae.net/tc2/TC014284.htm); the Desire for Control on Examinations Scale (DCE), (Wise, 1996 @ http://ericae.net/tc2/TC014284.htm); and the Science Anxiety Questionnaire – Revised (Roth & Roychoudhury, 1991 @ http://ericae.net/tc2/TC019511.htm).

With the number of different scales available, choosing a computer attitude or computer anxiety scale would depend upon the population that was the focus of the study, the reason or purpose of the study, and the resources available. No one scale would be a match for all researchers and all problems. With careful research and monitoring, the users of the scale should be able to gain valuable information to meet their research needs from several of these scales.

Kay (1990) reported that researchers had assessed more than 15 different constructs related to attitudes toward computers over the last 10 years, but since these studies did not have a theoretical justification, there was a need for clearer explanations. Kay suggested that these clearer explanations should come from self-efficacy, attitudes, and desirability for learning computing (Zhang & Espinoza, 1998).

Computer Self-Efficacy Measures

Computer self-efficacy can be directly related to Bandura's theoretical concepts about social learning theory and his (1982) definition of self-efficacy. For Bandura self-efficacy “centers on people’s sense of personal efficacy to produce and to regulate events in their lives” (p. 122). This being the case, Zhang and Espinoza (1998) related that “positive self-efficacy may encourage learning new skills, whereas negative self-efficacy may create resistance in operative capabilities” (p. 421).

In their recent study, Zhang and Espinoza (1998) found that computer comfort/anxiety was a significant predictor of computer self-efficacy in general. Computer self-efficacy tended to increase as the score of comfort about computers increased and was a predictor of students’ confidence levels about computers. The study also found that computer self-efficacy was a significant predictor of desirability of learning computing skills. The findings in this study confirmed that students’ attitudes toward computers effected their confidence levels about computers. The authors suggested that further study with the use of a demographic characteristic such as gender, grade level, or experience, as an independent variable was needed.

Several computer self-efficacy measures were found in the literature, but there did not seem to be one computer self-efficacy scale that was cited more than the others. Researchers used many different measures to measure this construct, such as the study by Dawes (1998), which found that targeting students in the seventh and eighth grades, who had the greatest differences between self-efficacy and performance, would provide for positive feelings about technical and scientific careers. Only Delcourt and Kinzie (1993) used a specific self-efficacy measure, which consisted of 19-item Likert-like scale.

Other self-efficacy studies included Ertmer et al., (1994); Hill et al., (1987); Kinzie et al., (1994), and Miura (1987), which all again indicated that computer self-efficacy tended to have an inverse relationship with computer anxiety; as self-efficacy increases, computer anxiety tends to decrease (Henderson, Dean & Ward, 1995; Martocchio, 1992, 1994). In a study by Henderson et al., 1995, computer self-efficacy was found to be the most important variable in predicting computer anxiety.

In a similar manner, Martocchio (1994) investigated the effects of computer training when it was presented as an acquirable skill condition, one in which subjects could develop necessary skills, versus a fixed entity condition, or one in which subjects should already possess necessary skills. Computer self-efficacy was measured using a modified version of a scale developed by Hollenbeck and Brief (as cited in Martocchio, 1994). Computer anxiety was measured using the Computer Anxiety Rating Scale (Heinssen et al., 1987). The result was that those subjects in the acquirable skill condition produced higher computer self-efficacy and lower computer anxiety after training, while those subjects in the entity condition experienced a decrease in computer self-efficacy and no change in computer anxiety. Results were attributed to the fact that acquirable skills conditions were viewed as an opportunity rather than a threat, and therefore, ability beliefs strengthened and anxiety diminished.

Two years earlier, Martocchio (1992) found that higher computer efficacy correlated well with lower computer anxiety (r = - .65). In Part I of Martocchio's study, a sample of subjects was asked on a questionnaire to describe events, which they perceived as an opportunity, a threat, or neutral from the recent microcomputer training they had received. The information for Part One was then used in Part Two of the study to actually implement two conditions of training in which it would be perceived as either an opportunity or as being neutral. The trainer presented the course with characteristics associated with opportunity or neutrality, as determined from Part One of the study. For example, "the class will enhance your job opportunities (opportunity) versus "you will learn the basics about hardware" (neutral). A separate sample of subjects was used for Part Two. Again, computer self-efficacy was measured using a modified version of a scale developed by Hollenbeck and Brief (as cited in Martocchio), and computer anxiety was measured using the Computer Anxiety Rating Scale (Heinssen et al., 1987). The results of this study indicated that when computer training was presented as an opportunity, computer efficacy tended to increase and computer anxiety levels tended to decrease.

In this study, Martocchio (1992) examined occupational differences on several psychological constructs associated with management of information systems' success. The psychological constructs included computer anxiety, computer attitudes, and computer self-efficacy. According to Loyd and Gressard (1984), these constructs were measured using the Computer Attitudes Scale (as cited in Henderson, Dean & Ward, 1995) which included subscales for anxiety, liking, and confidence with computers. Subjects included nursing and clerical/administrative staff. It was found that the nursing staff exhibited significantly lower computer self-efficacy, higher computer anxiety, and more negative attitudes towards computers than the clerical/administrative staff. The reasons for these differences were unclear, but it was suggested that the level and quality of computer experience might have interacted with the psychological variables. A stepwise multiple regression revealed that computer self-efficacy accounted for the majority of the variance in computer anxiety ($r^2 = .72$). The authors also suggested that computer self-efficacy workshops be provided in order to reduce computer anxiety and negative attitudes.

With so many scales for computer attitudes, computer anxiety and a few for computer self-efficacy along with other scales and refinements of scales for computer anxiety (Bandalos & Benson, 1990; Miller & Rainer, 1995; Rosen et al., 1993) researchers have had a wide variety of scales from which to choose. Some scales seemed to be more empirically researched than other scales were, and this factor should be an important part of the decision-making process. Finally, the theoretical assumptions behind the scale or measure should also be clear and suit researchers' purposes.

Computer Experience

Prior experience with computers was among the more influential variables in predicting computer anxiety. Computer experience was generally defined as a person's competence with computers achieved through previous office or occupational use, home use, or formalized training (Henderson, Dean & Ward, 1995; Igbaria & Chakrabarti, 1990; McInerney et al., 1994). Numerous studies have investigated the relationship between computer experience and computer anxiety; the majority of which contended that increased computer experience was related to lower computer anxiety (Crable et al., 1994; Farina, Sorbual & Carnes 1991; Henderson, Deane & Ward, 1995; Igbaria & Chakrabarti, 1990; Kinzie & Delcourt, 1991; Massoud, 1991; McInerney et al., 1994; Pogatshnik, 1983; Siann et al., 1990; Todman & Monaghan (1994); Woodrow, 1990.)

A literature review by Mauer (1994) revealed that the majority of research on computer anxiety indicated that prior experience tended to lower anxiety levels, with a few exceptions. However, Mauer recognized that prior experience alone could not adequately explain computer anxiety. This was also the case in a study by McInerney et al. (1994), which found that experience did decrease computer anxiety levels, but could not account for remaining levels of computer anxiety in some subjects. These authors concluded that, because anxiety remained in some subjects after receiving training, other variables might be interacting with the training. Some of these variables were hypothesized to be computer attitudes, self-efficacy, and success expectations (McInerney et al.).

Similarly, Igbaria and Chakrabarti (1990) found that computer training decreased computer anxiety and had an indirect positive effect on attitudes towards computers. They suggested that training programs might increase favorable attitudes towards computers due to increased understanding and increased self-efficacy. In addition, as mentioned previously, Henderson et al. (1995) suggested that experience might be interacting with other psychological variables. The research clearly emphasized the importance of prior computer experience, as it related to computer anxiety, but suggested that this variable might be acting in conjunction with other variables.

Several important studies used computer experience and knowledge as a major variable. Massoud (1991) reported a positive relationship between computer knowledge and attitudes toward computers, which was statistically significant. Siann et al. (1990) indicated that when primary school students had even minimal experience using the computer their attitudes toward computers were not as gender dependent. Woodrow (1990) experienced similar findings, which also indicated that computer experience reduces gender differences in attitudes toward computers.

Concerning computer experience and unemployment, a study conducted by Motorola, Inc. (1996) indicated that people in full-time work were more than twice as likely to be regular personal computer users than are those who were not working. The study also noted that employed workers were much more likely to further their personal computer skills by obtaining additional training outside of work. The purpose of this study was to demonstrate the importance of information technology to being employed. Motorola stressed that being out of work was crucial to individuals' ability to maintain contact with information technology, such as personal computers. The results of this study suggested that computer experience was much higher and advanced among employed workers than among the unemployed. Therefore, it would appear that computer experience was important to both computer anxiety and unemployment.

Dyck and Smither (1994); Henderson, Dean, Barrelle, and Mehar (1995); Henderson et al. (1990); Martocchio (1992, 1994); McInerney et al. (1994); Todman & Monaghan (1994); and Torkzadeh & Angulo (1992) indicated that self-efficacy and experience with computers had a strong negative relationship with computer anxiety. Other researchers also indicated that prior computer experience played an important role in predicting computer anxiety, but argued that experience alone could not sufficiently explain the phenomenon (Igbaria & Chakrabarti, 1990; Maurer, 1994; McInerney et al., 1994). Computer experience may interact with other variables, such as self-efficacy, in influencing computer anxiety (Henderson et al., 1995). Hill et al, (1987) found that computer experience and computer efficacy beliefs were significantly related.

Finally, researchers have indicated that computer experience and computer anxieties were highly related. Previous researchers have shown a connection between a subject's increased use of a computer and subsequent reduction in computer anxiety (see Jordan & Stroup, 1982).

A number of studies found computer experience had been a significant variable. Connell (1991) found that the variables that predicted attitudes toward computers for middle school students were computer literacy or computer experience. Other studies, which studied computer experiences were: Asserman and Reed (1995); Bear et al. (1987); Bowers and Bowers (1996); Chu (1990); Chu and Spires (1991); Colley, Gale, & Harris (1994); Connell (1991); Devlin (1991); Garrett and Bullock (1997); Gos (1996); Grogan (1991); Halpern (1995); Harris (1989); Hick (1999); Jay (1985); Lewin and Barry (1995); Liu (1998); Meier (1988); Miller and Varna (1994); Miyashita (1991); Necessary and Parrish (1996); O'Lander (1994); Parish and Necessary (1996); Pope-Davis (1989); Sariya (1991); Toppin (1998); and Yin (1989). These studies found that computer experiences were important to individuals' interest in, acceptance of, and use of computers.

The quality of the experience was also an important variable. Igbaria & Chakrabarti (1990) found that computer anxiety and attitudes towards microcomputers were dependent on the quality of the computer-based information system and training. Gos (1996) also found that it was the quality of the computer experience, which made the difference in attitudes and anxiety toward computers. Since 8% of the subjects in the CAIN sample had significant computer anxiety, Gos found that 94.5% of these subjects had previous computer experience. Therefore, it seemed as though computer experience had not been the variable that made the difference, but that the quality of the experience actually had made the difference.

Gender

Gilligan (1982) convinced many readers and researchers that women perceived and construed social reality differently than men did. Women tended to seek relationships, learning environments, and careers that provided them with connections to others. It was in these relationships with others that women often found their social realities. This difference was often expressed in terms of men and women's different reactions to difficult situations. An example of this was found in the Heinz dilemma (Gilligan, Lyons & Hanmer, 1989) concerning a husband whose wife needed an expensive special medicine, which only the druggist had, to cure her deadly disease, and how the husband and wife reacted differently to this life threatening situation. The wife's choice of action was to talk to or connect with the druggist, so that he would understand the situation and give her the medicine. The husband, however, had a different view, and decided that he would take action and steal the drug, because for him saving a life was more important than anything else was, and so was the more moral thing to do.

This dilemma focused on how boys and men process and make decisions based on 'rights' and 'fairness', and how girls and women tended to focus on 'response' (Gilligan et al., 1989, pp. 289-290). Because of these differences, Gilligan et al. found that men were far more likely to fear intimacy and women to fear isolation. The authors in the Emma Willard School study demonstrated that these differences have played a crucial part in the education of women. Most teachers have favored the logical male-orientated 'rights' and 'fairness' method, especially in math and science classes where they presented material by rules and examples. Thus, the 'response' mode has not been honored and girls have had to silence their relational world-view in order to succeed. This dilemma also helped to explain why girls did not want to be the only girl of few girls in classes traditionally dominated by males. What Gilligan et al. and her colleagues found at Emma Willard was that when teachers heard the stories that the adolescent girls told, they were able to change their teaching styles to more cooperative learning, students teaching other students, and collaborative teaching and learning. The use of these new methods reduced the tension and made the learning experiences more meaningful for the adolescent girls. Even on the playing fields and in sports competitions the young women were able to choose to compete with rather than against opponents, as men tended to do.

Women's Attitudes

Gilligan (1982) proposed that women's developmental histories were different from those of men. The societal and political atmosphere could not be separated from women's ego development and neither could an individual's experiences, cognitive developmental understanding of those experiences, as well as the interplay of behaviors at each developmental stage (Attkins & Hackett, 1995).

After the 1960s and the woman's movement, identity for women could be based on feminist theory and the impact of the social condition women shared. For women sexism played a large role in their reality and affected their career and occupational choices. Stereotyping, sex bias, and sexual harassment were all factors that influenced women's attitudes and perceptions about professions. This sexual bias has persisted as evidenced recently by five female faculty members who have indicated that they will leave Florida State University's law school. Four of these women charged that a group of elitist male professors had belittled women's scholarship and views. These women said that they were leaving the school because of a toxic atmosphere at the law school for women ("Toxic Atmosphere," 1999)

Education and Gender

During the first part of this century, college was thought to be the exclusive training ground for men. Later, if women attended college, it was often to get their "Mrs." degree or to act as a finishing school for them as they prepared for marriage. When women did attend college, they usually majored in the liberal arts, teaching, and nursing. This situation has changed and now women attend college at record rates and receive more undergraduate and graduate degrees than men do ("Women earn," 1999).

In colleges and in the workforce audiences have been more attentive when men spoke; men's accomplishments have been valued over women's; and men have been more likely to get more attention, praise, criticism, and feedback than women (AAUW, 1992). Roger et al. (1999) suggested that more connectedness between academic disciplines in school and the students in the school be instituted. More connectedness has also been needed among other academic disciplines, as has been more person-centered teaching and learning. This approach used women's experience as a resource and provided women with a connection to practical applications in all courses and activities (Roger et al., 1999).

Another factor, according to Roger et al. (1999), which has been present in science and technology, was that the professors have been approximately 90% white males. These males have fostered male-centered teaching methods that included a hard, competitive, and relatively non-supportive climate, which were used to weed out unsuitable students (Roger et al.).

Intelligence and Women

In terms of women's perceptions about themselves and their abilities, females have tended to underestimate their intelligence. According to Hogan (1978), in the United States more females than males underestimated their own IQ scores, despite the empirical evidence that this has not been proven. Hogan also found that females attributed higher IQ scores to other people and to their fathers than they attributed to themselves. Hamid and Lok (1995) found that similar circumstances occurred with Chinese women in Hong Kong, where women constituted a significant part of the workforce. In this study, both males and females also attributed higher intelligence scores to their fathers than to their mothers. Interestingly, when education was factored into the equation, education had no effect on the participant's estimates of their father's intelligence. Both genders estimated high intelligence for their fathers, even if the father had little or no schooling. However, education did have an effect on estimates of mother's intelligence. The higher the level of education of the mother, the higher the participant rated the mother's intelligence. Hamid and Lok emphasized that these examples of gender-stereotype effects and differential gender-based judgments of intelligence were likely to have an impact on both the education and careers of women. The results of earlier studies in the United States clearly refuted the belief that women were less intelligent than men are (Jacklin, 1989; Kimball, 1989; Linn & Hyde, 1989; Lummis & Stevenson, 1990 (as cited in Hamid and Lok). However, this lower estimation of IQ by women has seemed to persist.

Another factor that has limited women's career opportunities has been the lack of information about procedures, rules, and policies in male dominated fields, and this lack of information has tended to marginalize women. Similarly, women's tendency toward a more cooperative style and not taking credit for their accomplishments reduced and reinforced the belief that women possessed less scientific and technical talent (Petersen, Gaddy & Fox, 1996).

Even some counseling and career guidance programs have tended to limit young women's career options. Gefen and Straug (1997) indicated that this has been due to gender stereotyping and perceptions that these young women were not capable or interested in more male orientated subjects such as computer science and information technology. Freeman and Aspray (1999) were also concerned about the counselors' lack of understanding concerning the types of careers available to young women in technology fields.

Women's Career Choices

Since relationships and connections have been so vital to women, this need has often been evidenced in the kind of work women have chosen to do. Atkinson and Hackett (1995) found that when women worked outside of the home they were "overwhelmingly overrepresented in the lower-level or 'traditionally female occupations', in which the job duties and tasks parallel the helping, nurturing, and service aspects of the traditional female sex role" (p. 243). More women have been in the service industries, where they were able to serve and relate to others. Specifically in the field of computer and information technology, there have been more women in computer sales and human relations than in computer programming and engineering (Freeman & Aspray, 1999).

In a history of the philosophy of western science, Lloyd (1984, as cited in Roger et al., 1999) found that women have been systematically excluded from scientific fields and knowledge. Women were considered irrational and not suited to the “hard” sciences. Feminist empiricism considered this an example of “bad science,” but other women’s advocates have said that this has been the result of negative attitudes toward women. Roger et al. (1999) stated that generally women have been devalued through such practices as the use of family names for women in research, having their work ignored, and being referred to only as the wife of a particular man.

Gender Differences in Interest and Academic Subjects

Historically, young women and men have appeared to have different interests and preferences for school subjects as Hansen and Campbell (1985) noted. The AAUW’s (AAUW, 1992) study, which found that young women around middle school level stopped doing well in and liking math and science classes, noted these gender differences. This study punctuated the tendency of teachers to value males’ performance over females’ performance, to ask boys more analytical questions, and not to intervene when boys dominated in hands-on projects and computer experiences.

Because of the AAUW study (1992), schools have launched programs to try to correct the problem of inequity. Further, schools have looked at cooperative learning and other methods of instruction that were more female-friendly. Because of this movement, more young women now have been taking math and science classes. Some schools have even initiated single-sex math and science classes to help young women feel more comfortable and successful in these subjects.

Many studies have focused on gender as a factor in school and in careers. In a study by Franklin (1997) learning outcomes and the influence of faculty and student peers were studied. Similarly, Deege (1996) studied the type of work, wages and desirable working conditions of females who choose nontraditional vocational-technical occupations. Other studies involved recruitment and retention of females in training institutions and schools (Spear, 1993), high performing female students (Bateman, 1990), computer anxiety and young women (Pope-Davis, 1989) and internal barriers (Young, 1985). How women experienced their technical professions was the subject of a study which found contradictions between the "scholarly literature and how women actually feel" (Condron, 1997).

In the field of IT, young women have traditionally tended to take basic keyboarding and other business-orientated classes (Harrington, 1990). Not many young women have chosen or have been interested in the more advanced computer science and programming courses, and in Virginia female enrollment was 5% or less in 15 different technology education courses in 1994-95, according to Flowers (1998). Since computer science and programming courses tend to be focused on the individual and the computer, young women may see these classes as isolating and more male-orientated, as well as not valuing relationships and cooperation (Gilligan, 1982).

The AAUW (1992) study, considered the differences in what girls and boys liked to do in classrooms and found that girls tended to be more social and wanted to do things in math that related to the real world. The concern has been that because of their styles of learning girls were not having equal access and given equal chances to succeed. This preference for learning has continued into high school, where young women also liked working together with other young men and women in a group situation and helping each other.

Feminist Movement

It was not until the feminists began to support and counsel women that changes began to happen for women in education and the workforce (Issacson & Brown, 1995). Women's studies in higher education, the elimination of gender stereotyping in textbooks, and the increase of women in the workforce all had a positive effect on women's access to employment in the 60's and 70s. Title IX was to be the landmark legislation for women following the Women's Educational Equity Act of 1974 allocating funds for women's counseling. Title IX of the Educational Amendments Act of 1972 was to eliminate sexual discrimination in college admissions, financial aid, physical facilities, curricula, sports, counseling, and employment in educational institutions receiving Federal funds. This was an important legislative act for women, but was not always effective, because it was not enforced and was often limited by court decisions. Currently, however, this legislation has come to mean something, and women are seeing major changes in opportunities on college campuses and in sports (Issacson & Brown).

Title VI and Title IX

Healy (1999) summarized the draft guidelines that the U.S. Education Department's Office for Civil Rights has been circulating among college officials. The guide stated that "the use of any educational test which has a significant disparate impact on members of any particular race, national origin, or sex is discriminatory, and a violation of Title VI and/or Title IX, respectively, unless it is educationally necessary and there is no practicable alternative form of assessment which meets the educational institution's needs and would have less of a disparate impact" (http://chronicle.com/daily). Because schools have been recipients of federal funds and must be aware of potential discrimination issues, this was an important guideline for women, due to females' historically lower Scholastic Aptitude Test (SAT) scores (College Board, 1999).

Scholastic Aptitude Test Scores

The recent change that the College Board made in the Preliminary Scholastic Aptitude Test (PSAT), was another example of advances that have been made in equalizing access for women. According to "More females," 1999 this year about 350 more female students will be awarded National Merit Scholarships than in previous years, due to this change. Because writing has been an area where females tended to score higher than males, a section containing knowledge of grammar, syntax, and spelling was added to the PSAT. This was done to make up for the difference in the higher scores males received on both the math and verbal sections of the test. Before this new addition, males scored higher on the PSAT and thus qualified for more National Merit Scholarships, which have been based on the PSAT Selection Index (Verbal Score + Math Score + Writing Score). Women's groups accused Educational Testing Service of favoring male's abilities as opposed to females ("More females," 1999). Even with this change in the PSAT makeup, the difference between males and females on the SAT was still significant. The 1999 SAT National Average Score for males was 1040 and for females was 997. The Verbal Score for males was 509 and 502 for females, while the Math Score was 531 for males and 495 for females (College Board, 1999). The much lower math score for females may have pointed to the different attitudes of males and females about math and the unequal number of math and science courses taken by males and females.

High School Courses

Because of the lack of up-to-date and appropriate equipment in the high schools, women were not able to gain much early experience with technology, according to Freeman and Aspray (1999). They believed that this lack of experience has been a major factor in the smaller number of young women going into IT preparation programs and fields of work. There are many other factors and situations in high schools that may also act as barriers for women in these fields.

While test scores may have caused discrimination against females, the courses that young women have taken in high school may also be a discriminating factor. Gose (1999) proclaimed that the rigor of high school course work was the best predictor of college graduation. Those students who took rigorous courses including 4 years of English, mathematics beyond Algebra II, 2 years of laboratory science and of a foreign language, and no remedial classes, ended up in the highest quintile of the graduating class. These rigorous classes were called "academic intensity" and predicted a third more likely than either test scores or class rank whether a student would go on to graduate from college. Thus, young women who did not take a full credit load had lower-than-average graduation rates. Students who gave birth before age 22 also had lower-than-average graduation rates. On the other hand, students who took calculus and other demanding math courses during high school graduated from college at very high rates (Gose).

Since there has been a history of women taking fewer math and science classes than men (AAUW, 1992), another form of gender bias has effected young women's pathways to college graduation and eventual careers. While changes are being made daily in some of these areas, schools and society along with legislation have often failed to support women with any consistent stance.

<u>Other Legislation</u>

While much legislation has certainly helped women, Vace et al. (1995) chronicled the end of some positive legislation for women, when the Comprehensive Education Training Act (CETA) was cut off by the Reagan administration in the early 1980s. This program was to help women get the necessary education and training needed to become economically self-sufficient. Another blow to women came when the Equal Rights Amendment failed to be ratified in the early 1980s and put women again in a position of unequal access, training and pay. Because of the lack of enforcement of these laws, gender equality has not been a reality in the workforce (Vace et al.).

Women Preparing for IT Study and Careers

No place has inequality been more evident than in the field of IT. The numbers of women who pursue careers in computer science and computer programming were lower than the numbers for men (Brosnan, 1998; Freeman & Aspray, 1999; Melmead, 1996). The shortage of jobs in IT would be solved if an equal number of women sought careers in this field (Freeman & Aspray, 1999). The authors indicate that the current ratio has been one woman to every three men who were employed in the field. Gender bias and sex stereotyping in the computer field has been apparent since the beginning of the computer revolution. No scientists, mathematicians, statisticians, or inventors in the field were women. Actually, no women were mentioned when the history of computers was chronicled. A male-select group seemed to dominate the field. Not all was bleak, however, because there were some positive notes and changes happening in IT.

Women have been entering some programs, such as information systems programs, in greater percentages than in computer science and computer engineering programs. Information systems has been perceived as more people-oriented and having to do more with using the computer as a tool, which often has been appealing to women. Computer science and computer programming tended to be more focused on the technology itself (http://www.ne-dev.com/ned-0101998/ned-01-enterprise.t.html). Vehvilainen (1997) summed up the relationship of gender to technology when she drew the analogy that gender intertwined with information technology through social practices, and often these social practices have excluded women.

Women and Higher Education

Since 1984, the percentage of women entering the computer science pipeline and earning bachelor's degrees in IT fields has been decreasing steadily (Freeman & Aspray, 1999). Generally, the number of computer and information science degrees awarded has decreased every year between 1986 and 1994, and for women this decrease has been occurring at a faster rate. This rate has decreased although the percentage of bachelor's degree recipients who were women increased from 50.8 % to 54.6%, according to Freeman & Aspray (1999). With fewer bachelors' degrees in computer and information science, there were fewer women in the master's degree programs for computer and information sciences area.

It has been however, difficult to tell the exact toll this has taken on women in the field, because as of this date, there has been no reliable data on the number of women in the IT workforce, according to Freeman & Aspray (1999). The authors indicated that this data might not be reliable because of a number of variables. Some of these variables included: (a) The domain of workers studied has been too narrow; (b) There have been methodological problems with gathering and analysis of the data; (c) The data was too old to be useful; (d) Worker categories did not reflect the current state of IT work; (e) The occupational categories for computer programmers were too broad; and (f) Data collection was sometimes inadequate (Freeman & Aspray, pp. 124-125).

Surprisingly, this decline in the number of women studying in the field of computer and information technology is in direct contrast to the pattern of the late 1970s and the early 1980s when women were actively recruited into the field (Freeman & Aspray, 1999). There has been concern in the field over this disparity, and Carnegie Melon University has been doing a conducting a survey on "Women in Computer Science: Closing the Gender Gap in Higher

Education" (http://www.cs.cmu.edu/~gendergap), to find some solutions to deal with this troubling situation.

Lack of Women in IT

Freeman and Aspray (1999) summarized several factors that were pertinent to the lack of women in the field of computer and information technology:

> (1) A perceived image of IT work as being carried out in an environment in which one has to deal regularly with more competition than collaboration; (2) differences in socialization between men and women about whether they are performing well academically, which may encourage men and discourage women from the study of information technology in college—even when the male and female students are performing equally well academically; (3) a perception of computing as a solitary occupation, not well integrated into social discourse or social institutions; (4) a perception that software jobs are not family-friendly (long hours, lack of awareness of the opportunities for telecommuting and other flexible schedules); (5) the large percentage of foreign-born teaching assistants and faculty, some of whom have cultural values that are perceived as not being supportive of women being educated or joining the work force; and (6) concerns about safety and security felt by women and their friends and families about women working alone at night and on weekends in computer laboratories (p. 113-114).

Women's Experiences with Computers

It has been important to look at how females in school and other environments have related to computers. Hanor (1998) described how girls saw computers as tools or enabling devices and of a secondary interest, because the communications and the sense of being with another person were important to girls, rather than the computer itself. Sadly, Hanor presented girls' experiences with computers that have not always been positive. The author gave the following as examples: (1) Girls have reported being belittled at the computer by male classmates; (2) Girls liked to add lots of detail when working with the computer and felt as though they received less credit than boys did because of this; (3) Girls saw teacher expectations set higher for them than for boys; (4) Girls had less accessibility to computers than boys because of boys' verbal and physical aggressiveness which discouraged girl's participation; (5) Often girls did not know that the option to work on the computer was available; (6) Girls experienced conflicts in scheduling computer time as well as competing work requirements; (7) Boys were often selected as noontime aides for computers over girls; and (8) Girls did not feel empowered when it came to use of the computer.

Factors That Relate to Computer Attitudes

In the literature search for factors that related to computer attitudes, anxiety and avoidance, gender was the number one variable studied. There were over 75 individual dissertations, articles, and books that dealt with the effects of gender on computer use, attitudes, and anxiety. The majority of these (Ayersman & Reed, 1995-96; Bear et al., 1987; Bem, 1974; Bernhard, 1990; Brosnan, 1998; Chu, 1996; Colley et al., 1994; Collis, 1985; Connell, 1991; Dambrot, Watkins-Malek, Silling, Marshall, & Garner. 1985; Devlin, 1991; Garrett & Bullock, 1997; Grogan, 1991; Hanor, 1998; Harrington, 1990; Harris, 1989; Hawkins, 1985; Hess & Muria, 1985; Hick, 1999; Jay, 1981, 1985; Lewin & Barry, 1995; Linn, 1985; Loyd & Gressard, 1984, 1985; Massoud, 1991; McHaney, 1998; Meier, 1988; Miura, 1987; Morahan-Martin et al., 1992; Mouzes, 1995; Nickle & Pinto, 1987; O'Lander, 1994; Parrish & Necessary, 1996;

Persichette, 1993; Pope-Davis, 1989: Rosen et al., 1987; Russman, 1997; Shashaani, 1993; Shawareb, 1993; Siann et al., 1990; Silver-Miller, 1992; Smith, 1986; Spear, 1993; Swadener & Hannafin, 1987; Swadener & Jarrett, 1986; Toppin, 1998; Turkle, 1988; Vehvilainen, 1997; and only a few studies (Bowers & Bowers, 1996; Chen, 1986; Francis, 1993; Kinzie & Delcourt, 1991; Pope-Davis, 1989) indicated that there were no statistically significant differences in gender and attitudes. Some of the articles, however, found that gender correlated with less computer use and negative attitudes toward computers.

In other studies gender differences were closely related to computer experience. Shashaani (1993) reported that since boys seemed to have more computer experience, this variable also accounted for some amount of gender difference (Colley et al., 1994; Crable, Brodzunske, & Scherer, 1994; McInerney & McInerney, 1994; 1998; Wallus & Necessary 1996). Shashaani also reported that there were "significant gender-differences favoring boys in computer experience, computer class participation, amount of computer usage, and computer ownership" (p. 359). Shashanni's study also confirmed findings that students, in general, tended to have a greater expectation for males' computing performance.

In the area of gender differences and attitudes toward computers, Siann et al. (1990) found that these gender-related differences in attitudes toward computers by primary school students were reduced following some computer experience. Woodrow (1990) also found this to be the case and argued that when the computer experience was obtained in a controlled setting, gender differences were virtually non-existent. Massoud (1991) reported that concerning computer attitudes "males have more positive attitudes than females toward computers" (p. 274).

In a study with preschoolers learning Logo, Bernhard (1990) found that girls were considered disadvantaged in computer use. Boys in this study had more gender stereotypic attitudes toward computer-related objects and activities. Boys also completed more Logo tasks than girls did. Connell (1991) found that the in the list of determinants of attitudes toward computers in middle school analytical skills, sequential processing, and learning styles followed computer experience as the most important variables. Analytical skills and sequential processing were skills in which males usually tend to excel (Brosnan, 1998). Computer anxiety was also far more attributable to women than to men, and more women then men were considered to be "technophobic" (Brosnan, 1998), (p. 274).

Devlin (1991) discussed sex differences in computer programs and applications and found that men prefer computer programming and women prefer computer applications. He also found that male programmers had more positive attitudes than female programmers did, and female programmers were able to balance successfully both feminine and masculine characteristics.

Gottleber (1992) studied the relationship between computer attitude and the understanding of ethical issues and computers, finding that women had more ethical knowledge than men had. Conversely, Halpern (1995) found that male psychotherapists and counselors had more positive computer attitudes and experience than female psychotherapists and counselors. A difference was especially noted in male therapists who held cognitive behavioral beliefs.

Males were favored in computer use in a number of studies. Bowers & Bowers (1996) replicated the study of Vredenberg, Fleet, Kranes & Planter (1984, as cited in Bowers & Bowers), who asked a group of young students if a computer was a person would it be male or female. In this study three quarters of both males and females said that computers would be male. Beck (1987) studied the psychological dimensions related to computer work and found that the most positive and successful users showed a preference for and competence in masculine tasks. Chu (1990) found that males had more positive attitudes toward computers and those who use computers in technology programs than females had. The author found that males had higher computer skills, more computer experience, and participated in more computer classes than females. . Education majors, on the other hand, had more computer anxiety and less positive attitudes, confidence and liking of computers. Finally, Kidd (1992) found those students in grades 11 and 12 who had Investigative interests on the Holland scale correlated with technology majors. Social interests correlated with teaching and welfare work. This stereotyping of male and female roles in IT was strongly reinforced in the literature.

Parental Influences and Socioeconomic Level

Parental Influences

Parental influence on children's attitudes, beliefs, and actions was mentioned in the literature (Bateman, 1990; Choono, 1995; Colley, Gale & Harris, 1994; Delos Santos, 1982; Grogan, 1991; Gustafson & Magnusson, 1991; McHaney, 1998; O'Lander, 1994; Silver-Miller, 1992). These studies, however, were not consistent in their findings about the influence of parents; all did seem to agree however, that parental influence was a variable that might be connected with computer attitudes and beliefs.

Despite the limited number of articles and research on parents in the literature, the role of parents in young women's computer attitudes, anxiety, and self-efficacy has been significant. Family background, values, and goals have related to girls' ability and school adaptation in early adolescence (Gustafson & Magnusson, 1991). Choono (1995) studied the intent to persist factors among Puerto Rican, African-American, Cuban American, and International Latino students. He found that Puerto Rican students seemed more likely to persist at tasks and especially computer tasks. African-American students also seemed likely to persist due to their parents' influence and residential status.

Fathers, especially seemed to have a significant influence on women and technology and how these women felt about computers (Silver-Miller, 1992). Delos Santos (1982) also found that the father's use of computers influenced the children's involvement with home computer activities such as programming, education, and entertainment. Encouragement in the home and whether or not young women were exposed to their parents using computers also seemed to have an influence on their perceptions of information processing and computer use (McHaney, 1998).

Shashaani (1993) stressed the parents' importance in the development of positive attitudes toward computers. The author reported that the findings of his study "revealed that there are statistically significant relationships between the perceived attitudes of significant others and students' attitudes toward computers" (p. 177). Shashaani also found that feelings of low self-confidence in female students were directly related to perceived beliefs that fathers thought the computer "more appropriate for males than females" (p. 178).

The influence of mothers did not appear to be as important as the influence of fathers. Choono (1995) found that the mother's educational level effected Puerto-Rican students' success levels. Bateman (1990) also noted the influence of mothers in a study that investigated the differences between career aspirations of high performing science students in Northern Ontario. In this study, regardless of gender and language, the main variables that determined whether a high school student would aspire to a science or non-science career were the orientation to science variables. Females who chose science careers received more career support from their mothers, and they had mothers who had attained higher levels of education than males with science career aspirations and females with non-science career aspirations. Although Bateman found positive affects of mothers, the career choices of the subjects were still gender related, as

73 % of the girls chose female related careers in the Health Sciences.

Socioeconomic Level

Lower socioeconomic level students were less likely to have computers at home or at school to gain early exposure to information technology, according to Freeman and Aspray (1999). They also pointed out that when these students did have computers in their schools they were more likely to use them for repetitive math skills, instead of simulations and real-life applications of mathematics concepts.

Socioeconomic level also influenced the classes high school students took. Erickson (1987) found that lower socioeconomic students were excluded from some higher-level math classes because of the prerequisites required for entry. Thus, Algebra II was seen as a "gate-keeper" both to higher level math and science classes and computer science studies for many lower socioeconomic level students.

Both Toppin (1998) and Silver-Miller (1992) also found socioeconomic level to be an important variable in the acquisition of computer experience, computer self-efficacy, and computer usefulness. Delos Santos (1982) found that socioeconomic status correlated with high school students using home computers. In the author's study, Caucasian and Chinese were the ethnic groups having the highest percentage of home computers.

Role Models and Peer Influences

Role Models

According to Freeman and Aspray (1999), there has been a lack of women role models in IT. Sloan (1996) found that mentoring could and should be an important means to achieve the aims of diversity. This mentoring was described as not only a 'nurturing strategy' but as a means to secure diversity of performance. Sloan also suggested that mentors not become ‘clones’ of sex or race, but since the white male has been so overrepresented in technology fields, they will have to develop mentoring programs with those who do not match their characteristics.

In an early study in the early 1980s, Rudy (as cited in Evans, 1992) evaluated science/technology role models. The author found that boys liked their male role models at the beginning and at the end of the experience, and girls liked females only at the beginning. One of the important findings of this study was about unclear verbalizations and unattractive personality and appearance of their role models, which bothered girls. Since most teachers and successful computer programmers are men (Freeman & Aspray, 1999), this may be a factor for women who tend to learn in more non-linear ways and value different things about the process than boys do (Brosnan, 1998).

Role models were also found to be helpful in a study done in Pennsylvania with ninth grade students using the Career Decision-Making System Revised edition (CDM-R). Students indicated that role models were effective when they represented the updated trends in advancing technology fields (McCommons, 1994).

Mentoring as a form of role modeling, can be accomplished in a variety of ways. Riviere (1996) described how group teleconferencing could give careers a boost by having mentors act as role models in teleconferencing. This method could be used with a mentor and several prospective workers or among workers or would-be workers so that they could share concerns and support each other.

Davalos and Haensly (1997) described another successful high school mentoring program. The authors in this study described the importance of high school mentoring program for gifted students, but the need for mentoring should apply not only to the gifted, but also to all high school students. Computer technology classes and projects would benefit from the use of a mentoring program so those females who chose technology fields would be more supported.

In another high school study, Dugnan (1992) studied an elite science and technology high school in Northern Virginia to determine if a community-based mentorship program or a school-based research program could influence self-efficacy. No differences in gain scores were found between the experiential programs and the school based programs. However, those in the mentorship program felt more positive about their mentor, the scientific/technical nature of the experience, and the application and enjoyment of the program. Mentors spent twice as much time helping females, and school-based teachers spent twice as much time with males, possibly reinforcing the AAUW's (1992, 1994) findings that girls are being shortchanged in schools (Weinman & Haag, 1999).

Peer Influences

High school students, both young men and young women, have often been more influenced by their peers, than they have been by either their parents or their teachers. The social milieu of high school has placed great importance on what is the "in" thing to do. If computer technology could be viewed as a worthwhile and popular activity and a useful source of information, young women might be more likely to consider the field of IT.

Both Liang (1998) and Devlin (1991) reported that peer influences were variables in computer use in their studies. Students wanted to be in classes and situations where they were comfortable and with people who had the same goals and ways of working as they had. In both studies, this peer influence played a significant role in their choice of courses and outside activities, including computer use.

Since young women have sought cooperative learning experiences and relatedness (Gilligan, 1982), peer participation in computer and information technology will be an important variable to encourage other young women to consider this field as a career possibility. If mostly males populate computer and information technology classes, young women may not want to be involved because these males have a higher perceived affect for technology (McHaney, 1998).

Geek Factor

A geek in its original use was a carnival term that was used to describe a so-called wild man who bit off the heads of live snakes and chickens (Mish, 1983, p. 509). Now the word geek has a new meaning when it is used as the term for one, usually a male, who spends a significant amount of his time and energy using computers and has become extremely skilled in programming. Geeks have come to be known as individuals who “surf” the net, program computers, belong to “chat” groups, and are involved in a whole computer culture. Geeks have the reputation of being out of touch with anything but their computer world and are thought to always have pencil and pen protectors on their shirt pockets.

Now geeks have also been taking on a more dangerous image in our society. In current films such as The Net and Matrix, computer hackers and programmers have been involved in virtual reality and even subversive activities. There appear to be very few females who consider themselves geeks, and females generally have negative perceptions about these individuals (Geek Factor, 1999).

Computer Games, Media and Internet Influences

Computer Games

The way in which computers were presented to many high school students, often in terms of combative games, has limited the number of girls and young women who wanted to get involved with computers (Freeman & Aspray, 1999). These games tended to involve a small set of skills, which boys seemed to enjoy mastering by playing the games again and again, while girls seemed to get bored with the games' repetitiveness.

Girls have liked some games, as Hanor (1998) reported, and girls remembered some of them with detail. However, girls described these games to Hanor, as being not as enjoyable if they were played alone. The interpersonal relations were the factors that made girls enjoy games and sharing their experiences. This variable of the use of computer games when growing up may have been influential in shaping interest in IT careers. Boys seemed to be more involved in the use of computer games than girls, so spent more time on the computer when they were young. Girls, however, did like and use computer games, but seemed to enjoy them for different reasons. Girls tended to like the relational aspect of computer games. According to Hanor girls seemed to be interested in games that allowed them to be creative (new dresses for Barbie) and functional (designing rooms for houses) while boys seemed to prefer war games, conflict and adventure.

Since many schools are now using computer games to teach and reinforce skills at the elementary school level, girls may be more inclined to use and like these computer games. Girls may like to use computers to learn, and if they can do this cooperatively, this may be a way of giving girls the computer knowledge and skills they will need. An example of this was a study by Grignon (1992) where young American Indian women, who enjoyed using computer information systems and computer games, had more self-confidence than young women who had little experience with computer games did.

In the literature research, several articles addressed the use of computer games. Colley et al. (1994) reported that boys were more involved in computer games than girls were, and this made them have a more positive attitude about computers. Laing (1998) reported that Chinese American mothers rated computer play higher than European American mothers did, showing a cultural preference was present for liking computer games. Mouzes (1995) found that women's early life experiences taught them to view computers as the adversary, but that they could learn through structured support and safe play how to enjoy computers. In a study concerning attitudes and computer use in Guam, Delos Santos (1982) found that children who had home computers used them primarily for arcade games. However, as the students got older they tended to use the computer more for applications and computer programming.

Media Influences

The hottest product for girls has come not from Nintendo or Sega, but from Mattel Media, according to Ivinski (1997). This new girl-toy was a revamped Barbie in the form of a CD-ROM Barbie Fashion Designer, bringing Computer Assisted Design (CAD) software to girls in a safe and familiar format. Ivinski cautioned the reader to look carefully at this situation and whether or not it was actually good for girls, as Barbie has promoted an "unreasonable, even racist, standard of beauty, and encouraged stereotypically gendered behavior" (p. 48). Even under "Cool Careers," Ivinski found that the new Barbie has the same stereotyped outfits, miniskirts, and wedding dresses. Therefore, if a girl wanted to play Barbie Auto Mechanic, she would have to dress her in Ken's clothes or just pretend, which have been the same options she has had in the past (Ivinski).

Play has been the vehicle through which children tried out different roles, tested boundaries, formulated identities, and established templates for adult behavior and division of labor by gender. Ivinski (1997) saw Barbie as a "metaphorical template" for the adult opportunities available to the girls who play with her. Girls thus, have perceived that girls played with dolls, as their mothers took care of babies, while boys, who are given a computer game, have related it to what fathers do and use at work.

A positive movement has been created by Dr. Janese Swanson, production manager for the popular educational CD-ROM, 'Where in the World Is Carmen Sandiego?' to produce gender-neutral electronic toys (Swanson & Miller, 1998). Discouraged because managers targeted boys alone, Dr. Swanson established "Girl Tech," which has its on line focus, "Club Girl Tech" @ www.girltech.com. 38 Another pioneer, Theresa Duncan, a multimedia writer/producer, has encouraged girls to enjoy the world, by looking and being like a kid on a lazy summer day through her computer software. New games have been developed to fit the learning preferences of girls, who have preferred to concentrate on the journey, rather than the male's preference for the shortest linear path to an ultimate, winning, and destination. Duncan has developed a series of these traveling games, which were like opening a series of Chinese boxes and appealed to girls (Swanson & Miller).

Swanson and Miller (1998) also found that girls were being left behind in the culture of technology, because girls thought that the computer world belonged to males along with cars, fishing, and football. The authors found that this situation has resulted in limiting girls' choices and successes in the technology enhanced global market. Swanson and Miller also emphasized that before adolescence girls and boys were more alike than different in both biology and attitudes. Girls and boys, however, both wanted to enjoy experiences common to their gender and the culture, which determined what was appropriate for girls and boys. Swanson and Miller suggested praising girls for playing with technology and serving as role models for them. Since girls speak in a feminine voice, they have fantasies about "small flexible objects that can be worn or carried easily and that allowed women to communicate and connect to share ideas and stories." Males have fantasies about "magic wands or brain implants that allow men to transcend the limitations of time and space" (Swanson & Miller, p. 56). These gender differences and preferences are important variables for computer attitudes and experiences and need to be recognized when setting up computer experiences and training for youngsters.

Media Attitudes

The media has an influence not only on e-commerce, business, but also on young people's attitudes. A recent add from Dell Computers (www.dell.com) portrayed a young African-American school girl who was yelling to her mother "Mom, Sam won't stop doing his homework." The implication was that the computer was part of boys' worlds, because they liked to use the computer and girls did not, since there was no indication that the young girl wanted to use the computer herself. Bowers and Bowers (1996) also pointed out in their study that advertisers picture more males using computers and at the same time picture women as observers.

Wired magazine described the present state of the market place in an article titled "Girl Games" (Ivinski, 1997). The story assessed the current situation which has ignored women and stated that "after years of disregard and sporadic sometimes ludicrous attempts to serve the female market, the industry's game boys are experiencing a change of heart" (p. 24). Ivinski indicated that working women now commanded enough capital to make businesses notice them in the businesses that have traditionally been male focused, such as cars, golf, and computers.

Sales staffs in these companies have few women, and few of these manufactures advertise in women's magazines according to Ivinski (1997). The author said: "Although women now buy more home business and desktop publishing software than any other market group, few products have been developed specifically for women, or for girls—a remarkably shortsighted strategy, considering these girls are likely to be consumers of adult digital technology in the near future" (p. 24).

Media messages have perpetuated the gender stereotypes and sexualization of women. Movies, TV, radio, newspapers have continued to portray the sex role picture of females in our society. Rarely ever do young women see other young women working at computers in the media. These young women are usually in the advertisements to enhance the male's role or to be a sexual object (Brosnan, 1998).

Internet Influence

The Internet has become an overwhelming influence on society ("Internet Generation," 1999). The Internet Generation is composed of children born after 1944 and never lived without the Internet in their lives. At the same time that society has praised the age of the Internet, the Annenberg Public Policy Center published the results of a national survey of parents in computer households (Annenberg, 1999). Those parents were 'deeply fearful' about the Web's influence on their children. The study showed that 78% of the parents were 'strongly' or 'somewhat' concerned that their children might give away personal information on the Internet, or view sexually explicit material. Parents feared that the Internet would cause their children to become isolated (64%), interfere with parents' ability to teach values and beliefs (49%), and that too much Internet use could cause children to develop anti-social behavior (42%). Only 35% of the parents said that the Internet could have a community-building influence.

However, parents seemed to have conflicting views concerning the Internet because, according to the report (Annenberg, 1999) parents also believed that there were many positive attributes about the Internet. The results of the study indicated that parents saw the Internet as an essential tool with positive potential to discover fascinating, useful things (75%). Parents thought that the Internet would help children with their schoolwork (72%) and that children without Internet access would be at a disadvantage (59%). According to Annenberg (1999), this Jekyll and Hyde phenomenon has been due to the media presenting one fourth of the articles about the Internet involving sex crimes with children. Two thirds of the articles also gave negative aspects of the Internet about sex, pornography, and invasion of privacy (Annenberg, 1999, @ http://www.appcpenn.oro/internet/).

The Internet has also perpetuated the gender stereotypes and sexualization of women, just as the media had done. One computer add which flashed on AOL invited the user to go to this site by unzipping a woman's blouse. The incidence of pornography on the Internet has also been a topic of continued discussion. Most of these sites have been directed at men. Women rarely ever visit such sites, so there are many areas of the Internet that have sex-role variables attached to them, again separating the way men and women use technology and the Internet. There have however, been many positive aspects of the Internet.

The Internet may appeal to young women sooner, because it allows them to have the ability to communicate with others, to share ideas, stories, and advice, which has been of continuing interest to women (Brunner & Bennett, 1998). Many new Internet sites have been developed to cater just to women and their particular needs. Beatrice's Web Guide (http://www.Bguide.com), a new site, was launched by Women's Wire and Yahoo! Another site, which has been developed http://winchester., has given women a place on the Internet to read about the exploits of women in cyberspace.

Another change has taken place, which was also of interest to women. The Internet has changed the way colleges interact with prospective students and new students. Olsen (1999) described how Loyola Marymount University issued pagers and cyberculture messages to the new "digital-device-loving" class. The messages were sent to the new freshmen in less than a minute, and these messages were practical, covering everything from the kind of sheets students should bring, to reminding them to prep themselves for the placement exams.

"Cyber-democracy" was what has been happening in New York City, where press conferences were rebroadcast on the web. The City Council in King County, Washington has also been taking public-hearing testimony over the Internet (Wolf, 1999). In city government, residents were able to complain about graffiti, trash, or to register for races and even register their bikes on-line. In Blacksburg, VA, the Electronic Village has been running a business directory in the city of 35,000 (Wolf).

The Internet has also allowed on-line publishing, as well as on-line socializing to occur. Floyd (1999) described how individuals create on-line personages called ‘avatars" to portray themselves. In The Psychology of Cyberspace, Suler (as cited in Floyd) described how people have behaved when they participated in groups on the Internet. On-line people have felt free to express aspects of themselves that they would not have revealed in other kinds of encounters. Suler (as cited in Floyd) repeated the general feeling from several authors about the Internet, explaining that the Internet was another communications tool, neither good nor bad. "As a phenomenon, the Internet happened very quickly. It went from something only computer geeks knew about to your next-door neighbor has a Web site. It has as much capacity for improving people's ability to communicate as it does for creating potential harm" (Floyd, 1999, p. 1).

Biemiller (1999) described another new possibility coming from the Internet. The author explained how researchers at Brown University used a virtual environment to enable them to walk through their data in a six-sided room or 'cave', like the Electronic Visualization Laboratory at the University of Illinois at Chicago. Because of the possibility of computer power doubling every 18 months, this virtual reality environment will become commonplace and used by businesses as well as researchers.

Turkle (1995) has long studied the new technology, and she agreed that the Internet has opened new possibilities especially for women who can find meaning in virtual reality and personalities. The author explained how the world of the Internet will continue to provide new experiences in learning for both men and women. She added that the medium has allowed both sexes to experience what it would be like to be a member of the opposite sex and experience this on-line.

School, Counselor, Teacher and High School Classes Influences

Educational Background

Marland (1974) cited several educational figureheads who were influential in setting the requirements for what education should be. First, Alfred North Whitehead (1929) in The Aims of Education (as cited in Marland) said that "education should turn out the learner with something he knows well and something he can do well" (p.1). Conant in 1960 (as cited in Marland) proclaimed, "I submit that in a heavily urbanized and industrialized free society the education experiences of a youth should fit his subsequent employment" (p. 4). David McClelland (as cited in Marland) felt that the "root difference between technologically and economically advanced nations and those less sophisticated was that they speak of work, relevant motives and of achieving, whereas non-achieving societies do not do this" (p. 31).

Edwin L. Herr, Penn State (as cited in Marland) gave the message to schools that career education was a part of the educational responsibility dating back to the 1914 Grand Rapids, Michigan keynote address of the National Vocational Guidance Association. This message stated that "the schools should be refocused to provide each learner a conception of his industrial obligations and opportunities" (p. 60). John Dewey (as cited in Marland) addressed that same convention and said that from his experiences at his occupational orientated Laboratory School at the University of Chicago, "democratic education required no separation of vocational training from academic training" (p. 60).

All of these educational leaders put career education clearly in the hands of the teachers and schools. However, Frank Burnett in Guideposts (1973, as cited in Marland) said that counselors were "to join with teachers, administrators, and colleagues in non-school settings and the general public in placing a collective shoulder behind career education" (p. 61-62). The roles of teachers and counselors have been clearly separate in their responsibilities for career education and career counseling. Career education was the responsibility of the teacher, and career counseling and guidance, the role of the counselor.

Counselor Influences

The counselor has had a pivotal role in the academic, career, and personal/social aspects of guiding and counseling young men and women about careers and especially careers in IT. Guidance and counseling programs have included career counseling as an integral part of their comprehensive and developmental programs, which were focused on helping all students. It has been vitally important for counselors to understand the impact of the technological age and the future of young women in these fields. If counselors have not used or understood computers, they will not be able to adequately guide their counselees and provide them the information about possibilities in IT. With the proliferation of computer software and internet sites devoted to career and college placement, the counselor must be technologically capable of accessing this information and making it available and understood by their counselees. By seeing counselors, and especially female counselors, as being comfortable using the latest in computer technology for college searches, database information, and spread sheet comparisons, young women may understand that computer technology is an integral part of the counselors' job at the high school level (Gsybers et al., 1998).

Blum (1997) outlined the four important components in a successful counseling program. Blum stressed that the program must include consultation, coordination, counseling and guidance services, and within these components it was the counselor's responsibility to facilitate career decision making, as well as equal access for young women. In providing these services, the counselor can become a champion for information technology in the schools. Since so many counselors are themselves women, they can act as role models for young women and provide equal access to IT careers.

Freeman and Aspray (1999) noted the lack of informed guidance counselors who were knowledgeable about the requirements of an IT career. Often counselors have not encouraged young women to take courses in mathematics and science, which were requirements for degree programs in computer science and computer engineering, due to outdated stereotypes of aptitude and interests (Freeman & Aspray). If counselors did not know much about the IT workforce, they could not counsel or guide students toward this type of preparation. Counselors, who themselves have not used computers or have not understood the Web, will not be able to be adequate guides, helpers, and role models for their counselees.

Many of the students' parents also know less about the computing professions than the more established professions, so the high school guidance counselors must also educate the parents about the field and the career opportunities available. The guidance counselor needs to know the community as well as the parents who are in IT careers and the IT resources within the community. This knowledge will be necessary for students to shadow or to have an internship with one of the IT companies.

To support students' planning for careers in high school, the American School Counselor Association's (1997) National Standards for School Counseling Programs, listed career development as one of the three areas of focus for the school-counseling program (Campbell & Dahir, 1997). There were three standards for career development that were particularly applicable to counseling for careers in IT:

> First, the school-counseling program enables all students to acquire the skills to investigate the world of work in relation to knowledge of self and to make informed career decisions. The competencies for students are that they will be able to develop career awareness and employment readiness. Secondly, the school-counseling program enables all students to employ strategies to achieve future career goals with success and satisfaction. The student competencies are that students will acquire career information and acquire career goals. The third standard for the school-counseling program will enable all students to understand the relationship between personal qualities, education, training and the world of work. The student competencies are to acquire knowledge to achieve career goals and to apply skills to achieve career goals (Campbell & Dahir, 1997, pp. 23-25).

This commitment to career counseling forms the vehicle for counselors to establish up-to-date programs, including highlighting the opportunities available in technology careers, to meet these goals. Counselors work with parents, which can be an area where career counseling and guidance can begin. Due to the interactive nature of parent and adolescent contacts and influences, counselors are able to look at the family from a social constructionist paradigm and help their clients understand their options in a changing workforce and society. To meet the needs of educating students in IT, secondary schools are instituting technology plans and new courses to prepare students for the technological society, in which they live and will work. The counselor must be an integral part of these plans.

Teacher Influences

According to Freeman & Aspray, 1999, the lack of K-12 teachers who were knowledgeable about IT has been alarming, because this situation has limited access and understanding to many students. Many of these teachers were trained before computers were being used in the schools, and many of these teachers have never caught up with the new technology. As technology has become a major part of the educational process in most high schools, some teachers have also been found technophobic (Rosen & Weil, 1995).

Teachers also have a tremendous influence concerning who has the opportunity to use computers and when this happens. Hanor (1998) reported how girls often have felt that boys were favored to be computer aides by teachers, and the girls resented this treatment. Since students do not experience computers autonomously with the influence of the teacher, teachers have a direct influence on girls' use and enjoyment of computers. Kinzie and Delcourt (1991) found that "teachers who use computer technologies are likely to be important models for their students, helping to produce positive student attitudes toward these technologies" (p. 2).

Shashaani (1993) noted that teachers as well as parents were important as sources of encouragement of positive attitudes concerning computers. In Shashanni's study, gender preferences of teachers could tie differences to the lack of encouragement of female students. Rosen and Weil (1995) studied this influence of teachers on student attitudes as they related to technology. The authors and found that even though schools tended to have a significant amount of technology hardware and software available for teachers and students to use, the teachers often did not use these technologies. This was primarily due to their lack of training and acceptance of computer technology (Rosen and Weil). This technophobia of teachers may be serving to "promote the continuation of negative reactions to computers and other forms of technology" (p. 26).

Freeman and Aspray (1999) recognized that it was during the high school years that students usually received their first knowledge and skill sets in computer and information technology. Much of this learning, however, did not occur in formal programs in the schools. Instead, this kind of learning occurred through personal exploration and interaction with peers. Especially as personal computers have become increasingly common in homes and schools, there will be more opportunities for exploration and even earlier introduction of computers into the curriculum.

When high schools have offered vocational technology programs that train students for many different occupations, students often did not get the needed skills for occupations in the field of IT (Freeman & Aspray, 1999). The courses, such as data entry and electronics technology, were exceptions, but otherwise the horizons were limited for people who enter the IT workforce through this route, unless they have further training. Freeman and Aspray gave another example of IT talent being used too early. This problem has occurred when companies have hired talented computer operators before they have graduated from high school. These students usually have been proficient in Web page design and programming, but because of stopping school so early, they often did not progress or continue learning.

Another limitation has been in vocational high school technical classes or tracks that have not given students the foundational skills for further education and career advancement (Freeman & Aspray, 1999). There have been some exceptions to this situation, particularly in vocational programs that have stressed the strong academic and college preparation courses along with the technical courses. A local industry and two- and four-year colleges in the area usually have sponsored these types of programs. Because of the strong academic component, the participating students have been easily able to move into further education training along with the IT job. Therefore, high schools must assure their students the kind of preparation that will lead them to further education and training, especially in the field of IT.

Freeman and Aspray (1999) noted two kinds of programs that appeared to be succeeding in preparing high school students for IT careers. One program offered college level courses in computing, which could also offer college credit, taught by high school teachers or faculty from local colleges. This type of program was usually directed toward students who were already on the academic track. The second type of program targeted at-risk students who might not enter college by making technical careers attractive to these students. Freeman and Aspray gave an example of this program, which was called the Engineering Vanguard Program of the National Action Council for Minorities in Engineering, Inc. (NACME). This program has been aimed at students who may be minorities or come from poor communities and might not otherwise enter college and get professional jobs. Students entered the program not based on high school grades or evaluations, but by qualifying under NACME's assessments. Students were given intensive academic enrichment and then sent to participating colleges on full scholarships. This program has shown excellent retention rates (Freeman & Aspray).

High School Classes and School Influences

In measuring the determinants of attitude toward computers in middle school, Connell (1991) detailed the importance of a local analysis before beginning a computer program for a school. This local analysis has been important because each school has been in a unique situation, and, therefore, blanket solutions often have not applied. For instance, in a study of factors that influenced the intent to persist in technology, Choonoo (1995) found that both African-American and Latino students faced discrimination in pursuing computer fields. Cuban-American students were the other minority studied and this group did not seem to be effected by this discrimination. Therefore, it will make a great deal of difference whether or not a school has discrimination problems, and what particular groups need to be targeted for special help with computers. Other factors may be socioeconomic level of the school, experience of the teachers, aspirations of students and parents, as well as the available resources in both the school and the community to assure a quality and effective computer training program.

Advanced High School Classes Influences

One of the articles in the literature found that students who were enrolled in a technology course had a more favorable attitude about computer and information technology (McHaney, 1998). In a few schools, technology initiatives have recommended or instituted advanced technology classes to prepare students to enter the computer dominated work place. However, for a number of college-bound students these programs have not been available in their high schools. These basic classes also may have not suited their needs or put them in a position to be accepted by competitive colleges (colleges which take less than 50% of those students applying) and universities (Gose, 1999)

In the two most widely accepted advanced programs for secondary schools, the Advanced Placement program (AP) from the College Board in Princeton, New Jersey and the International Baccalaureate program (IB) from the International Baccalaureate Organization in Geneva, Switzerland, there have been advanced offerings in computer science. In the IB program, a course, classified as dealing with computer and information technology, is now available. This course is called IB Information Technology in a Global Society (ITGS) and has been offered in a few IB schools in the United States. It is a part of the IB curriculum and diploma program as a course for Individuals and Societies or the social sciences (IBO, 1998), (http://www.ibo.ogr.com).

At this time in Northern Virginia, the High School in Falls Church, Virginia, is the only school that has been offering this advanced computer and information technology class for the past two years. This new course, ITGS, has seemed to meet the career, academic, personal and social needs of both young men and women in the last two years of high school in the United States who may be interested in information technology. The course is relational, which also should appeal to young women, because it involves the sociological and ethical relationships in computer and information technology and allows the students to work cooperatively to solve problems and create new information tools. Since it is not a programming course, the young women may feel more interested in finding out what the computer, the web, and various information systems can do to help them in their daily lives and prospective career patterns.

The official course description from the International Baccalaureate Organization (IBO) stated that:

> Information Technology in a Global Society examines the interaction between information, technology, and society. The course is designed to help students develop a systematic problem solving approach to processing and analyzing information using a range of information tools. The course also focuses on the impact of modern information technology on individuals, on relationships among people and on institutions and societies. The course is centered on six themes including: (1) individuals and machines/comparisons and interactions, (2) information systems in today's society, (3) the system life cycle/problem solving, (4) responsible use of information tools, (5) the social impact of information technology, and (5) evolution from the past/insight into the future (International Baccalaureate Organization, 1997).

Strong Interest Inventory

Introduction to the Strong Interest Inventory

Many very successful career assessment programs have been available in secondary schools in the United States. Many of these programs were, however, male conceived. Males have developed most of the career and interest inventories, and most of these inventories were written before IT became such an important field of its own. Most of the career inventories in print and in use in the schools focus on separate job categories and descriptions, which do not really fit IT. IT is not only a career category, but it is a career skill that has been and will be needed in almost all professions and jobs. The Strong Interest Inventory has allowed students to select areas and careers of interest to them. It also has been used to find out if a person's personal style or areas of interest would influence them to consider or explore careers in IT.

The Strong is an interest inventory that was first developed in 1927. Women and men in general sample occupations scales were subsequently developed for the 1981 Strong Occupational Scales (Hansen & Campbell, 1985). The current Strong has separate scales for males and females, but students are able to see both of the scores. The inventory has been labeled sexist and reinforcing stereotypes for males and females, due to these separate scales. These separate scales for males and females can be useful to relate to the different courses and careers which young men and women choose or aspire.

The Strong Interest Inventory measures interests, using the Holland Codes, which include the Realistic, Artistic, Investigative, Social, Enterprising, and Conventional scales (RAISEC). The profiles of young women and men have been different (Strong, 1955). Men's interest profiles tended to be more in the realistic, investigative, conventional and enterprising areas, and women's interests clustered more in the social and artistic areas. Of course, there were overlaps in these areas of interest, but the different norms for women and men indicated that interests were somewhat gender specific (Hansen & Campbell, 1985).

According to Phillips & Imhoff (1997), counselors have been warned that because of the gender differences in the structure of interests, the use of Holland's theory and its derivative tools for women may be questionable. The authors noted that this is because of the tendency of the scales to perpetuate existing sex segregation. Unfortunately, some counselors and teachers still recommend sex stereotyped jobs, especially for young women (Hansen & Campbell, 1985). Counselors should not recommend sex stereotyped jobs just for young women, but instead they should seek to help young women understand their interests, course choices and career plans realistically and see their interests as important, but not the deciding factor.

There were many occupations on the Strong where data could only be gathered on males or females, because data was only available on one sex (Hansen & Campbell). Typical male occupations on the Strong include: machine shop supervisor, cabinetmaker, forest ranger, rancher, telephone technician, tool-and-die maker, union leader, auto mechanic, petroleum engineer, merchant marine officer, animal husbandry professor, astronaut, NASA scientist, urologist, osteopath, food scientist, electronics designer, astronomer, economist, orchestra conductor, priest, agricultural extension agent, football coach, juvenile parole officer, labor arbitrator, industrial salesperson, sports reporter, traveling salesperson, auctioneer, factory manager, farm implement manager, auto sales dealer, appliance salesperson, manufacturer, printer, and production manager.

Typical female occupations include: scientific illustrator, children's clothes designer, costume designer, fashion model, illustrator, writer of children's books, director of Christian education, vocational counselor, teaching nun, receptionist, occupational health nurse, professional dancer, waitress, women's style shop manager, dancing teacher, administrative assistant, courtroom stenographer, office worker, dental assistant, dietary assistant, hospital records clerk, hospital secretary, and proofreader.

The Strong Interest Inventory has four Personal Style Scales. The first scale is the Work Style scale, which determined how much contact with people students want in their jobs. The Learning Environment scale helps students decide what kind of education they wanted to achieve and their work goals. The Leadership Style scale helps students determine what kind of leader they preferred to be. The Risk Taking/Adventure scale helps students use their preference regarding risk taking to choose career and leisure pursuits. On the personal style scales of the Strong Interest Inventory men tended to have higher risk-taking and adventure scores while women tended to have higher working with people styles (Cronin, 1995).

History of Scaled Score Career Self-Report Assessment

The history of career assessment and the guidance and counseling movement in the United States paralleled the development of vocational education. Two giants in the field, Frank Parsons (1909) and E. K. Strong, Jr. (1927b), set the tradition and theoretical model for matching people to jobs (Donnay, 1997; Kapes, Matlock-Hetzel & Martinez, 1996). In Massachusetts in 1906, the National Society for the Promotion of Industrial Education (NSPIE) began the efforts to establish vocational education in the public schools. The NSPIE later led to the establishment of the National Vocational Guidance Association (NVGA), which evolved into the American Vocational Association (AVA), and finally into the American Personnel and Guidance Association (APGA), (Kapes et al., 1996).

At about this same time in Massachusetts, Frank Parsons began the work that led to the establishment of the Vocation Bureau in 1908 and the publication of Choosing a Vocation in 1909. Choosing a Vocation was based on Parson's many years of working on social reform and helping the underprivileged make good decisions about their life's work which were based on scientific methods. The vocational guidance model proposed by Parsons was one of the first major efforts to apply mental assessment that was not based on a deficit model, but rather on a positive frame of reference (Kapes et al., 1996). Many attempts were made to develop some standardized approaches to obtain this kind of affective information through asking people about their interests on questionnaires.

According to Donnay (1997) one of the first and most successful approaches to assessing interests originated in a graduate seminar taught by Clarence S. Yoakum on interests during the 1919-1920 school year at Carnegie Institute of Technology. The Carnegie group focused on the use of paper-and-pencil questionnaires to differentiate people in various occupations. The group put together a common pool of 1,000 items and developed interest inventories, including the beginnings of the Strong Vocational Interest Blank (SVIB). The SVIB was constructed by E. K. Strong, Jr., who was at that time the head of the Bureau of Educational Research at Carnegie Institute of Technology (Donnay).

Edward K. Strong, Jr.

Edward K. Strong, Jr. left the Carnegie Institute of Technology in 1923 and went to Stanford University as a psychologist where he continued his study of interests and their measurements. Strong had a graduate student, K. M. Crowdery, who had written a dissertation demonstrating that different professional groups, such as lawyers, engineers and physicians, tended to have different response patterns to items that reflected interests (Kapes et al., 1996). Dubois (1970, as cited in Kapes et al., 1996, p. 39) described the process as building on Crowdery's instrument, when Strong developed a system of using three letter grades, A though C, to report respondent's scores. "A" was the score that was obtained by the most typical 7 % of successful individuals in an occupational group. "B" was obtained by the remaining 25 % of the group; and "C" listed scores more or less outside of the distribution for the occupation in question. Each person taking the test could be scored on the key for each of the 18 occupations in the early version of the Blank. Of the 263 items in the Crowdery inventory, 182 were retained and 238 new items were added with three new sections including order of preference of activities, comparisons of interests, and rating of present abilities and characteristics. These 420 items, with like, indifferent, and dislike responses, constituted the SVIB in 1927.

E. K. Strong's Vocational Interest Blank (SVIB) (1927a) was the first inventory to use empirical methods of contrasted groups, which were constructed from the responses of individuals in certain occupations as contrasted to people in general (Kapes, et al., 1996). The development of indices by comparing the preferences of respondents with the typical preferences of persons successfully and happily engaged in certain occupations set a firm foundation for predicting vocational behavior and for later innovations in career assessment (Campbell, 1973; Donnay, 1997).

The Study of Interests

The study of interests has been historically important in both vocational and educational counseling. Interests have been measured more by indirect methods and approaches, since usually subjects do not have enough information about various occupations to simply tell the examiner what occupations they like (Anastasia, 1976).

The interest inventories that were produced dealt with the subject's liking or dislike for a variety of specific activities, objects, or types of persons, which were common to the test takers. Individuals responded to the items and these responses were empirically keyed for different occupations that met a certain criterion. This structure was important, because it was found that “persons engaged in different occupations were characterized by common interests that differentiated them from persons in other occupations,” (Anastasia, 1968, p. 468). Not only did these differences pertain to hobbies and sports, but also to types of plays or books enjoyed by subjects, social relations and other aspects of everyday life. What emerged from this early interest inventory was that it was possible to question individuals about their interests in relatively familiar things, and see how closely their interests were like those of people successfully engaged in different vocations (Donnay, 1997)

Vocational Interest Blank

Strong's original Vocational Interest Blank (Strong, 1927a) contained only 10 men's Occupational Scales and was followed by the Strong Vocational Interest Blank in 1933 which included the interests of women in various occupations (Donnay, 1997). There have been several revisions of the Strong Vocational Interest Blank since then. In the 1930s and 40s, the Occupational Scales were updated and expanded for both the women's form and the men's form. In 1966, the Basic Interest Scales were added, which measured interests in 23 general areas of activity, such as math and writing. The Basic Interest Scales were homogeneous content scales, which were developed using the interrelations of the Strong Vocational Interest Blank to provide greater organization and interpretation of the original Occupational Scales (Donnay, 1997). The Personal Style Scales expanded the use for the Strong, because they categorized individuals' interests being around different types of people, in various leisure activities, and in working or living in a variety of environments.

Strong Vocational Interest Blank (SVIB)

The Strong Vocational Interest Blank (SVIB) was published in 1966 and consisted of 399 items, grouped in eight parts including occupations, school subjects, amusements, activities, and types of people (Anastasia, 1968). The subjects circled whether they like, dislike, or are indifferent to the items. In the next three parts the subjects ranked given activities in order of preference, compared their interests in pairs of items, and rated their present abilities and other characteristics. Fifty-four occupational scales could be scored on the men's form, and thirty-two could be scored on the women's form. There were also four nonoccupational scales, which included Specialization Level (SL), Occupational Level (OL), Masculinity-Femininity (MF), and Academic Achievement (AACH). Anastasia (1968) reported that the field or occupational group of the individual's eventual employment could be predicted fairly well with high school students using the SVIB, however, prediction of specific occupation or job success or satisfaction was more questionable.

Donnay (1997) described Strong's group difference method as "a primitive form of discriminant function analysis" (Dawis, 1991, p. 842, as cited in Donnay). The author explained that this method resulted in heterogeneous scales composed of items that best discriminated specific occupations from people in general. Strong's method was subsequently adopted in developing the Minnesota Multiphasic Personality Inventory (Hathaway & McKinley, 1940, 1942, as cited in Donnay), as well as several other structured questionnaires (Borgen & Harmon, 1996). This method made the Strong one of the great contributions in the history of applied psychology. The other major interest inventory, the Kuder, used content-related measurement and had the advantage of rank ordering interest in occupations, as well as using homogeneous item pools. However, the Kuder has never been as popular or widely used as the Strong (Donnay, 1997).

Strong had originally studied sales and advertising, but also studied personality structure under Cattell and was influenced by Thorndike's (1912) work on factors (as cited in Donnay, 1997). This background led him to question if it was possible to differentiate occupational groups from one another based on interests, which he studied while at the Carnegie Institute of Technology. Strong had moved from Carnegie Institute of Technology to Stanford to do his research, and finally moved to the University of Minnesota where he began working with Campbell, who helped him, established the Center for Interest Measurement Research. Strong moved all of the records from Stanford to Minnesota and closed the Strong Vocational Research Bureau there on September 1, 1963. Strong died the following December in California, but his work continued under the direction of Campbell and his graduate assistant, Jo-Ida Hansen (Donnay, 1997).

The Strong Campbell Interest Inventory (SCII)

The Strong Campbell Interest Inventory (Campbell, 1974) was published with separate forms for men and women, 124 Occupational Scales, the same Basic Interest Scales, and two new scales to measure academic comfort and introversion-extroversion dimensions. The most notable development of this new scale, however, was the new General Occupational Themes Scale that used rational scale construction, representing the six Holland personality types (Donnay, 1997). The importance of the General Occupational Themes was that they could classify individuals and occupations, which added clarity and usefulness to the Strong profiles. More significantly, however, was that by marrying Strong's empirical data with Holland's vocational theory, many more applications for the Strong were available. These new Occupational Themes made it possible to include the Holland codes from the Strong with the Dictionary of Occupational Codes, and meant that group occupational membership could be predicted (Donnay, 1997).

For some groups, however, such as women, the General Occupational Themes are less predictive than they are for men (Bartling and Hood, 1981, as cited in Donnay, 1997.) Donnay and Borgen (1996) also have found that the General Occupational Themes were not as predictable in terms of occupational group membership as were the Basic Interest Scales.

A number of research articles and dissertations used the SCII and found interesting support for the instrument. Jacobs (1985) did a study using the Strong Campbell Interest Inventory to evaluate the effectiveness of Strong's validity in predicting college majors. The author administered the SCII to the entire freshman class of a large urban university before registration and then tracked for college major stability after 5 years. Jacobs found that for the Occupational Themes, the Basic Interest Scales, and the Occupational Scales, student scores were found both concurrently and predictively valid.

Tinkham (1984) reported that the SCII produced results that indicated that managers and technical personnel converged on the scales related to scientific and engineering interests. This made the SCII able to be used as a selection device or instrument to identify those technical specialists who might benefit most by managerial training programs. The SCII could also be targeted for career counseling to aid the technical specialists who were considering moves into management (Tinkham).

Earlier, Kittrell (1980) found that when studying Ohio Cooperative Extension County Agents, those subjects with high social interest theme scores on the SVIB-SCII tended to be more satisfied with their job. On the other hand, agents with high artistic interest scores tended to be poor performers. Additionally, McNeeley (1983) found that there were no significant differences between the career interests of boys in therapeutic boarding schools and boys in public schools. There were also no significant differences between the career interests of boys 18 to 20 years old and the career interests of boys who were 16 to 17 years old (McNeeley). Dopkin (1983) found that nontraditional male high school students enrolled in home economics related occupations and health occupations differed from the traditional males. These nontraditional males scored significantly lower on the realistic type and significantly higher in the social, conventional, enterprising, and artistic types, while at the same time the nontraditional males scored higher than females in the realistic personality type (Dopkin).

Holland’s theory of personality and vocational choice began to be questioned in the 1960s as to whether or not they were applicable to African American populations (Morrow, 1983). Morrow found in a sampling of high school youth in the State of Illinois that the Strong Campbell Interest Inventory was sensitive to race, the rural-urban setting, and age. Hines (1983) found that the SCII was only moderately valid for African American college students attending a predominantly African American urban college. The study showed the strongest area of support was in the relationship of African American women's interests to their majors with similar or only slightly reduced "hit rates" compared to those obtained with Caucasian college women. Additionally, Hines found that neither the academic orientation nor the differentiation of interests was predictive of African American students' academic success as has been true for non-African American students.

Strong Interest Inventory (SVIB-SCII), (4th Edition)

The next important revision of the Strong was the Strong Interest Inventory (SVIB-SCII), Hansen & Campbell, 1985). This revision was supervised by Jo-Ida Hansen, who had replaced Campbell as the director of the Center for Interest Measurement Research at the University of Minnesota (Donnay, 1997). Conoley & Impara (1995) said that the purpose of the revised scale was "to inquire about a respondent's interest in a wide range of occupations" (p. 995). The revised inventory was composed of the General Occupational Themes, the Basic Interest Scales; and Occupational Scales which were developed from items that differentiate women or men in a particular occupation from groups of women- or-men-in-general. The inventory also included the Academic Comfort and Introversion-Extroversion Scale as well as four Administrative Indexes.

Seventeen new vocational-technical occupation groups were sampled (34 paired male and female scales) and six newly emerging professional occupations (12 scales) were added (Busch, 1995). Old occupational norms were updated and additional male and female parallel occupational scales were developed. The result of this change meant that only five scales were not paired by gender and sixteen smaller criterion group samples were increased in size so that the test results would be relevant for the 1990s (Busch). The sampling of occupations involved a total of 40,197 individuals in 162 occupations in 1981. Some difficulty, however, was noted in identifying sampling frames and obtaining responses in the 1995 The Twelfth Mental Measurements Yearbook in a review by Worthen (1995).

Worthen (1995) indicted that there were inconsistencies between the Basic Interest and Occupational Scales, where pairs that were obviously related such as art and fine artist and mathematics and mathematician had highly contrasting scores. Concerns were also voiced in the lack of data on the construction of the special scales of academic comfort and introversion-extroversion. Two other concerns were noted by Worthen. The first was the failure to report response rates in data collected on the Occupational Scales, because of the bias, which is caused by volunteer responses. The second concern was the failure to include the typical response rate statement when administering the inventory. This response rate statement said: “In general, people respond like to about one-third of the items, dislike to about a third, and indifferent to about a third” (p.6) and should always be used when administering the inventory. Not using this statement caused an unnecessary source of variation in testing conditions.

The extensive revision and research on the 1985 revision was influenced by the women’s movement, because of the inequities of the Strong use of separate Occupational Scales and norms for men and women (Worthen, 1995). With the new revision, 101 of the occupations had matching scales for females and males out of the 106 occupations represented. In addition, the single-sex inventory construction was reevaluated in this revision. From the beginning Strong had used single-sex scales because he felt they were more valid predictors than combined sex scales were (Strong, 1943 as cited in Donnay, 1997). Donnay (1997) stated that Hansen and Campbell (1985) agreed with this position and that women and men did respond differently to interest inventory items.

Hansen and Campbell (1985) had stated that the response differences between the women-and men-in-general samples were 16 % or larger on 109 of the 325 items. An example of this would be the male who selected the like response for Interior Decorator was joined by only 29% of the men-in-general sample, as compared to 64 % of the women-in-general sample (Hansen & Campbell). This difference was also constant across all occupations in the General Occupational Theme, and no occupation was free of them. The differences did not disappear when only women and men who had made the same occupational choice were compared. Hansen and Campbell noted that the difference was also true for items over time with the gap between men and women from the 30s, 40s, 50s, 60s and 70s comparable with only a slight reduction occurring during the 1960s.

As researchers found in earlier studies on the SVIB and the SCII, there appeared to be a difference between the way African Americans and Caucasian Americans scored on these interest inventories (Hines, 1983; Morrow, 1983). Ford-Richards (1992) found that the standard scores for Caucasian Americans were significantly higher ($p < .01$) than for African Americans on the Realistic and Investigative General Occupational Themes, while scores for African Americans were significantly higher ($p < .01$) than for Caucasians on the Enterprising and Conventional General Occupational Theme standard scores. Ford-Richards recommendations were to develop African American norms on the Strong Interest Inventory.

Strong Interest Inventory (Strong)

The 1994 Strong Interest Inventory (Strong) is the most current updated version of the original Strong Vocational Interest Blank (SVIB). The new Strong replaced the Strong-Campbell Interest Inventory (SCII). The SCII was a merged version of the male and female forms of the older SVIB, created by David Campbell in 1974, revised with Jo-Ida Hansen in 1981 and 1985 (Hood & Johnson, 1997).

The new Strong dropped 43 items from the 1985 version and added 35 new items, as well as enlarging the general reference sample from 300 to nearly 10,000 for both men and women (Donnay, 1997). The gender split included 9,467 men and 9,484 men (Betsworth & Fouad, 1997). Other differences were that the Basic Scales were altered somewhat and increased from 23 to 25. Four new scales were added including: Applied Arts, Culinary Arts, Computer Activities, and Data Management, and two Basic Interest Scales, the Domestic Arts scale and the Adventure scale, which was adapted as one of the new Personal Style Scales were dropped (Donnay, 1997). New data was collected from 50 occupations and some for the first time, such as Audiologist and Technical Writer, and four new Personal Style scales were added (Hood & Johnson, 1997). The General Occupational Themes remained the same reflecting the six Holland types, but the items and scales were somewhat changed to increase reliability according to Betsworth & Fouad (1997). The item content of some of the scales was modified, and several scales were moved from one Holland theme to another. The Occupational Scales increased from 207 to 211, including 14 new occupations. Additionally, some scales were renamed, some occupational groups were re-sampled, and some items were changed. Finally, the profile was redesigned to make for easier understanding and presentation of data (Betsworth & Fouad, 1997).

Differences Between Men and Women

The sample of the 1994 Strong showed that men and women differed in their like or dislike responses by at least 16 percentage points for approximately one quarter of the items on the Strong (Harmon, Hansen, Borgen & Hammer, 1994). Women were more interested in culinary arts, art, and music/dramatics, while men liked mechanical and military activities and athletics. The reason that separate sex norms were presented was because of the large differences shown in the preferences of men and women. Separate sex norms made it "easier for people to show interest in nontraditional activities for their sex…women who major in science do not express as much mechanical curiosity as do men who major in science, but they are just as successful as men in their course work" (Goldman, Kaplan, & Platt, 1973 (as cited in Hood & Johnson, 1997, p. 165).

There appeared to be sex differences on the interest scales, especially the Social and Realistic themes. It, however, was not clear whether these differences were occupationally relevant, or whether men and women in the same occupation have different interests. Harmon et al. (1994) reported that only 10% of the occupations on the 1994 Strong had a difference of at least one standard deviation between the scales for men and women in the same occupation.

Fouad and Spreda (1995) concluded that the sexes differed in their vocational interests. The authors explained that there was an overlap between the items that men and women have endorsed. However, the real concern should be the meaning given to the differences and those endorsements, especially when men and women endorsed those items that were typically endorsed by the opposite sex (Fouad & Spreda, 1995).

Cronin (1995) found that women who scored high on the Adventure scale were more open to risk-taking behaviors and might seek physically risky activities, pursue new sensations and experiences, and avoid repetition. These same women often adopted a non-traditional gender role orientation and might be more willing than low-scoring women to consider nontraditional occupations (Cronin).

Gender Bias

Earlier versions of the Strong Interest Inventories in the male and female forms were accused of using male pronouns, male-oriented occupational names, and of listing stereotypical occupations for each sex. What had been happening was that students were being channeled into various occupations and fields of study based on sex, and therefore, options were limited as were considerations of certain careers. Another difficulty was that there were many more occupations shown for men than for women, which also may have limited the options and number of careers women considered.

The newer versions of the Strong Interest Inventories and especially the 1994 revision have eliminated gender bias by the use of norms for both sexes. These have been included in the subjects' scores, so that they can see what the opposite sex options are. The newer revisions have also attempted to develop the same number and type of scales for both men and women. This has become a reality unless it was very difficult to find a norm group of one sex, such as male home economics teachers or female pilots. In addition all sexist language has been eliminated and policeman, replaced with police officer and mailman, with postal worker (Hood & Johnson, 1997).

Another issue has been the number of sex-balanced items on the inventories, because of the need to include interest items that were equally attractive to both sexes. To have a truly sex-balanced inventory there must be enough items that tended to receive approximately equal responses by both men and women. The new Strong was certainly more sex-balanced than the earlier versions, but male interest items continued to outnumber female or unisex interest items.

The Strong has attempted to eliminate gender bias by using single-sex norms and basing their occupational scales on these separate-sex criterion groups. The Strong has also reduced this bias by including scores on all occupational scales for both sexes in their profiles. Finally, the Strong has attempted to eliminate stereotypical language and develop sex-balanced items. However, until societal influences limit the experiences that men and women are exposed to or are able to explore, there will be gender-biased restrictions (Hood & Johnson, 1997).

Comparisons of Interest Inventories

There have been a number of interest and career inventories over the years, yet only a few of these have survived. According to Kapes et al. (1996), the following career assessment inventories were still in use: the Armed Services Vocational Aptitude Battery (ASVAB), the Differential Aptitude Tests (DAT), and the General Aptitude Test Battery (BATB) in the cognitive domain, and the Kuder Occupational Interest Survey (KOIS/Kuder DD), the Self-Directed Search (SDS), and the Strong Interest Inventory (SVIB/SCII/Strong) in the affective domain. Of the inventories that have survived, the Strong was the most widely used (Donnay, 1997; Hood & Johnson, 1998; Kapes et al., 1996). The Strong was based on empirical theory, Holland's personality theory and types, and reported multiple scores projecting a view of human capacity as being multipotential and made it possible to use the information provided in a profile analysis.

Kapes et al. (1996) compared the Strong to the other affective measures. The authors reported that: (1) The Strong reports the largest number of scores, 245, (2) has a minimal cost of $5.90 per student, (3) has workable time requirements of between 25 and 35 minutes, (4) has had the most recent renorming and scoring, (5) covers the widest population from High School to

Adult, (6) is based on homogenous actual responses that differentiate individuals within a group from people in general, (7) compares scaling to a norm group rather than forced choice options producing a total score across all scales as a constant number, (8) is machine scored, (9) is computer based, (10) reports scores in terms of percentiles, and standard scores, and (11) is available with various interpretive guides and career planning. By using the profile analysis high, moderate, and low scores could be contrasted to each other and the profile could also be compared to the various occupational/career opportunities being considered (Kapes et al., 1996).

Skills Confidence Inventory

The Strong's usefulness has currently been increased by the addition of the Skills Confidence Inventory (SCI), which is available only in combination with the Strong (1994). Betz, Harmon, and Borgen (1996) developed a measure of self-efficacy to assist research and practice in the vocational domain for the six Holland themes. The use of Holland's occupational organization provided a way for self-efficacy to be organized in a manner like the Strong organizes interest information.

Self-efficacy has been used as a predictor of occupational interests, choices, and adjustment behavior in a number of instances (Subich, 1997). Therefore, the addition of the Skills Confidence Inventory to the Strong will increase its usefulness not only as an interest inventory but also as a predictor of occupations. Self-efficacy for scientific occupations relates to interests in the scientific and technical areas among college students according to Lent et al., 1989 (as cited in Subich). Betz & Hackett (1981) found that math self-efficacy, too, predicted an individual's choice of math-related college major. Lapan et al. (1989, as cited in Subich) also found that occupational self-efficacy was an important component predicting causes for occupational interests. Subich also found that gender differences in self-efficacy for Holland themes were consistent with gender differences in Holland interest patterns when using the self-efficacy measure and the Strong Interest Inventory. More recently Lent, Lopez, and Bieschke (1992, as cited in Subich, 1997) studied mathematics self-efficacy and interests and found that past success experiences in math improved self-efficacy, encouraged math interests, and motivated choice of mathematics education and vocational activities.

Cultural Differences

Fouad, Harmon, and Hansen (1994) reviewed the Strong for its relationship to cultural differences and biases. The authors found that African-American men and women indicated greater liking for outdoor items and Hispanic/Latino men and women, a greater liking for languages. However, these item differences were apparent on only a few scales of the Strong and there were no differences found on the Occupational Themes. The differences on the Basic Interest Scales showed that religious activities were higher for African-Americans and Nature lower for African Americans than found in average scores on the General Reference Sample (Fouad et al.). The Personal Style Scale and Learning Environment Scale measures also showed lower interests for American Indians than the General Reference Sample. Hansen, Sarma, and Collins (1999) found that Latinos and Chicanos had different interest patterns in social elements on the Strong than did their Caucasian counterparts. Fouad et al. found that ethnic minority group members within an occupation were similar to others in that occupation in terms of the items that differentiated them from the General Reference Sample.

Studies (Fouad & Hansen, 1987 Fouad, Hansen, & Arias, 1986, 1989; Lonner, 1968; Lonner & Adams, 1972; Shah, 1971; Strong, 1943 [as cited in Betsworth & Fouad, 1997]) have been used internationally to see if police officers, engineers, and physicians correlated with the benchmarks that were found in the U.S. testing. Findings indicated that people within an occupation were more similar across countries than individuals in the same country across occupations (Betsworth & Fouad).

Counselor's Role

Goldman (1994) argued that most counselors should use qualitative assessment, because only 10 % of counselors who are qualified should use quantitative assessment. Hood and Johnson (1997) disagreed because of the higher standards imposed by recent licensing and certification requirements for counselors, they should be more qualified to use the newer tests such as the Strong Interest Inventory, which also has been improved. Randahl, Hansen, and Haverkamp (1993), found that clients who had their Strong Interest Inventory profiles interpreted to them made significant progress in their career planning.

Counselors need to be aware of the differences between male and female norms and counsel their students with this in mind. Hood and Johnson (1997) gave an example of this when they explained that women who major in science do not express as much mechanical curiosity as do men who major in science. However, these women were just as successful as men in their course work were. Additionally, if they were held to the same standards of expressed interests as men, they would be less encouraged to enter a scientific field, despite the fact that they could be just as successful (Hood & Johnson).

Testing

According to Hood & Johnson (1997) the role of the counselor in testing and in counseling situations was to be the facilitator, while the client was the primary user of test results. Counselors used the tests for problem-solving purposes to assist their clients. Because of this relationship, counselors would usually discuss, describe, and interpret test results with clients. What tests provide are an opportunity to obtain standardized information concerning individual differences that can be useful in planning counseling interventions and promoting clients' understanding of themselves. The use of an interest inventory has been among the most popular of the tests used with clients, and of the interest inventories available, the Strong was by far the most popular and well respected (see Donnay, 1997).

The Strong has been used to help the client explore their patterns of interests, personality characteristics, possible job options, career paths, and college majors. The Strong could also be used to help clients develop their potential to the fullest and find out what were areas of satisfaction for them. To be effective, however, the counselor must have an understanding of the instrument they were using and be skilled at interpreting the results to the clients. Research studies have shown that if the Strong results were presented to the client in an understandable and useful manner, there would be a significant chance that the results would point to a successful occupational choice (Goldman, 1994).

The Personal Style Scales of the Strong (1994) have been shown to be helpful in identifying personality factors that might need expression in a chosen career (Prince, 1997). Therefore, counselors would be in an ideal position to work with these personality factors with their counselees. The affective needs of clients can best be met by a facilitative therapist as described by Carkhuff and Berenson (1968), so that clients are left feeling more hopeful and more courageous than they were before coming to the counselor.

Cognitive Behavior and Social Learning Theory and Computer Self-Efficacy

Cognitive Behavior Theory

Cognitive behavior theory has viewed individuals as the producers and the products of their own environment (Corey, 1996). Reinforcement has formed a large part of this theory, both from the social environment and from individuals' own experiences. Cognitive behavior theory has been based on the simple idea that individuals' thoughts and attitudes, and not external events, have created their moods (Burns, 1989). The underlying tenant of cognitive behavior theory was that psychological distress or anxiety was largely a function of disturbances in cognitive processes. Cognitive behaviorists believe that changing cognitions will produce the desired changes in affect and behavior (Corey).

The background of cognitive behavior theory can be traced back to the ancient Greeks. Ellis (1985) noted that ancient Eastern and Western philosophers saw the interrelationship among cognitions, emotions, and behaviors. As an example of this, Ellis referred to Epictetus from the first century AD, who said "people are disturbed not by things, but by the view which they take of them" (Corey, 1996, p. 319). In modern times Ansbacher & Ansbacher (1956) recounted how Alfred Adler stated that individuals' emotional reactions and lifestyle were associated with their basic beliefs about their world and their lifestyle and were, therefore cognitively created. In cognitive behavior theory, the basic hypothesis was that our emotions come mainly from our beliefs, evaluations, interpretations, and reactions to life situations. This reaction of individuals to their social worlds was an important component of the concept of cognitive behavior theory.

Social Learning Theory

Everything individuals have done has occurred within and been influenced by a societal framework. The nature of man has been one of being an actor as well as a reactor, and therefore, individuals and their worlds influence their attitudes, thoughts, fears, and anxieties and beliefs Bandura (1977b). Thus, social learning theory represented that what has occurred between man and society was the basis of socialization. Through social learning theory, the newborn gradually creates a social self, usually within the context of the family.

Social-psychological theories have examined the interactions of the individual with the social environment such as other individuals, groups, and organizations. Social learning theory focused on meanings and how those meanings were built up, persisted, were modified and the resulting consequences in social situations (Bandura, 1977b).

Social learning theory formed the basis of how others constrained action and formulated behavior. Because social learning theory was about acting and behaving, it was basic to cognitive behavior theory and acceptance or rejection of new experiences (Burns, 1988). Responses constrained action and therefore, constructed reactions by shaping the process involved in the construction of choice, the dynamics of the situation, life cycles, and the encounters young people have which have influenced and changed them. Social learning theory stressed the meaning of choice and pointed out how the choice might reflect the shared meanings and role expectations of the family and society (Bandura, 1977b).

Therefore, the manner in which individuals have decided what actions to take have formed a complex process involving a number of variables, which will form the basis of this study. Individuals have not been alone in forming their attitudes. The role of society, family, friends, counselors, teachers and the media all have had major influences on the individuals' attitudes, and how they have perceived themselves. Their self-efficacy concept and beliefs have largely determined how individuals have perceived their competencies.

Computer Self-Efficacy

Self-efficacy has been an important social psychology construct originating from social cognitive theory as developed by Albert Bandura. Self-efficacy can be defined as the belief that one has the capability to perform a particular behavior (Bandura, 1977b, 1988; Compeau & Higgins, 1996). Self-efficacy has also included a person's confidence in providing appropriate behavior to produce a desired outcome (Bandura & Adams 1977). The authors pointed out that self-efficacy perceptions have been found to influence decisions about what behaviors to undertake and the effort exerted and persistence in attempting those behaviors. Self-efficacy perceptions also influence the emotional responses caused by performing those behaviors (Bandura and Adams, 1977; Barling and Beattie, 1983; Betz and Hackett, 1981; Brown and Inouye, 1978). Another important aspect of self-efficacy was the conviction that one could successfully execute the behavior required to produce a desired outcome (Bandura, 1982; Locke et al., 1984; Schunk, 1981; Wood and Bandura, 1989).

Self-efficacy expectations were anticipations of personal competence for executing behavior that was required to produce desired outcomes (Bandura and Adams 1977). Perceived self-efficacy was defined as a person's judgements of their capabilities to organize and execute courses of action required to attain designated types of performances (Bandura, 1986). This perception was concerned with judgments of what individuals could do with their skills, rather than the actual skills themselves. Bandura and Adams (1977) described outcome expectations as anticipations about which behaviors would lead to desired outcomes; while Meier (1985) said that reinforced expectations were anticipations concerning whether certain outcomes would meet one's goals.

Generally, the construct of self-efficacy was related to experience, confidence, and performance. Bandura (1986) in his explanation of self-efficacy, indicated that experience with successful outcomes tended to increase efficacy beliefs, and therefore, confidence in attaining future similar successful outcomes increased as well. The result of successful outcomes was performance. The level of performance at which particular tasks were accomplished would appear to vary with the level of confidence in successfully completing the task, as suggested by Bandura and Adams (1977).

Bandura (1986) contended that individuals were not passive agents subjected to the society in which they lived and to their surroundings, but instead individuals have a tremendous capacity to affect their environment. Individuals learn not only through direct experiences, but also through observing others, especially through imitating or modeling these behaviors (Corey, 1996). Bandura (1977a) emphasized that most fears were developed through social transmission rather than through direct experience with aversive stimuli.

Relationship between Theories

Social cognitive models and the resulting behavior genetics studies have indicated that between 40% and 50% of the variance in vocational interests could be attributed to genetic variance and environmental influences (Betsworth & Foaud, 1997). In particular, self-efficacy might arise from environmental sources as well as from outcome expectations that have influenced the development of interests. These social-cognitive influences from the subjects' environment have joined with the genetically related attributes of individuals' personality and ability to form the basis of interest development (Betsworth & Foaud).

Both the society and the workforce have changed since vocational interests were first studied, and they have continued to change daily. Women and racial-ethnic minorities have continued to enter and advance in the workplace. Technology also has greatly changed occupations and has led to both occupational specialization and occupational generalists (Betsworth & Foaud, 1997).

Interests have arisen in a social context (Prince, 1997). Rolo May (1967) commented that "personality cannot be understood apart from its social setting," (p. 61). The social setting of personality has been thought of as a community of other persons and has given the individual personality a world in which to function and react. Without this social system and setting, the individual personality would have no meaning. How individuals have learned and formed attitudes has been dependent on their social system. Individuals might model or copy the actions or beliefs of others, especially if these others were meaningful to their social world. The responses from the social environment have been a significant predictor of actions, thoughts, and beliefs. Behavior has also been influenced by the social world, and individuals have tended to behave according to the attitudes and beliefs they hold. Therefore, social learning theory and cognitive behavior principles along with self-efficacy measures have been major determinants explaining why people think, feel, and act the way they do (Bandura, 1986).

Survey Research Methods

According to Alreck and Settle (1995), survey research has been conducted to influence or persuade an audience, to create or modify a product or service, or to predict or understand a particular human behavior or condition. Survey research has been performed for business and professional and academic audiences, because the results usually have provided a better understanding of a situation, attitude, or behavior.

Surveys, in the form of questionnaires or other measures, have been used for practical or applied purposes, because they have guided decision making and usually have resulted in some sort of action. Other surveys have been theoretical and gathered information about people or tested hypothesis, to enhance knowledge in the field (Alreck & Settle, 1995)

Surveys were foremost measurement tools that gather information but generally did not measure causality. Fowler (1993) indicated that the purpose of the survey was to produce statistics or quantitative or numerical descriptions of some aspects of the study population, usually by asking people questions and these answers would constitute the data to be analyzed.

The survey researcher has ethical responsibilities to both the sponsors of the research and the respondents. The researcher must maintain the privacy and anonymity of the participants, if this was what had been promised. Surveys usually involved asking questions and obtaining self-reports by respondents and as such constituted behavioral samples (Alreck & Settle, 1995).

Single-Case Research Design

Kazdin and Tuma (1982) described single-case research design as a design that could “detect mechanisms and dynamics or lawful interactions that are the essence of development” t o understand the underlying behavioral processes (p. 81). A single-case research design was “only a tool to be used when relevant, appropriate, feasible, and cost effective, both financially and in terms of the scientific costs of missing a true phenomena of reporting as true what in reality may be random error” (Kazdin & Tuma, 1968, p. 86).

In the present study, the choice of a single high school was relevant, appropriate, feasible, and cost effective. Because the High School was an elite high school in an unusual community, there should be little difference in the attitudes of males and females about computer and information technology or any anxiety about computers. All the factors, which would assure computer access, seemed to be available in this community. Good schools, supportive and knowledgeable parents, high computer use in homes and at school, advanced courses in both computer science, a relational computer and information technology course, and 95% college attendance rate for the students were all present at the High School. However, since there has been a difference in the pattern of courses taken, career preferences, and student attitudes toward computers, this single case study should provide new information to the field of computer attitudes, anxiety, self-efficacy and computer use.

Summary

This review of the literature revealed that there were major components affecting computer attitudes and anxiety. Gender, computer experience, self-efficacy, media, Internet, school, counselor and teacher influences, were all vital to understanding the roles of men and women in IT. Significant gender bias and sex stereotyping were discovered in the literature concerning IT and women's roles in the field. The influences of parents, peers, and other role models were also important, although not as widely studied, as were the effects of gender and experience on computer attitudes and anxiety. Little research was discovered, however, related to the differences in attitudes between young men and young women in an elite, computer-rich environment with all of the computer advantages, training and courses available in the community and at the high school site.

The review of the literature identified that some level of technophobia or anxiety toward computers was being exhibited by 25% to 55% (mostly female) of individuals, students and business professionals (Brosnan, 1998; Heinssen et al., 1987; Meier, 1988; Rosen, Sears & Weil, 1987, 1993; Rosen & Weil, 1990, 1995). These statistics constitute significant percentages and seem to warrant the assessment of high school student’s technophobia and computer anxiety levels to identify areas where changes, new programs, support mechanisms, and counseling are necessary.

CHAPTER III

METHOD

This chapter details the method of the study, which was designed to determine if there were gender differences in computer attitudes, interests, and usage in a population of computer literate juniors and seniors at an elite high school in a high-tech area of Northern Virginia, just outside of Washington, D. C. The specific topics to be addressed in this chapter include: (a) a restatement of the problem, (b) the sample including the site and the community, (c) the research design, (d) an explanation of the instruments and variables in the case study (e) a description of the procedures used, (f) an explanation of the data analysis procedures, and (g) a chapter summary.

Problem Statement

Despite the introduction of computers into homes and schools, the equal access legislation and school programs, and the significant increase of available and high paying jobs in IT, there has been a gap in the number of females, who have had an interest, have studied, planned careers, and have actually worked in IT. This gap appeared to be operating at an elite high school in Northern Virginia. Therefore, the present case study was devised to examine the gender differences in computer attitudes, interests, and usage of the 11th and 12th graders in this High School.

Community and Sample

City of Falls Church

The city of Falls Church is a small suburban city located 7 miles from Washington, DC. Falls Church is a family-oriented urban village of 10,000 where most families are dual income earners and have college degrees. Citizens of Falls Church were determined to improve the quality of local schools and led a successful effort to separate Falls Church from Fairfax County in 1948. This made the City of Falls Church the only known community at that time to establish itself as a city primarily to provide an independent school system. The quality and reputation of the school system has always been a priority in Falls Church City where the average per pupil cost is $9,233 per year (School Profile, 1998-99). The school system is composed of two elementary schools and the middle school and high school, all of which have received the Department of Education's Excellence in Education award.

An Elite High School

This High School is a 9-12 secondary school of 524 students with a pupil/teacher ratio of 18 to 1 (School Profile, 1998-99). The school is accredited by the Commonwealth of Virginia and the Southern Association of Colleges and Schools. The campus consists of 36 acres of land with soccer, football, baseball, and softball fields, as well as a quality track and four illuminated tennis courts. The High School is located at the northwest end of the city near the West Falls Church Metro Station, giving students and faculty easy access to Washington, DC. The school is also located next to the new University of Virginia/Virginia Polytechnic Institute and State University (Virginia Tech) Northern Virginia Graduate Center campus.

Falls Church City Schools currently have a partnership with Virginia Tech and share a sophisticated state of the art computer center. This facility is available to all the High School students during the day and to Virginia Tech students in the evenings. The City of Falls Church 1995 Technology Plan was commended by the State of Virginia as a model program with a facility that is among the best in Northern Virginia.

Challenge Awards

The High School was ranked as the number two school among America's 25,000 public high schools in Newsweek's March 13, 2000 article: "The 100 Best High Schools" (Mathews, pp. 50-53). The High School had previously been named the most challenging high school in the greater Washington, DC area for 1997 and 1998 (Washington Post Magazine, March 22, 1998 and Washington Post Magazine, October 24, 1999).

Student Body

The make-up of the student body includes representatives from 35 different countries throughout the world. The racial and ethnic mix is approximately 72% White, 14% Hispanic, 10 % Asian, 3% African American, and 1% American Indian (School Profile, 1998-99). Approximately 24% of the study body are international students, 29% are bilingual, and 36% are transfer students to the school. The student body is high achieving with 95% attending college, 80% at four-year institutions, and 15% at two-year colleges. The dropout rate at the High School is less than 1% and usually 4% to 5 % of the students go into military service and either work or travel after graduation.

The Class of 1999 had an average SAT I score of 1140 compared to the National Average of 1016 (Educational Testing Service, 1999). Females at the High School had higher mean scores in both the Verbal and Math SAT I (Verbal SAT I, 577; Math, 576; Total, 1153) than males did (Verbal, 565; Math, 562; and total SAT I, 1127). This was converse to the national mean scores, where females scored lower (Verbal, 502; Math, 495; and total SAT I, 997) than the males (Verbal, 509, Math, 531, and Total SAT I, 1040), (Educational Testing Service, 1999).

Curriculum

The curriculum at the High School provides a diversified and individualized academic and vocational program to students. Gifted students may participate in the science and technology magnet school, and students who wish to take hands-on vocational courses may attend a separate career center in Arlington, VA. Transportation from the High School to the career center is available three times per day.

To qualify for graduation with a regular diploma of 21 credits, students must have the following: English credits (4), history credits (3), math (2) and science credits (2), an additional math or science credit (1), a fine or practical art credit (1), physical education credits (2), and elective credits (6). In the class of 1999, 28% of the students received this diploma.

An advanced studies diploma requires the same credits and more difficult course work, including more advanced math including Algebra I and II and Geometry, lab sciences (3), and foreign language (3). In the class of 1999, 71% of the students received this diploma. Certificates of attendance are awarded to students who do not seek a high school diploma or are taking and Individualized Education Program of studies. In 1998-1999, one student received a Certificate of Attendance.

International Baccalaureate Program

A very challenging academic program, the International Baccalaureate (IB) is also offered to students at the High School. This program of syllabi and examinations incorporating global perspectives offers a rigorous, comprehensive education during the last two years of high school. Approximately 86 % of the class of 1999 participated in one or more of these classes and 18% received the IB diploma. The IB diploma requires a minimum of 24 points, in six examinations graded on a 1-7 scale in Higher Level (IBH = 2 years of study) and Standard Level (IB = 1 year of study) courses of study. Three of these courses and examinations must be in Higher Level courses. Students must also complete a 4000 word extended essay, the Theory of Knowledge course, and 150 community service hours. Between 10% and 25% of each year's graduating class generally receive the IB diploma (IBO, 1999).

The High School was the first school in the State of Virginia to establish the IB Program in 1983, and the school has trained a number of new IB schools in the area. In the IB program students study in six general subjects including: (1) first language, (2) second language, (3) individuals and societies; (4) mathematics, (5) sciences, and (6) a sixth elective subject such as theater arts, art, music, and computing studies. In the area of computing studies there are three IB offerings including, IB and IBH Computer Science and IB Information Technology in a Global Society (ITGS). The High School is currently the only school in the greater Washington, D.C. area to offer ITGS.

<u>High School Credits and Grade Point Averages</u>

All courses at the High School are divided into unit's equivalent to one half of the school year. Students earn .50 credit for each semester course passed. Each semester of work is independent and no final year grades are given. Students take seven classes per semester for seven credits. Classes are scheduled in alternating A and B block days. Three 100-minute blocks and one 50-minute block (5^{th} for lunch periods) are held each day. Class rank is computed using quality points (A - 90 to 100 = 4.0; B - 80 to 89 = 3.0; C - 70 to 79 = 2.0; D - 60 to 69 = 1.0), which are divided by the number of credits earned to determine Grade Point Averages (GPA). All high school subjects, whether passed or failed, are included in the GPA computation. IB courses are weighted by applying an additional 1.0 quality point to the final grade. All students enrolled in IB classes are required to take the IB examination.

College Attendance

Students from the High School attend the finest colleges and universities in the United States and throughout the world. Most students choose to stay in the State of Virginia and attend in order of preference, University of Virginia, College of William and Mary, James Madison University, Mary Washington College, Virginia Tech, George Mason University, and Virginia Commonwealth University. The most popular out-of-state universities in order of preference are: University of North Carolina at Chapel Hill, Duke University, Yale, Princeton, Harvard, Dartmouth, Amherst, Cornell, New York University, Northwestern, Caltech, University of California at Berkeley and San Diego, University of Michigan, University of Ohio, University of Florida, University of Colorado, the Naval Academy and West-Point. Students also attend schools abroad including Oxford, Cambridge, and schools in Norway, Sweden, Spain, and Italy. Students who attend two-year colleges enroll at Northern Virginia Community College Annandale or Alexandria branches for the Associate of Arts (AA) degree and then may transfer to four-year colleges in Virginia.

Technology at the High School

The High School has the latest computer equipment and an experienced staff. Courses are offered in word processing, web page design, basic programming, computer science, basic technical drawing, mechanical drawing, engineering drawing, and the three IB computer classes; two in programming and one it IT. Nearly 90% of the students at the High School have taken one or more computer classes during high school. Students may also participate in IT courses at the career center including computer aided design, introduction to engineering, electronics, and computer assisted commercial art. The new computer lab, TLC, is available to all students taking computer technology classes and to those working on the high school literary journal and the school newspaper. Students also take the journalism elective class using the equipment in the TLC.

When students have “topped out” in terms of math classes at the High School, they have the option to enroll in the advanced mathematics courses on the Web from Virginia Tech’s Math Emporium in Blacksburg, VA for college credit. Students use the computers in the TLC to access these advanced math courses and the High School pays for the college classes.

The ratio of students to computers is one computer for every five students. Four computer labs are available for students in the school. One lab is located in the Media Center with 35 computers for research and other assignments. A separate classroom in the Media Center contains 15 computer workstations. There is a large computer lab for the math department containing 30 computers. There is also a writing lab for the English and social science classes containing 30 computers. The middle school has two separate computer labs. A full-time Computer Coordinator and an assistant manage this technology. There is also support from a central office computer-coordinator and programmer.

The faculty who teach computer science, IT, keyboarding, and word processing are all females, all trained in math except the keyboarding and word processing instructor. The teacher of the new IB technology class was an engineer in the corporate world before coming to the High School. A male, who is a gifted artist and designer, teaches all the three technology drawing classes. The entire faculty participates in computer training at least twice a year. Every teacher has a computer or two in their classrooms and all are computer literate. All school messages are sent using E-mail, so everyone participates in the computer network. All school computers are hooked up to a Local Area Network (LAN), contain Microsoft Office 97, PageMaker, and are connected to the Web.

The Juniors and Seniors at the High School

During the 1998-99 school year, the junior and senior classes of the High School were the participants for this study. The Class of 1999, the senior class, was composed of 107 students and the Class of 2000, the junior class, was composed of 131 students. Most of the students in these classes have been high achievers in terms of their GPAs, SAT I scores, PSAT scores, participation in IB classes, and college aspirations.

The juniors and seniors have also been active in both extracurricular and volunteer activities. Because of the nature of the student body, internationalism is a priority at the High School. The students are involved in the Model UN, the International Club, and participate in activities that provide opportunities for all students to experience different cultures. Approximately 80 % of both classes participate in extra-curricular activities including sports, clubs, student government, volunteer activities, the newspaper, yearbook, and literary magazine. There is a great deal of school spirit and many activities to round out the academic program of studies.

Tuition Students

Partly because of the IB program, but also because of the small class sizes and atmosphere of the school, a number of students elect to leave their home school and come to the High School as tuition students. Tuition students pay approximately three-fourths of the per pupil cost to attend this high school. The 1998-99 tuition was $7,500 with another $200 for participation in special programs such as the IB. In the 1998-99 school year there were 28 tuition students enrolled at the school. These students come from surrounding counties and cities. Many military families come to this school and several students have driven from Bolling Air Force Base, MD.

Summary

The High School is a unique school in a unique community and therefore, the choice of this school for the case study seems appropriate. Although there may not be many schools like the High School, this is a school where one would expect little resistance to computer technology and study and, also, little computer anxiety or technophobia. With all of the technology available, one would expect that several of the students, both male and female would consider IT as a field of study or career. However, despite all of the advanced technology available at the High School, the college aspirations, and the strong test scores, few females have taken advantage of the more advanced computer and technology classes.

In the 1998-99 school year, one female planned a major and career in computer and information technology. She seemed to have been the exception rather than the rule. This young woman was one of the four young women and eleven young men to take the new IB course, ITGS in the 1998-99 school year (Peterson's, 1999; McGraw-Hill, 1999). As we progress in the new millennium, technology will continue to gain popularity in the workplace and as career choices. However, if young women are not interested in or proficient in technology, they will be seriously disadvantaged.

Research Design

This study is a descriptive case study, which focuses on the computer attitudes and usage of 11^{th} and 12^{th} graders in an unusual school. Students in the 11^{th} and 12^{th} grades were selected because they have all taken the Strong Interest Inventory as preparation for their college searches, and as juniors and seniors are ready to leave high school and consider career and college major options. The study summarizes the gender differences in the computer attitudes, interests, and usage of the 11^{th} and 12^{th} graders, as well as their demographics, perceptions, influences, course selections, and college majors.

Instruments and Variables

Three sets of instruments are used in this study. The first instrument, the Computer Attitude Survey, is the student questionnaire designed by the researcher. This instrument asks the students about demographic characteristics, their ratings of computer anxiety and self-efficacy, the usefulness of career counseling and education, computer technology, computer experiences, coursework, influences, future computer study and usage, and college major and career choices.

The second instrument, The Strong Interest Inventory, is used to determine what the career interests and characteristics are of the 11^{th} and 12^{th} grade students. At the High School, this inventory is given to 11^{th} graders in the spring semester of their junior year to help them with career planning, college options and majors. According to Donnay (1997), the Strong is a well-known and well-researched interest inventory that has been used more than any other interest inventory by professionals in the field.

The third instrument combines three measures of scholastic aptitude and performance. These include the Preliminary Scholastic Aptitude Test (PSAT), the SAT I (Scholastic Aptitude Test I/total SAT I), and the students Grade Point Average (GPA) from the end of the junior year at the High School. Since standardized tests are used by colleges to determine the probability of academic success of the test takers, they are important variables in choosing colleges and college majors. GPA measures how well a student does (grades) compared to the other students in his/her class. Each of these instruments is described below.

Computer Attitude Survey Questionnaire

The student questionnaire consists of 107 items (see Appendix E). The first section of the questionnaire contains two measures, one of computer anxiety and computer attitudes, and another of computer self-efficacy. These two measures were carefully researched to assure that they would be appropriate for this high school population. Computer anxiety was measured by Heinssen, Glass and Knight's 1987 Computer Anxiety Rating Scale (CARS) containing 19 items, and computer self-efficacy was measured by 8 items from Delcourt and Kinzie's 1993 Attitudes toward Computer Technology (ACT) self-efficacy scale.

The other questions were developed from the literature review, conversations with counselors, high school students, and other school staff involved in the career counseling of high school students. The questions were kept brief to encourage participation.

The questions were structured so that the responses would fall into predetermined categories or scale values. The researcher precoded the questionnaire by giving a number code to each structured question. The researcher combined the "response codes" (Alreck & Settle, 1995) with the format codes which indicated that position where the data for each item would be keyed. Then the researcher placed the section and question number to the right of each section or box answer. The checklists and open-ended questions varied and therefore, were not precoded. Dichotomous responses were also not coded because they are usually "yes or no" variables.

The researcher presented the student questionnaire to the Spring Semester, 1999 Virginia Tech class in Survey Research. This class of doctoral students and professionals had studied survey research for the past four and one-half months and had many helpful suggestions and revisions. This revised student questionnaire contained a series of questions pertaining to computer attitudes, interests, usage, and career counseling resources, as well as student and parent demographics, career, and college major choices.

Content of the Student Questionnaire

The student questionnaire consists of a one-sided title page “Computer Attitude Survey” followed by two blank lines. The top line is for the student’s name and the bottom line for the students grade level. This page was destroyed after the responses were entered into the spreadsheet for confidentiality purposes. The student names were used only to gather academic data.

Section A contains the 27 computer attitude, anxiety and self-efficacy items (19 CARS items and 8 ACT items) with a stem and a 5-point Likert-like scale ranging from 1 = Not at All to a 5 = To a Great Extent. This scale contains 13 positively worded items and 14 negatively worded items in random order. Sections B and C contain 17 items which students rated the importance of career counseling and guidance needs and tools on 5-point Likert-like scales including, 1 = Not Important, to 5 = Extremely important. Additionally, a sixth category of Not Applicable (N/A) was also provided for students to choose. Section D contains 8 items on a 5-point Likert-like scale about the amount of time students perceived they spent on the computer during the past week. The choices included doing various tasks and 16 check list items about parents’ use of computers for specific tasks. Sections E and F contain 16 items on a 5-point Likert-like scale about the current and future importance of computers to students. Other items concerned the importance of salary, interests, aptitudes, and other reasons for choosing college majors or careers.

Demographic data about parental occupational status, income, and computer use at home were queried in eight check box items in Section G, and in seven check box items in Section K.

Section K also includes demographic data about student's educational plans and college majors. Section H contains two open-ended questions about a "dream career" and the use of computer technology in this career. Section I contains 4 items on a 5-point Likert-like scale, 1 = Disagree and 5 = Strongly Agree, and one open-ended "other" item about computer usage and restrictions at the High School.

Computer Attitude, Anxiety, and Self-Efficacy Measures

Choice of Computer Attitude and Anxiety Scale

Since there have been so many different computer attitude scales developed and used by researchers, the choice of a particular scale was difficult. Most of the attitude and anxiety scales were geared for certain problems, populations, and research methods, therefore, the measure of the best scale to use for the current problem was determined by the population and issues studied. Connell (1991) argued that computer attitude was a complex phenomenon, therefore, simplistic generalizations were not possible. Because there were so many parts to attitudes and the attitudes were often, so site specific, dealing with anxiety, which might be the product of attitude, seemed to make more sense (Connell). Further, Brosnan (1998) reported that attitudes were poor predictors of computer use. The author explained that because people could hold both negative and positive attitudes and since anxiety was not a type of attitude, but a separate construct, it was a more viable measure to study.

According to Brosnan (1998) computer anxiety involved more affective responses and fears that students would be embarrassed, look stupid, or damage the computers. The author continued by stating that "even though attitude and anxiety combine to form technophobia, it is the anxiety rather than the attitudes that predict computer-related performance" (p. 33). Heinssen et al. (1987) found that computer anxiety was a "unique construct, which is related to but is considerably different from other forms of anxiety" (Heinssen et al., p. 56).

Computer Attitude Rating Scale (CARS)

CARS (Heinssen et al., 1987) was the only computer anxiety instrument found by the researcher that was designed to be used not just to measure computer anxiety, but to provide counseling and treatment for the outcome of the anxiety. From both a research and a counseling point of view, CARS is an appropriate instrument to use, because of the validity and reliability of the scale (Chu and Spires, 1991) and the purpose of the current study. The purpose of the current study is to assess the level of computer anxiety and to institute treatment objectives in a setting that would not be expected to have computer anxiety. If computer anxiety exists, the counseling staff of this and other high schools might be able to set realistic goals and treatment plans to help correct or alleviate some of the factors, influences, and consequences of computer anxiety.

CARS was also one of the few scales that was based on a strong theoretical foundation. Heinssen was a clinician, who firmly believed in cognitive behavioral theory and therapy, which he practiced with his patients at Chestnut Lodge outside of Boston, MA. Cognitive behavioral theory has been widely accepted by clinicians, therapists, counselors, and other members of the helping professions. A popular example of this theory in action is Ellis's (1985) Rational Emotive Theory (RET), which uses cognitive thought processes to understand and deal with the every-day frustrations and anxieties that all humans experience. Cognitive factors play an important role in computer anxiety, as technologically challenged people try to cope. Heinssen and Glass (1986) found that CARS scores of computer-anxious individuals showed a decrease as a function of cognitive-behavioral interventions for computer anxiety.

Heinssen et al. (1987) found that 70% of the references dealing with computer anxiety were non-empirical and often correlated computer anxiety with state anxiety, or were unpublished and not extensively validated. CARS examined the behavioral, cognitive, and affective components of computer anxiety, and produced a multimodal validation of the scale (Heinssen, et al.). Recently, CARS has been used in a number of articles, theses, and dissertations (Asserman & Reed, 1995; Bogom-Haselkorn, 1991; Bowers & Bowers, 1996; Chu, 1990; Chu & Spires, 1991; Garrett & Bullock, 1997; Gos, 1996; Harris, 1989; Hick, 1999; Parrish & Necessary, 1996; and Rameriz, 1997).

CARS contains nine positively worded and ten negatively worded items to control for response set. These items correlated at a statistically significant level with the total score, ranging from .23 to .64 ($p < .0001$) with an average item-total correlation of .48 (Heinssen, et al., 1987). The responses to positively worded items on CARS are reversed by the researcher before analysis so the higher scores on all items indicate greater levels of anxiety. CARS 19 item scale had a mean of 43.58 ($n = 270$, $SD = 11.73$), and scores ranged from 21 to 89 out of a possible range of 19-95. CARS demonstrated high internal consistency (Cronbach alpha = .87), and was reliable ($r = .70$, <. 0001) and stable ($t = -1.06$, $p < .30$) over a test-retest interval of four weeks (Heinssen et al.).

To measure concurrent validity of CARS, the Computer Attitude Scale (CAS) by Loyd & Gressard (1984) was used as the validity measure. CAS is a popular attitude scale and was cited many times in the literature search. The correlations that were obtained between CARS and the three CAS (Loyd & Gressard, 1984) scales were Anxiety, - .69; Liking, - .60; and Confidence, - .74, all based on $n = 270$, $p < .001$. Computer experience was - .33 based on $n = 270$, $p < .001$. Math anxiety and trait anxiety showed that higher levels of computer anxiety were statistically significant and related to greater math and trait anxiety, although these correlations were low (.26, and .20), ($n = 270$, $p < .001$). Discriminant validity of CARS was obtained by including measures of trait, math, and test anxiety. CARS was also shown to correlate negatively with SAT scores (SAT Verbal and SAT Math scores = - .32, n = 59, p <. 01), such that students who did more poorly on both quantitative and verbal subscales tended to report more computer anxiety. Finally, mechanical interest correlated negatively at - .48 (n = 59, p < .001) (Heinssen et al.). The mechanical interest scale from the Kuder Preference Record (Kuder, 1934, as cited in Heinssen et al., 1987) was compared to CARS results. Heinssen had found through his clinical experience and clinical interviews, that low mechanical interests were related to some individuals' apprehension about computers.

Heinssen et al. (1987) found that students who had little interest in or experience with mechanical or technological applications might hold the false belief that they would never be able to understand how computers worked. The authors also noted that students, who had lower levels of mechanical interests, which correlated with higher levels of anxiety, might see computers as intimidating due to their association with machines and technological innovation. The authors also reported that there were statistically significant correlations between CARS and measures of math and trait anxiety, which may in part be associated with the perception that computers are mathematical tools.

Concerning gender, an analysis of CARS scores found that women reported higher levels of computer anxiety (M = 44.57, SD = 10.94) than men (M = 41.97, SD = 12.81). However this difference was not statistically significant, F (1,268) = 3.16, p < .08 (Heinssen et al., 1987). The same pattern was noted concerning experience. Women reported less experience with computers (M = 7.64, SD = 4.74) than did men (M = 11.08, SD 5.39), F (1,264) = 29.71, p < .0001 (Heinssen et al.).

Heinssen et al. (1987) as cited in Hess and Miura (1985) indicated that since women had lacked the computer experience of men, girls were not becoming as involved with computers as early as young men were. Heinssen et al. also cited in Kiesler, Sproull, & Eccles (1985), indicated that girls tended not to want to enter the computer domain, because it was dominated by the male culture of computing. Heinssen et al. recommended counseling for high anxiety scorers on CARS. The authors also stated that: "It may be the case that efforts to increase women's access should focus as much on increasing knowledge and skills and promoting enrollment in computer-related courses as on dealing directly with computer anxiety" (p. 57).

Choice of Computer Self-Efficacy Measurement Scale

Since there has not been a pure computer self-efficacy measure developed, the scale that was mentioned the most often in the literature was the "Attitudes toward Computer Technologies Scale" (ACT) by Delcourt and Kinzie (1993). This survey consists of 19 items on Likert-like scale. Several items were very close to Heinssen et al. (1987) CARS questions, and several questions were specifically about work situations, which would not be appropriate for high school students. Eight questions, however, did appear to be appropriate to the high school population to provide a measure of self-efficacy. These eight questions, four positively worded, and four negatively worded items were added to the 19 items CARS measure in Section A. This positive negative ratio followed CARS 19-item scale ratio of nine positively worded and ten negatively worded responses.

The Delcourt and Kinzie (1993) ACT scale had an internal consistency reliability estimate of .86 for the entire 19-item scale ACT. The alpha reliabilities derived for subscale comfort/anxiety and usefulness were .86 and .82 respectively. The internal reliability coefficients were compatible with results and similar to those in the Murphy, Coover, and Owen

(1989) computer self-efficacy scale.

The Strong Interest Inventory (Strong)

According to Harmon et al, (1994), the Strong is an interest inventory that produces scores on the following five scales: (1) Administrative Indexes, (2) General Occupational Theme Scales, (3) Twenty-five Basic Interest Scales, (4) Occupational Scales, and (5) Personal Style Scales. The current study uses all but the Administrative Indexes and the Occupational Scales. According to Hood and Johnson (1997) the Occupational Scales are more relevant for individuals 20 years or older and the administrative scales are used more for checking response sets and omissions.

The General Occupational Theme Scale (GOT) is a homogeneous scale and gives a summary or overview of the Strong profile and a framework for interpreting the other scales. Holland’s (1985) descriptions of the six types of occupational personalities form the basis of this scale and each of the six scales contains items to fit these categories. The GOT scales have been standardized using t-scores so that the general reference sample of 9,484 men and 9,467 women will obtain a mean of 50 and a standard deviation of 10. These t-scores are based on combined-sex norms, but with bar graphs beside the scales on the profile sheet to indicate how the scores are distributed for each sex (Hood & Johnson, 1997). Below are the six types of interests (RIASEC) that classify people and are usually presented in a hexagon indicating that the closer the categories are to each other, the more highly they are interrelated:

> R (Realistic): People who enjoy or do well in technical, physical, mechanical, or outdoor activities. I (Investigative): People with scientific, mathematical, analytical, or scholarly interests or skills. A (Artistic): People who like or do well in music, art, writing, drama, or other creative activities. S (Social): People interested or skilled in working with or

helping others (e.g. teaching, counseling, or nursing.) E (Enterprising): People with interests or skills in business, management, sales, public speaking or leading others. C (Conventional) People with interests or skills in keeping records, organizing data, attending to detail or following through on others' instructions (Hood & Johnson, 1998, p. 164).

The 25 Basic Interest Scales represent a single type of interest, which are subscales for the RIASEC categories. The Basic Interest Scales are grouped into the six GOT categories based on correlations between the two sets of scales and the GOT scales subsuming three or more of the Basic Interest Scales (Hood & Johnson, 1997). The Basic Interest Scales are standardized in the same manner as the GOT scales and are based on separate sex-norms.

These separate-sex scales are present to take into account differences in social conditioning (Hansen & Campbell, 1985). This career interest inventory was chosen specifically for the present study, because it contains these separate scales for men and women. The latest Strong has made a clear statement about the different ways males and females are socialized and the effect this has on the career interests. Subjects, however, are able to see both of the scores, but only the like sex scores are plotted on the Strong printout. The Strong manual indicates that the two scores are highly correlated, but men tend to obtain higher scores on cross-sex scales for traditional male occupations such as military officer. Women obtain high scores for traditional female occupations such as interior decorator (Harmon et al., 1994). Hansen and Campbell's (1985) comments still apply because these differences should not be used to discriminate against or repress any individual of either sex. The route to equal treatment should not necessarily be through identical treatment, but should be used to expand rather than limit options.

The Personal Style Scales measure personality factors that are related to educational and career planning and yield bipolar high score and low score ratings (Hood & Johnson, 1997). The four scales consist of: (1) Work Style where high scorers prefer to work with people, while low scorers prefer to work with ideas, data, or things; (2) Learning Environment where high scorers have academic interests associated with advanced degrees, while low scorers have more practical interests associated with technical or trade school attendance; (3) Leadership where high scorers prefer to direct others, while low scorers prefer to lead by example; and (4) Risk Taking/Adventure where high scorers prefer to take chances, while low scorers prefer to play it safe (Hood & Johnson, 1997).

Harmon (1994) indicates that the Personal Style Scale Scores correlate highly with the GOT scales, especially the Work Style Scale while the Social and Enterprising scales are negatively correlated with the Realistic and Investigative scales. The Learning Environment scale overlaps with the Investigative and Artistic scales as does the Leadership Style scale and the Enterprising, Social, and Artistic scales; and the Risk Taking/Adventure scale which is highly correlated with the Realistic scale. Campbell (1972) cautioned that the Personal Style Scales do not have the validity of the occupational scales and should be used with caution and always by trained individuals.

Reliability of the Strong Scales

The earliest Strong Inventory demonstrated adequate reliability and permanence (Strong, 1935, as cited in Donnay, 1997). The 1994 Strong Interest Inventory scores have considerable test-retest reliability, which is a measure of consistency over time, even when the second test is taken many years later (Hood and Johnson, 1997). The authors list some synonyms for reliability including “dependability, reproducibility, stability, and consistency” and indicate that reliability is concerned both with the natural variation in human performance and with the technical aspects of psychological measurement, p. 43).

The General Occupational Theme scales were found by Tracey and Rounds (1993, as cited in Hood and Johnson, 1997) to be one of the best sets of measures of Holland's proposed types. Hansen, Sarma, and Collins (1999) reported median test-retest scores for the GOT scales are .91, .86, and .81 over 2-week, 30-day, and 3-year periods, respectively. Measures of internal consistency for the GOT scales are also high: median coefficient alphas are .91 for women and .92 for men (Hansen & Campbell, 1985).

Validity of the Strong

There has been conflicting information about the validity (whether or not the instrument measures what it is supposed to measure) of the Strong. Strong early on emphasized criterion-related evidence of validity for the scales use in discriminating among occupational groups and predicting the occupations of individuals (Donnay, 1997). Criterion-related evidence of validity can be either concurrent or predictive. Both concurrent and predictive studies attempt to assess the degree to which test data can be used to estimate scores on a specific criterion. For the Strong this criterion is occupational group membership (American Psychological Association, 1985, as cited in Hood and Johnson, 1997). The authors attest that the 1994 Strong Interest Inventory does have some predictability of the occupation that a person is likely to enter in the future and how long they will stay in the occupation, but not so much predictability for success in the occupation. The Strong Interest Inventory also has "treatment validity," which means that the results obtained from the test make a difference in the treatment (Hood & Johnson, 1997). Numerous other studies have demonstrated substantial evidence of predictive validity for the Strong (Hansen & Swanson, 1983; Hansen & Tan, 1992; Spokane, 1979; Swanson & Hansen, 1985 (as cited in Hansen, Sarma & Collins, 1999).

According to Hood and Johnson (1997) the 1994 Strong Interest Inventory General Occupational Themes and Basic Interest Scales possess a high degree of content validity because of the manner in which they were constructed. Empirical validity studies indicate that both sets of scales effectively discriminate among people employed in different types of occupation (p. 165). The concurrent validation studies of the occupational scales show that they differentiate between "people in the occupation" and "people in general" (Harmon et al., 1994). A number of longitudinal research studies have been conducted to examine the predictive validity of the Strong. These studies indicated that that "between 55% and 70% of the people who take the Strong will become employed in occupations congruent with their high scores on the Occupational scales" (Hood & Johnson, p.168).

Stability of the Strong

Hansen (1984, as cited in Betsworth & Fouad, 1997) reported that the interests of individuals, as well as occupational groups and society in general were stable across studies (Strong, 1943, 1955; Hansen & Stocco, 1980; Swanson & Hansen, 1988 (as cited in Betsworth & Fouad). Recently, Hansen (1988, as cited in Betsworth & Fouad) studied the stability of interests and found that by using archival data from the Strong Interest Inventory that spanned 50 years, both women and men exhibited stability of interests within occupations over extended periods of time. Hansen selected six occupations that were tested at least three times between the 1930s and the 1980s and had archival data for men and women in these occupations.

In order to study changes in society, Hansen (1984) took data from "women-in general and men-in general samples" that were used for developing the Strong Interest Inventory. These results showed that the interests for women were nearly identical over time and the interests for men revealed only a few small changes. Thus, both stability of interests for men and women over a 50-year period and the persistence of sex differences in interests were chronicled (Hansen & Campbell, 1985).

Academic Aptitude Measures

Preliminary Scholastic Aptitude Tests (PSAT) and Scholastic Aptitude Tests (SAT I)

Both the PSAT and the SAT I tests measure student's aptitude for academic tasks. Anastasi (1968) said that the PSAT has been used as a shorter comparable form to the Scholastic Aptitude Tests (SAT) since 1959. The PSAT is a qualifying examination for the National Merit Scholarship competition taken by all juniors in October each year. Both tests are written and produced by the Educational Testing Service of the College Entrance Examination Board (CEEB) and College Board examination rules and regulations restrict their use. Both tests have been "recentered" resulting in change of name for the SAT to SAT I, to distinguish it from the specific achievement tests.

Both the PSAT and SAT I follow the standard format of multiple-choice for the Verbal sections, as well as filling in the grids for the Math sections. In 1997, the Preliminary Scholastic Aptitude Test/National Merit Scholarship Qualifying Test (PSAT/NMSQT) added a writing test to the PSAT to help more females qualify for National Merit Scholarships. The rationale was that since females tended to do better on written expression tasks, the addition of this new scale would even out the scoring distribution. The results appeared to be successful because this year more girls were in the high scorers category, most likely due to the new selection index calculation, which was a combination of the Verbal, Math, and Writing Scales ("More females," 1999).

The Verbal PSAT and SAT I sections consist of analogies, sentence completion, and reading comprehension items. The Math PSAT and SAT I sections consist of test items measuring concepts and processes involved in mathematical reasoning and interpretation of graphs and diagrams, and includes items dealing with arithmetic, geometry, and algebra. The students are able to show their work and grid in the correct answer in the space provided. Students are given credit for all questions answered correctly, and a small number of points are subtracted for incorrect answers. The PSAT takes approximately one and one half-hours to administer, while the SAT I takes three hours.

The PSAT is not classified as a measure of intelligence, but rather of academic aptitude and the prediction high school students performance on the SAT I. This then is taken as a predictor of success in college, the ability to do college level work, and actual college grades. Students from higher socioeconomic levels do tend to do better on both tests, but the quality and kind of high school math and English preparation has also been an important variable on the scores received (Hood & Johnson, 1997). Students who read a great deal will have an easier time recognizing some of the vocabulary words, understanding the analogies, and understanding the reading comprehension sections.

PSAT and SAT I Scores

Scores on the Verbal, Math, and Writing PSAT scores have a range from 20 to 80. These scores are designed to be comparable (with an additional 0 added to each score) to the SAT I scores that students would be expected to obtain when they take the SAT I. The SAT I has only Verbal and Math scores, which range from 200 to 800 (Hood & Johnson, 1997), and total scores (Verbal + Math) from 200 to 1600, with a mean of 500 and a standard deviation of 100.

Selection Index

The other index that is important for the PSAT is the "selection index" score. This score determines the "high scorers" category, or the top 5% of the students taking the PSAT each year (College Board, 1998). This score traditionally came from doubling the Verbal score and adding the Math score to it to give the selection index score, but now comes from adding the scores of the three scales (Verbal, Math, and Writing). Students are named National Merit Semi-Finalists if they fall in the top 1% of scorers apportioned state by state, according to the number of juniors in each state. The remaining high scorers are named "commended scholars."

Fixed-Reference Scale Measures

Both the PSAT and SAT I, but not the Selection Index scores, are examples of score scales based on a fixed reference group. Between 1926, when the SAT was first administered and 1941, SAT scores were expressed on a normative scale in terms of the mean (M) and standard deviation (SD) of the candidates taking the test at each administration. However, as the number and variety of College Board member colleges increased, and the composition of the candidate pool changed, the College Board concluded that scale continuity should be maintained (Anastasi, 1968). If this continuity was not maintained then an individual's score would depend on the characteristics of the group tested during a particular year.

Another factor favoring this scale continuity was that at different times during the year, students did better on the test than at other times of the year (Hood & Johnson, 1997). For instance, very bright and competitive students in their junior year often took the SAT during the spring of that year, especially in May and June. These students often did this so that they would be able to apply to colleges on an "early decision" basis. Because the first SAT I of the year is not offered until October of the senior year, this date is too late for some early decision applications.

Validity of the PSAT/SAT I

Debates about the validity of the PSAT and SAT I measures have been discussed for many decades. Most studies, along with high school teachers and counselors, have found that that high school grades rather than SATs were the best predictors of college grades (Hood & Johnson, 1997). The authors stated that the typical correlation of SAT I scores to college grades was only from .30 to .50 for freshmen grade point averages (p. 99). They also found that correlations tended to be higher at institutions with more heterogeneous freshmen classes, and lower among homogenous freshmen classes, especially at the very highly selective institutions where the range of student scores were low.

The standard error of the SAT I scores is an important variable when considering the academic aptitude scores. Hood and Johnson (1997) said that for the SAT I Verbal and the SAT I Math scores, the standard error "is in the vicinity of 30 or 35, suggesting that two thirds of the time the student's true score will fall within 30 to 35 points in one direction or the other from the obtained score" (p. 100). Similarly, the standard error of the PSAT scores is 3.0 to 3.5 and the same characteristics apply.

SAT I and PSAT scores are variable according to institution and high school. High achieving high schools with student populations from higher socioeconomic levels and more educated parents tend to have higher SAT I and PSAT score levels than students have from economically depressed areas. There has also been some question of the validity of these scores for some racial and ethnic populations, but these tests are still widely used by colleges and do have an influence on college acceptances. Therefore, for this reason, the SAT I and PSAT scores are still an important measure of student's academic aptitude and overall characteristics.

The SAT I and PSAT Selection Index scores are used in the "The College Counselor" (Peterson's, 1999) database system used by the researcher to make a scattergram for students' college applications. The scattergram plots SAT I and GPA scores with college acceptance at each school.

Grade Point Average (GPA)

As a measure of academic achievement, GPA from The College Counselor database was retrieved in a similar manner to the SAT I and PSAT scores for each student. GPA, even though not a consistent predictor of college grades because of the variance among schools and grading systems, according to Hood & Johnson (1997). However, GPA is still an important variable in that it measures numerically the achievement of students in all of their classes ranked from highest to lowest GPA's.

Procedures

Human Subjects Protection

Because human subjects were involved in this study, the researcher completed the appropriate University documentation and received approval to conduct the study. This was an important step in the process, because it is vitally important that students, when they are part of a research study, be protected.

Initial Permission Letters

The next step in this process was to send a letter outlining the purpose and procedures of the research study to the Principal of the High School for his approval (See Appendix A). When the Principal and the Superintendent gave their permissions for the procedures, they signed the Statement from the School and School District (Appendix B). The researcher then outlined the procedures, sent letters to the parents of the students in the 11th grade, and gave these procedures to the students in the 12th grade (Appendix C). Almost all of the students in the 12th grade were 18 years of age and did not require parental permission to participate in the study. Those students who were not 18-years old were asked to take the permission form home for parents to sign, and if they were not returned, these parents were telephoned by the researcher to get verbal permission.

The letter to the parents summarized the purpose and outline of the study and asked the parents to give their permission (by signing the Consent Form) for their son or daughter to participate in the study (see Appendix D).

Strong Interest Inventory Data

The researcher contacted the Consulting Psychologists Press office in Washington, D.C., which publishes the Strong Interest Inventory, to discuss the survey research project. The office agreed to send the scores to the researcher, who was the Director of Guidance and Counseling at the High School, because the High School had been using the Strong to test all of the juniors every year for the past 13 years. The data files for the 1999, 11th and 12th graders arrived on June 15 and were stored in the researcher's personal computer for later merging with the student questionnaire data.

Pilot Study Questionnaire

The researcher performed a pilot test by giving the questionnaire to the smallest of the four Senior English classes (12 students) at the High School. Since all of these students were seniors and over 18, no permission letters from their parents were required, as the students themselves agreed to participate and fill out the student questionnaire. Two students were absent, so 10 students actually filled out the pilot-study student questionnaire.

The researcher explained the purpose of the student questionnaire and distributed the student consent forms explaining the purpose of the project. The students then began completing the questionnaire. The entire testing took 14 minutes for all of the students to complete. Students did not seem to have any difficulty with the questions, seemed to understand the directions, and proceeded without incident. The use of group administration was time effective and yielded a good response rate.

When the last student finished the questionnaire, the researcher formed the students into a focus group (Krueger, 1994) and students were asked to comment on the questionnaire and suggest any changes. Students seemed eager to discuss the student questionnaire and did have two major suggestions. There were two questions that the students felt were biased. One question asked about father's work outside of the home and not about mother's work outside of the home, and this question was subsequently changed to add mother's work outside of the home. Another variable that was questioned, was the use of blue-collar worker, which some of the students did not understand. This item was kept in the survey because no other suitable term could be supplied to gain the needed information. In addition, since the counselor and English teacher were present during the administration of the questionnaire, they could explain this concept to the students who had trouble with it. Finally, the students suggested that some of the questions have a different order because they were in too much of a pattern.

The pilot testing helped point out questions that were unclear or confusing to the students, as well as questions that students had difficulty with or refused to answer. The pilot testing also gave the researcher the opportunity to re-formulate questions, change the order, and add or subtract questions. Three questions were reworded for clarity and two questions were dropped from the questionnaire.

Permission Forms for 11th Graders

The permission forms were given to the 11th grade students in their English classes during the week of May 24, on Thursday, May 27 and Friday, May 28. The forms were to be returned by Thursday and Friday, June 3 and 4 of 1999 to prepare for the testing the following week on Monday and Tuesday, June 7 and 8. If the students had not returned the permission forms by Friday, June 4, the researcher telephoned the parent(s) on Saturday, June 5 and Sunday, June 6 as a reminder and to obtain permission. This was done in case the student did not bring back the signed form before the student questionnaire was scheduled to be given on Monday, June 5 and Tuesday, June 6. All calls were made and messages left with the researcher's telephone number to return the call if the parents were not at home at the time of the call. The six parents who could not be reached were called on Monday, June 7, before the students were to participate in the survey questionnaire. All permissions were granted and no parent denied permission, and all seemed pleased for the students to be participating.

Before the survey questionnaire was administered, every parent whose son or daughter had not returned the permission slip verbally agreed to his or her participation. Many of the permission slips had been signed and sent in with the students, but had not been returned to the English teacher and most of these were turned in on Monday. The verbal permissions constituted 28% of the sample. The names, dates, and times of the telephone calls were kept in a log by the researcher with a note indicating any comments or concerns the parents had.

The consent form contained the researcher's name and telephone number for any questions or follow-up. No calls were received concerning problems with the student questionnaire, either before or after the student questionnaire was administered.

Administration of the Student Questionnaire

The English teachers for the 1999 juniors and seniors and the school counselor at the High School facilitated the process of sending home the permission letters. This was done after the counselor explained the letter and student questionnaire to the students in each English class. The student questionnaire was then administered during the English classes under the direction of the High School English teachers and the High School counselor.

Both the counselor and the English teachers were briefed and given examples of the questionnaires several days before the testing data, so they were familiar with the questions and could answer any concerns or confusion the students had. Most of the testing took two days, on Monday and Tuesday June 7 and 8, rather than in the Mustang Café due to problems in scheduling that space. One class met at the same time as another class and had two different teachers, so a counselor was not available to help with the administration, so this class was given the questionnaire on Wednesday, June 9. Those students who were absent were given the survey by the High School English teacher or asked to go to the Counseling Office to complete the survey.

When the students completed the questionnaires, they were collected and inserted into a sealed envelope container by the high school counselor and English teachers. The envelope was delivered to the researcher by the English teachers. To ensure confidentiality, the researcher kept the material under lock and key at all times. When the data analysis and final write up was completed the researcher deleted the information from the computer file and hard drive, and stored only one back-up copy under lock and key for follow-up information.

Input and Storage of Data

The researcher organized and stored the data, using Microsoft Office ’97 (Word and Excel). The spreadsheet analysis was chosen (Excel, 1997), because of the ease with which the data could be entered. The first step was to enter all of the data in the form of numbers (answers to the questionnaire and anxiety and self-efficacy measures), after reversing the positive responses on A1-27 into the Excel spreadsheet. The positively worded items on CARS and Self-Efficacy measure were changed to negative values in order to compare the positive and the negative values and get a measure of computer anxiety. The procedure involves subtracting 4 points from each 5 answer to convert the score to a 1, subtracting 2 points from each 4 score to convert the score to a 2; leaving all 3 scores the same, and adding 2 points to each 2 score to convert the score to a 4, and adding 4 points to each 1 score to convert the score to a 5.

The spreadsheet data file was precoded with categories from the questionnaire as the columns, and each case was listed as a row with each individual record number. At the beginning of each row, the researcher gave a one digit record number, starting with case number one, to each case. The researcher was careful not to mix cases and data, so started a new record with a new section and never split a data field. The four open-ended questions were analyzed first to see if the two “other” categories (F9 and I5) could be made into variable columns. This was not possible, because so few students wrote anything and none of the “other” replies were given by more than one student. The other two items were coded as to computer importance on a 1-5 basis (none to a lot) for H1 and for computer connection on H2 using 1 as no connection and 5 as connection to computers. Only H2 was made into a variable column because of the lack of standardization of H1 answers and their ratings.

All of the data was entered into Excel (1997) and checked for accuracy by using the original questionnaires and counting the number of 5, 4, 3, 2, and 1 responses for each question, as a cross check procedure. Then the numerical data was transferred to SPSS Base 9 (SPSS, 1999). This step was vital in the process, because the transfer must not corrupt the data. The Excel 97 files had to be converted to Excel 3.0, because of the nature of the SPSS transfer program.

When all of the data was in the SPSS Base 9.0 program (SPSS, 1999), the files were checked against the Microsoft Excel (Excel, 1997) spreadsheet database to determine if there were omissions or duplications. When the researcher was certain that the entries were in tact, the file was saved with the current data, updated, and saved with a new date when any changes or additions were made to the data.

Some of the changes and additions included refining categories such as adding a new category for participation in computer science classes rather than just number of computer science classes taken. Another change was made in reforming question K-6 data into separate data fields for each college major. Then student answers were coded 1 if they chose that major and 2 if they did not, in order to perform Chi-square analysis procedures.

After data were entered into a Microsoft Excel (Excel, 1997) spreadsheet and then imported into SPSS Base 9.0 (SPSS, 1999) statistical package for analyses, the researcher used SPSS Base 9.0 to compare male and female responses. The researcher used chi-square analysis for categorical items and t tests for independence for metric data.

Limitations of the Study

1. The site of the case study was in an upper-middle class technologically advanced suburban area, so the findings might have been different if the study had been conducted in a

different kind of community. However, the purpose of the study was not to generalize the findings to the entire population of high school seniors, but to determine why in such an ideal setting, females do not choose to study or plan careers in IT at the same rate as males.

2. The participants categorized some of the demographic data from the student questionnaire as "not sure." This may have been because the mother or father was not in the home, was deceased, or the participants did not know the educational, occupational, or computer use of the parent.

3. Twenty-eight of the participants (15.5%) did not have SAT I scores and twenty-nine (16.1%) did not have PSAT scores as measures of academic aptitude. However, only 15 (8.3%) of the participants did not have either measure.

4. There was some confusion about Question K 7, which asked the students to check the number of computer and technology classes (including computer science) they have taken during high school. Some students chose only computer science classes while others did not include computer science classes. Therefore, participation in computer science classes was also determined from the student records as either taking one or more classes (2) or not taking any computer science classes (1).

Summary

Chapter III provided a summary of the descriptive case study method used for the study including: (1) the problem statement, (2) the sample, (3) community, (4) research design, (5) instruments used, (6) the general procedures including data collection methods and analysis, and (7) the limitations of the study. Particular attention was paid to the student questionnaire and the CARS and ACT measures of computer attitudes, anxiety, and self-efficacy.