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GENDER SCHEMA AND COMPUTER ATTITUDES OF FEMALE COLLEGE STUDENTS AT SINGLE-SEX AND COEDUCATIONAL COLLEGES

Dissertation

by

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Abstract

Title: Gender Schema and Computer Attitudes of Female College Students at Single-Sex and Coeducational Colleges

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The purpose of the study was to investigate the influence of traditional sex-role stereotypes and educational environment on computer attitudes of college women. The study considered three measures of computer attitude: anxiety, confidence, and liking. It classified as sex-typed women having the combination of high measures of femininity, and low measures of masculinity, using a sex-role inventory. All other women in the sample were classified as non-sex-typed. The sample consisted of 150 women at a single-sex college and 104 at a coeducational school. Students were in their second through fourth years of study. Both colleges were highly selective.

The research investigated differences between sex-typed women and non-sex-typed women on computer attitude measures in two situations: no distinction between educational environment, and controlling for math anxiety and computer experience. It also investigated differences among sex-typed women on computer attitude measures between single-sex and coeducational environments.

The findings of the study are:

1. The only computer attitude measure significantly related to sex-role perception was computer confidence. Sex-typed women were less confident about computers. Measures of anxiety and liking were not significantly different between sex-typed and non-sex-typed women.
2. Computer attitudes of sex-typed women at the single-sex college were more positive than those of sex-typed women at the coeducational college. Single-sex students were more confident and less anxious about computers.
3. Math anxiety and computer activity were consistently identified as significant predictors of computer attitude. Controlling for math anxiety and computer activity, there was no statistically significant difference between women in the sex-typed and non-sex-typed groups in computer anxiety and computer liking. There was significant difference in computer confidence.

These results have several implications. First, social behavior such as sex-role, influence computer attitudes and must be acknowledged. Second, an educational environment supportive of women's learning styles can improve computer attitudes. Finally, the design of computer instruction curricula should consider anxiety about mathematics, and computer experience, in order to encourage women's achievement.

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Finally, I would like to dedicate this research to the memory of my father, Leo C. Leger.

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Chapter One

Introduction

Over the past two decades there have been many studies examining sex differences in the use of computers (Bagadliacco, 1990; Chen, 1986; Dambrot, et. al., 1985; Fariña, Arce, Sobral & Carames, 1991; Gressard & Loyd, 1984; Hawkins, 1985; Marcoulides, 1988; Rosen, Sears & Weil, 1987; Wilder, Mackie & Cooper, 1985). The increasing importance of computer usage in everyday life makes the question of whether there are differences in how computers are perceived, valued and used, between the sexes one of significance. Attitudes toward computers can be broken into different components such as enjoyment, usefulness and anxiety (Loyd & Gressard, 1984). The present study investigates whether differences in computer attitudes between the sexes can be accounted for by gender socialization and/or a single-sex[1] versus a coeducational college setting.

Gender Differences Considered

Hare-Mustin and Marecek (1990) consider the question "what difference does difference make?" in terms of the meaning that becomes attached to the difference between the sexes. In their view, modern society

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[1] The term single-sex will be used throughout this paper to indicate a women's college, or a women-only college and not a men's college.

has constructed many of the differences that appear to exist between the sexes. Their description of alpha and beta biases show that empirical evidence can be used to support or refute the existence of difference. For Hare-Mustin and Marecek, and many other feminist researchers, the result is a politically and philosophically charged question.

There is empirical evidence of actual, albeit small, differences between sexes in areas of spatial reasoning and social behaviors. The differences occur particularly in the area of mathematics anxiety, computer attitudes and computer usage (Benbow & Stanley, 1980). There is also evidence that perceptions of difference are common in American culture, and that these perceived differences have a more prevalent and pervasive influence than reported empirical evidence (Eccles, 1987). These perceived differences are socially influenced and therefore may, with significant effort, be altered or changed.

Social influences have had the greatest impact on the study of difference, whether of gender, race or other factors. So perhaps, as Jean Baker Miller (1986) states, research should focus on the society and culture that has created and perpetuated difference, and in so doing, devalued particular groups. It would be naive to think that major changes would occur simply from the study of where perceptions of difference occur, but Miller points out that "many women, along with male allies, have tried to change political, economic, social, cultural, and religious institutions, but these powerful structures do not change readily; they respond with powerful counteractions. Each new step reveals the necessity of analyzing more deeply the cultural and psychological forces impinging on us all" (Miller, 1986, p. xvi).

The study of differences between genders also provides frames of reference for understanding behaviors within the cultural constraints in which we work and live. For many women, validation of feelings and strength in sharing have come from works by such people as Carol Gilligan (1982), Evelyn Fox Keller (1985), Mary Belenky (1986), and others. It seems clear that if women are valued by other women for their unique contributions and their own style of working and thinking it will be much easier for them to gain respect and expect equal treatment from men than if they simply try to act and think like men.

In the 1970's Sandra Bem (1974) proposed a theory of androgyny in which all individuals would be healthier, and the sexes equal, if everyone changed behaviors to eliminate strongly masculine and strongly feminine stereotypical activities. Her research did not substantiate the theory, and in fact her definition of androgyny contained many "masculine" traits. In her more recent writing, Bem (1983, 1985) proposes a gender schema through which individuals perceive each other according to their inner comfort with characteristics of one or the other gender. Bem's theory takes socialization of individuals into account and creates a frame of reference for their behaviors and attitudes. In so doing, Bem uses difference as a tool to quantify the magnitude of social stereotypes on an individual. This is discussed throughout the present study.

Maccoby and Jacklin (1974) performed an extensive survey of empirical research on the existence of sex differences. They found only four areas where there was a substantial level of evidence to support such claims. These areas were: aggression, visual-spatial ability, verbal ability and mathematical ability. Jeanne Block's (1983) review of the literature of sex differences points to similar findings. Block however, places her findings within the realm of socialization, not with the confounding influence of innate abilities or traits since "these cannot be assessed" (Block, 1983, p. 1348). The setting and environment surrounding children, and their interactions with parents, teachers and peers are important to the development of cognitive schemata or filters with which the child interprets the world and him or herself. The present study addresses the social aspects of sex-typing, or the adoption of characteristics attributed to one or the other sex in relation to computer attitudes and the impact of a higher educational environment, single-sex or coeducational, on this relationship.

The final questions about the magnitude and significance of differences also illustrate the attitudes between and among women. Hare-Mustin and Marecek (1990) suggest that feminist political agendas are at the heart of some of history's debates about difference. They contend that by looking for, and publicizing difference, women are perpetuating stereotypes, extending negative expectations and simplifying complex issues into dichotomous arguments. Hare-Mustin and Marecek have proposed two views of studying gender difference; alpha and beta bias. In alpha bias the researcher sees a difference where there is none, in beta bias the researcher does not see a difference where one exists. In either case, difference is often misinterpreted and simplified according to the philosophy of the observer, hence the term "bias." They write, "The idea of gender as opposites obscures the complexity of human action and shields both men and women from the discomforting recognition of inequality" (Hare-Mustin & Marecek, 1990, p. 54).

Stereotypical views of what is "appropriate" or more "acceptable" behavior for each of the sexes may color the attitudes of a large social group, or influence the individual attitudes of one person. The strength of sex-roles, and their associated stereotypes, begins when a child is born. Immediately the child has an identity, as either male or female. The child is treated in speech, actions and dress as one of two very different groups. These stereotypes have had a profound impact on women's roles in society, particularly in the recent past when women have tried to "break into" traditional male career realms. For example, when typewriters were first invented the majority of typists were men. However, as time passed and the work was not seen as important or something only a man could do, the jobs passed to women. When this happened, social regard for the position quickly fell (Frissen, 1992; Kramarae, 1988).

History of Women in Computing

Women have played a role in the use of computers since the inception of the computer. In the early history of computing, computers were the size of large rooms, extremely expensive and very few in number. Women entered data and programmed the computers to perform many mathematical computations. Men were playing a different role by using the calculations produced, designing new and improved versions of the computing hardware and directing the tasks done by women (Frissen, 1992). The computer was regarded as a tool for doing very complex tasks, mostly mathematical in nature. From the forties through the late 1960's the computer was not a part of everyday life, but restricted to the government, the military, and a few large universities and corporations. In the 1960's the use of the computer spread throughout academia and the business world. The size and price of computers were still large, but the number of individuals able to use them for practical purposes was growing. Most large colleges and universities had access to a computer, if not on their own campus, perhaps at that of a neighboring institution. In business, and in higher education, computers were commonly used to maintain large databases of customer or student lists for billing and record keeping and for the traditional mathematical calculations for which they were best known.

In the early 1970's linking computers together, or networking, became possible. This linking and timesharing, which allowed many tasks to be done in synchronized fashion on one computer, made the computer more accessible. Communication between computers to share files and information was part of the development of networking and time-sharing. This eventually led to the creation of the Internet as we now know it. The other significant development of the 1970's was the creation of the personal computer. This breakthrough changed the entire industry and made the computer the tool of many instead of an elite few.

Early personal computers required some knowledge of programming. The user was required to input instructions in a rigidly structured manner to perform any task. The first commercial programs for these machines were spreadsheets, word processors, database managers and games. In much the same way that calculators took over the role of the slide rule for mathematics, computers took over many roles in business and academics eventually replacing typewriters, file cabinets and ledgers.

The history of the personal computer is important to the discussion of differences between the sexes in computer usage. In the 1960's, when computers were first used in higher education to perform mathematical and scientific calculations, relatively few women were attending colleges and universities and even fewer were in the fields of math and science. Opportunities for women to access computers were therefore somewhat limited. When women did use computers in education or business, it was often at a clerical level. Women worked as keypunch operators to input data for accounting and other routine business functions. Subsequent women began using word processors, but primarily in secretarial positions or in typing pools (Frissen, 1992).

Gender Issues in Computing

The strong link between computers, math and science is a reason commonly cited for women's lack of involvement with computing (Badagliacco, 1990). Most computer programming courses in higher education have mathematical course prerequisites. Computer programming instructors often use mathematical problems to illustrate programming techniques and as homework assignments. Thus, women interested in computing, but not in mathematics, have been severely limited in their options for entering the computer science field and learning basic computer concepts. The number of women graduating in computer science has not increased at the same rate as the numbers in the medical and legal professions. In 1970 only one percent of computer science Ph. D.'s were awarded to women. In 1993, 15 percent of the computer science degrees went to women. In medicine, women made up 8 percent of graduates in 1970, and 38 percent in 1993. The percentage of law degrees granted to women in 1970 was 5 percent, and in 1993 it was 42 percent (U. S. National Center for Education Statistics, 1995).

Sex-role Identity and Computers

The field of computing has its own unique culture, due perhaps to the predominance of men within it, or simply the nature of the work. An extensive look at the culture of computing after the introduction of the personal computer was done by MIT professor Sherry Turkle. In one study, Turkle (1984) observed young children playing with computers and other mechanical toys, and interviewed many students taking computer courses, to understand their attitudes toward the computer. In her analysis of their reactions, Turkle found differences between the sexes. She reported sex-based differences in attitudes toward computers and other mechanical objects beginning in children as young as three and four years of age. The differences she observed surrounded the degree to which students "engaged" with the computer and the nature of their involvement with computing. Turkle found that males tended to anthropomorphize the computer, to develop a relationship with it. Females generally did not engage in such relationships and viewed the process as uninteresting and unnecessary. According to Turkle, these attitudes demonstrate a difference in cognitive style between sexes.

Turkle's recent (1995) views on why computers are seen differently by the sexes are related to the usefulness each sees in the tasks they need or want to accomplish. The ease with which they can accomplish their tasks, their level of involvement in the process of accomplishing those tasks, and previous experience are often the borders between the sexes. Women often report a more utilitarian view of the value of computers. They prefer not to become involved in the underlying operations, but want to "get the job done" in the simplest manner (Turkle, 1995). Many men, according to Turkle, prefer to know what is happening and to know how things work.

They also are reported to have more of what Turkle (1991) calls the "Bricoleur" or inventor/tinker in their approach, an entrepreneurial and playful attitude to see what happens if . . . . These behavior patterns are important in the way they may be applied to the relationship between computer attitudes and the socially constructed perceptions commonly called gender.

Gender role theory (Bem, 1987) suggests that there are learned, socially-driven influences affecting much of our daily decision making. Gender role schema set a psychological framework by which an individual perceives him or herself and how they perceive others according to a socially imposed structure of "acceptable" and "unacceptable" female and male behaviors and how those features fit into a cognitive structure that organizes perceptions of the world (Bem, 1987, p 231).

Sandra Bem's (1987) gender schema theory merges segments of psychoanalytic, cognitive, and social learning concepts into a phenomenon called sex typing. This phenomenon concerns information processing, cognitive approaches and social structures that influence the perceptions individuals have about each other on the basis of sex. Gender schema theory posits that an individual views and interprets external cues from others according to their own learned cognitive structures. These structures have sex-specific information that is applied to each individual and in turn permits the individual to attach socially or culturally prescribed meaning to behaviors they observe, or infer such things as personality traits or personal preferences.

Bem's analysis of gender is based on the concept that socially imposed attributions of traits to either one of the sexes has too much emphasis in modern life. "Thus if gender schema theory has a political message, it is not that the individual should be androgynous. Rather it is that the network of associations constituting the gender schema ought to become more limited in scope and that society ought to temper its insistence on the ubiquitous functional importance of the gender dichotomy" (Bem, 1987, p. 245). According to Bem, other criteria for classification and identification would remove the emphasis on gender from our current social system. "In short, human behaviors and personality attributes would no longer be linked with gender, and society should stop projecting gender into situations irrelevant to genitalia" (Bem, 1987, p. 245).

It is Bem's view, and that of this study, that individuals make choices and act in particular ways based upon their values of who they are in society and what expectations follow from their standpoint. The idea that women would value attributes commonly associated with positive female behaviors and men would do the same for masculine behaviors is the center of this theory. Not all individuals will have or value each trait or behavior in the same way, nor will they necessarily value and see themselves having the greatest number of traits matching their sex. For example, not all men will see themselves as having traits or exhibiting behaviors that are rated as strongly male, but are more likely to report possessing more masculine than feminine traits. Many women may feel they have traits or exhibit behaviors that are more often regarded as masculine, yet still have feminine traits as well.

In current American culture, traits which are strong and decisive are commonly attributed to masculinity while many of the "weaker" traits are attributed to femininity. Traits such as yielding, sensitivity and understanding are acknowledged as being "feminine," and seen as desirable in the "ideal" person (Bem, 1976). The relationship between these socially acquired behaviors and the attitudes students have toward computers has been investigated by a small number of researchers (Albert, 1988; Colley, Gale, & Harris, 1994; Ogletree & Williams, 1990; Rosen, Sears, & Weil, 1987). The findings, which are discussed at length in the review of literature to follow, show that those individuals reporting more feminine traits also report higher levels of computer anxiety than those with either masculine or androgynous ratings.

Perry and Greber (1990), discussed the feminist perspective on computer technology, and expressed concern about the marginalization of women in the industry. "The computer's effects on women's lives appear not so much determined by the technology per se, as perpetuated and reinforced by particular social, economic and political structures" (Perry & Greber, 1990, p. 78). As a socially constructed measurement, gender schema assumes that if the culture and/or environment were substantially altered, different patterns of behavior would be learned, and the nature of "gender" as it is understood now, would change. If the gender traits of "femininity" are related to higher levels of computer anxiety and traits of "masculinity" are related to lower levels of computer anxiety, the resulting career and educational choices appear to have significant social influences. The significance of this study is based on determining whether or not gender is a salient factor in determining attitudes toward computers, in other words, that these attitudes are socially constructed.

Educational Environment and Computers

Reports such as the American Association of University Women report (Wellesley Center for Research, 1991) "How Schools Shortchange Girls," Hall and Sandler's (1982) and Sandler, Silverberg, and Hall's (1996) recent discussion of the "chilly classroom climate," and Sadker and Sadker's (1994) book Failing at Fairness, describe the disadvantages girls appear to have in school environments. These studies propose that the environment, teachers, parents and other children tend to perpetuate these negative stereotypes.

Single-sex educational environments are a potential alternative to the negative, socially influenced, double standard toward achievement for girls and boys, which is found especially in math and science in standard coeducational structure in most schools. The single-sex versus coeducational question has been debated for many years. The possibility that separate instruction for girls and women could improve their opportunities for learning and success has been both supported by and refuted by many research studies (Bressler & Wendell, 1980; Kim & Alverez, 1995; Miller-Bernal, 1993; Oates & Williamson, 1978; Riordan, 1992; Smith, Wolf & Morrison, 1995; Stoecker & Pascarella, 1991; Tidball, 1989).

The relationship between single-sex instruction for girls and women and computers is an important one for several reasons. First, the environment of single-sex classrooms is often more supportive of a girl's confidence (Kim & Alvarez, 1995). Second, the classroom can provide a non-competitive structure where girls do not worry about the impression they will make on the boys in class (Hall & Sandler, 1984; Sadker & Sadker, 1994; Sandler, Silverberg, & Hall, 1996). This has been shown to be a critical factor for adolescent girls (Sherman & Fennema, 1977) especially in the areas of math and science. Third, many applications used by boys, as they learn about the computer, are games that are violent in nature or have sports-related themes (Kiesler, Sproull & Eccles, 1985). By providing an atmosphere where other options for playing with computers are available, girls may feel more at ease with the computer. Astin's (1984) theory of student involvement provides a framework for defining necessary mechanisms to ensure support for female students coping with the challenge of computer study. In a supportive yet challenging environment, as prescribed by Astin, girls and women have greater opportunities for achievement since they receive the help they need yet are encouraged to push themselves to their highest potential.

Elizabeth Tidball (1974), in an extensive review of studies assessing the productivity and activities of women college graduates over a 70 year period, reports that the proportion of women achieving academic or career success is substantially greater for graduates of single-sex institutions than for graduates of coeducational colleges or universities. "Women's colleges have an unparalleled record of graduating women who attain a variety of measurable post-college accomplishments. Accordingly, they represent a strong force for the advancement of women" (Tidball, 1989, p. 157). The difference, in Tidball's view, between coeducational and single-sex education is the narrow focus of the women's college on educating women. "It is clear," writes Tidball, "that the environment of women's colleges is more enabling of women than that of coeducational institutions" (Tidball, 1989, p. 160).

The issue of career choice as discussed by Tidball (1974, 1989), Astin (1977) and others is a critical one for women, particularly with reference to the computer field (Pascarella & Terenzini, 1991). The environment of a women's college offers unique opportunities for women who may be insecure about selecting a traditionally male profession such as computer science. Historically many women's colleges were established to educate women who could then make their own way in the world (Solomon, 1985).

"To acquire an independent livelihood"[2] was the philosophy of one such women's college. However, it is not the goal of this study to investigate the long-term outcomes of attending a women's college by examining career choice or attainment, but rather to investigate sex-role and computer attitudes at women's colleges versus coeducational colleges.

Computer Attitudes

In this study computer attitudes are measured in three segments: computer anxiety, computer liking and computer confidence. Computer anxiety itself is a complex attitude that may depend on many factors. The attitude of anxiety may be a reflection of fear of failure, lack of understanding, previous negative experience or other influences. The source of the anxiety is not being studied here, but rather any differences in attitude between students enrolled in two different educational environments. Computer liking, whether an individual has a like or dislike of the activities done with a computer, and computer confidence, whether an individual values the computer as a tool or an object to assist with some type of task, are both important since these attitudes may differ between the sexes. Some studies

[2] John Simmons ' wish as he established Simmons College for Women to educate women in the female professions.

have shown these perceptions of use and function to be a strong dividing line between the sexes (Turkle, 1995). Computer confidence is an attitude that may be related to self-esteem, or other larger issues. In this study, however, confidence with computers is considered an indication of past success using computers. For women, computer confidence could demonstrate the lack of, or the overcoming of, the stereotypical male dominated computer culture.

Mathematics and Computers

Kramer and Lehman (1990) studied the nature of women's work with computers to determine causes for the different perceptions and stereotypes surrounding men's and women's uses of technology. Their findings indicate a number of misconceptions about the connections between computers, math and uses of technology. They found that while traditional training in computer science frequently requires high level mathematics courses as prerequisites, some women practice computer science in a non-linear and non-mathematical fashion. According to Kramer and Lehman, "An examination of the contexts of computing may reveal that women's choices are governed as much by positive preferences for certain styles of knowing and thinking as by negative stereotypes and discrimination" (Kramer & Lehman, 1990, p. 172). Research findings are inconclusive on the issue of whether math anxiety plays a role in computer attitude formation. The impact of mathematics anxiety on computer attitudes is discussed at length in the review of literature (Chapter 2).

Summary

The problem to be investigated in the present study is whether there exists a relationship between sex-role stereotypical motives, called gender schema (Bem, 1974, 1987) and women's attitudes toward computers. The research problem also includes consideration of whether the type of learning environment in which a woman is engaged has an impact on those computer attitudes. Specifically, does a women's college environment effect women's attitudes about the stereotypically male-dominated subject (Kiesler, Sproull & Eccles, 1985; Turkle, 1984) of computers?

The second aspect of the question concerns attitudes toward computers. A study by Jay (1981) identified a phenomenon he called "computerphobia." Jay's definition stated that computerphobia is "(a) resistance to talking about computers or even thinking about computers, (b) fear or anxiety toward computers, and (c) hostile or aggressive thoughts about computers" (Jay, 1981, p. 47). Jay's definition is very broad and does not include positive or ambivalent feelings. Attitudes toward computers are not always negative, nor are they static and unchangeable (Turkle, 1984,1995). The range and type of computer attitudes are wide and complex. The problem to be investigated focuses on the issue of women's computer attitudes. Many studies (Badagliacco, 1990; Dambrot, Watkins-Malek, Silling, Marshall & Garver, 1985; Hess & Miura, 1985; Kramer & Lehman 1990; Lockheed, 1985; Loyd & Gressard, 1986; Turkle, 1984) have found conflicting data on whether women have different or more negative views toward computers than men.

The present study investigates the possibility of differences in self-reported computer attitudes between women in single-sex and coeducational colleges. Furthermore, what relation, if any, does gender schema play in the distribution of these attitudes between the two groups? The study considers the literature of gender schema theory, computer attitudes and usage, math anxiety and computers, and reported advantages and disadvantages of single-sex and coeducational environments. The study investigates the possibility that a difference in female computer attitudes exists between students at coeducational colleges and students attending single-sex colleges.

Chen (1986) and Collis (1985) reported on an aspect of computer attitude that illustrates the significance of the present study for educators and parents. In their analysis of female attitudes toward computers Chen and Collis found that girls and women express confidence in the abilities of women, in general, to achieve success with computers. However, many girls and women lack confidence in themselves to achieve such success. The phenomenon called "We can, but I can't" has also been reported in studies related to mathematics (Fennema, 1980). The present study looks for an understanding of how this situation occurs by testing the relationships between gender schema, educational environments, computer attitudes and math anxiety. If socio-psychological conceptualizations of gender are factors in the creation of attitudes toward computers, educators, parents and others should develop new non-stereotypical approaches to the use of computers for girls and women and eliminate the inequities that result.

Chapter Two -- Literature Review

Introduction

This chapter presents a review of the literature on sex-role stereotypes, attitudes toward math and computers, computer attitudes in relation to gender, and of single-sex education's advantages and disadvantages as a positive learning environment. A portion of the review concentrates on the instruments to be utilized in the present study.

The review of literature on sex-roles includes the effect of sex-role stereotypes on career aspirations in the sciences, and in mathematics and computer science in particular. Career aspirations are one of the common measures used to assess the success or advantage of women's colleges, and therefore provide a connection between sex-roles and career achievements. Mathematics is frequently associated with the study of computer science and math anxiety is often cited as a cause of computer anxiety. The study of mathematics is discussed in this review for its prominence in the literature of computer anxiety, and for its reputation, like computer science, as a male-dominated subject. The discipline of computer science is highlighted because of its technical content, its similar reputation as a male-dominated subject, and because it provides a useful context for discussion.

Computer attitudes have been measured and evaluated since the early days of computing. The possibility that there might be differences between the sexes in these attitudes has been studied for a considerable period of time. The literature discussed in this paper provides a cross-section of research on the topic. The studies investigate the possible factors contributing to such differences, including age, computer experience, self-esteem, and math anxiety. The key factor considered in the present study is the nature of the interaction between the individual and the social environment, in other words whether different attitudes change under different conditions.

The third area of literature presented is on single-sex education. Researchers have investigated differences between coeducational and single-sex environments. Studies covered in this paper focus on the intellectual development, career attainment and self-confidence of women from single-sex institutions and the impact those institutions may have had on those women. The college educational environment may foster a positive and significant influence on how women view their use of computers. The growing role of computers in everyday life presents an opportunity that women cannot ignore, the chance to enter into the realm of computers, an area that has traditionally been considered a male domain. It is also important to examine the role of women's colleges since there are relatively few women's colleges left in the United States and their place in modern education is being challenged.

<u>**Sex Role Stereotypes and Gender Difference**</u>

Sandra Bem (1974, 1985, 1987) suggests that society places a strong emphasis on the difference between the sexes. The process of individual identification with one sex or another is referred to as sex typing. Bem's theory explains the process of sex typing through a set of attributes she calls gender schema. These gender schema attributes become part of the individual's cognitive structure and form the framework through which they understand themselves, the world and other people. Gender schema theory combines elements of cognitive development and social learning concepts.

> "In particular gender schema theory proposes that sex typing derives in large measure from gender-schematic processing, from a generalized readiness on the part of the child to encode and to organize information -- including information about the self -- according to the culture's definitions of maleness and femaleness. Like cognitive-developmental theory, then, gender schema theory proposes that sex typing is mediated by the child's own cognitive processing. However, gender schema theory

further proposes that gender-schematic processing is itself derived from the sex differentiated practices of the social community. Thus, like social learning theory, gender schema theory assumes that sex typing is a learned phenomenon and, hence, that it is neither inevitable nor modifiable [sic]" (Bem, 1987, p. 231).

Bem's (1972) early work centered on the concept of androgyny for men and women. She proposed androgyny as an alternative to the social culture of the time. Androgyny was considered by Bem, and others, to be the answer to the negative social position in which many women found themselves. Bem believed that dominant male-oriented culture did not encourage the instrumental, or task oriented, side of women, nor the expressive, or communicative, side of most men. Bem presented a model that was neither predominately instrumental, nor predominately expressive. Sexual equality through adoption of androgyny was offered as an alternative to the passive female and dominant male stereotypical roles.

Bem created a scale, the Bem Sex Role Inventory (1974), to measure androgyny. It was also created to measure "masculinity" and "femininity" as determined by socially accepted norms. Bem gathered data from several hundred people who rated 400 items on their social desirability for one or the other sex. The Bem Sex Role Inventory (BSRI) consists of adjectives and phrases classified as masculine, feminine or neutral. In the 1970's the instrument was trying to identify androgynous individuals, a personality type Bem considered superior to stereotypical feminine or masculine personality types.

In the absence of substantial empirical evidence to support her views, Bem revised her perspective and withdrew from the focus on androgyny (Lott, 1990). Bem now suggests that there are different types and degrees of gender processing, which are divided between masculine, feminine, undifferentiated and androgynous characteristics. The assimilation of masculine, or feminine, traits and characteristics may differ by degree for each individual. Some people have a greater affiliation and see themselves as having more characteristics of one sex and fewer of the other. The BSRI is used to measure the degree of sex typing and extent to which an individual aligns him or herself psychologically with one sex or the other (Bem, 1985). "Sex-typed individuals are seen to differ from other individuals not primarily in the degree of femininity or masculinity they possess, but in the extent to which their self-concepts and behaviors are organized on the basis of gender rather than on the basis of some other dimension" (Bem, 1987,

p. 233-234). Sex-typed individuals process information using "sex-consistent" (Unger, 1990, p. 120) categories spontaneously because these criteria are more salient for these individuals. Unger, a leader in the field of women's psychology, argues that Bem's conceptualization is descriptive and that "little attention has been paid to the role of the situation in eliciting sex-differentiated beliefs about oneself or others" (Unger, 1990, p. 121). In Bem's view, gender schema is a cognitive process that reflects social contexts.

> "More specifically, gender schema theory proposes that a category will become a schema if: (a) the social context makes it the nucleus of a large associative network, that is, if the ideology and/or the practices of the culture construct an association between that category and a wide range of other attributes, behaviors, concepts, and categories; and (b) the social context assigns the category broad functional significance -- that is, if a broad array of social institutions, norms and taboos distinguishes between persons, behaviors, and attributes on the basis of this category" (Bem, 1985, p. 211).

Bem and Lenney (1976) tested the hypothesis that sex-typed individuals would be more likely to avoid performing tasks that were opposite sex-stereotyped, because they use gender schema to decide whether a task is appropriate for them or not. They asked students to engage in activities that fell into either masculine or feminine stereotypical categories. Students who had been classified as sex-typed expressed the greatest discomfort in completing those tasks that were stereotyped for the opposite sex. The conclusion Bem and Lenney drew from this data was that "gender-inappropriate behavior is motivationally problematic for sex-typed individuals so they actively avoid it, that is, sex-typed individuals are motivated to restrict their behavior in accordance with cultural definitions of gender appropriateness, as gender schema theory implies" (Bem, 1985, p. 207).

These cultural definitions of behavior are part of a modern society that places high value on the dichotomous variable of sex (Freud, 1994). In education, as in many other disciplines, study of the implications of that dichotomy has been underway for some time. Klein and Ortman (1994) reviewed the literature to investigate the inequities and differences present between the sexes in the field of education. Their findings indicate the continuing problem of differential achievement between the sexes at all levels of education. In the area of mathematics this is particularly true. "Despite their higher course grades, and higher National Assessment of Educational Progress writing achievement scores, girls continue to score lower than boys on complex mathematics, to have lower self-confidence in mathematics, and to be less likely to take risks to solve mathematics problems. Girls are also likely to receive less teacher attention and parent support for work in mathematics" (Klein & Ortman, 1994, p. 15).

There is also a body of literature investigating gender inequities in the sciences. Factors often linked to women's underrepresentation in the sciences divide into three categories: cultural, socio-psychological and institutional. Cultural influences include the nature of the scientific field itself, which can be competitive and narrowly focused (Keller, 1985). For example, women engineering students faced the obstacle of strong negative stereotypes. In a Sloan Foundation study of attrition rates for women studying the math/science and engineering fields, Hewitt and Seymour (1991) found that "both in focus groups and interviews, many women expressed their feeling of being outsiders in a male-dominated culture. The notion that there is something 'inappropriate' about women entering these majors seems to be imported from the male world outside academe" (Hewitt & Seymour, 1991, p. 99). In the Sloan study, many women reported that sustaining a constant struggle to participate in male-dominated, competitive scientific fields was not worth their efforts and they switched disciplines of study.

External cultural influences may also put women at a disadvantage (Pearl, Pollack, Riskin, Thomas, Wolf, & Wu, 1990). Children of different genders may receive different exposure to computers. For example, many computer games for children are based on sports or violence, traditionally male-oriented subjects (Pearl, et al., 1990; Turkle, 1984). When these students arrive in college, there is a difference in their comfort and affinity for computers. The "hacker elite," as Pearl and her colleagues describe it, is a unique culture with its own language and norms for behavior. Pearl argues that although, "these problems may affect male as well as female students, the situation is likely to be more pronounced for females who, because of the differences in early experiences with computers, are less likely to be a part of the elite" (Pearl, et al., 1990, p. 49).

Socio-psychological influences such as self-confidence and perceived ability are frequently observed in relation to women's involvement with scientific study in general, and computer science in particular (Frenkel, 1990; Pearl, et al., 1990; Rayman & Brett, 1995). Fennema and Sherman's (1977) studies of girls' attitudes toward math found that self-perception and the value of learning math were key factors. The literature of gender differences and computers can be categorized according to differences between the sexes in cognitive styles, mathematical or logical abilities, learned behaviors or previous experience with computers and socio-cultural influences such as sex stereotypes or parental expectations. An underlying theme of these studies is that computing, per se, is not an activity in the male "domain" (Badagliacco, 1990; Frenkel, 1990; Pearl, et al, 1990; Perry & Greber, 1990; Shashaani, 1994; Turkle, 1984, 1995).

Kramer and Lehman (1990), in a review of feminist literature on gender difference in computing, point out, "Although studies that have examined the expression of positive preferences and values in relation to computing are few, the existing literature suggests that an important starting point is the recognition of computing as an activity that incorporates and reflects social relationships and has social and psychological impacts" (Kramer & Lehman, 1990, p. 172). In particular, the present study examines how internal and/or external factors affect these relationships and perceptions.

Mathematics anxiety

Mathematical skill is frequently used as a standard to limit entrance into advanced study in many technical fields (Kramer & Lehman, 1990). Computer science, physics, astronomy and other technical fields require high level abstract mathematics courses as prerequisites (Hewitt & Seymour, 1991). Unfortunately math education is not a comfortable area for many girls (Benbow & Stanley, 1983; Sadker & Sadker, 1994). Research has been done on both math anxiety in general (Fennema & Sherman, 1977) and on math anxiety or avoidance in relation to computing (Kramer & Lehman, 1990; Collis, 1985; Dambrot, et al., 1985; Gressard & Loyd, 1984; Igbaria, 1990; Fariña, et al., 1991; Parasuraman, 1990).

Two conflicting, but frequently cited studies investigated differences in math abilities between adolescent girls and boys. Benbow and Stanley (1980) wrote about a study they performed over several years testing the mathematical abilities of excellent students taking the SAT's. Their tests showed that of superior students taking SAT's, from all parts of the country, with a nearly even split between sexes, fewer girls than boys scored above the mean of the high scoring group. They interpret their findings to mean that boys, in adolescence, have superior mathematical skills. Eccles and Jacobs (1986) counter-argue that the differences found were the result of socialization and cultural expectations that girls perform less well in math than boys. They report that the media and parents' confidence and expectations play a crucial role. "Furthermore, parents' beliefs, especially mothers' beliefs, appear to have a greater influence on students' attitudes than do students' mathematics grades" (Eccles & Jacobs, 1986, p. 354).

Many researchers theorize that women possess similar levels of math and computer anxiety. Dambrot, Watkins-Malek, Silling, Marshall, and

Garver (1985) tested a large sample of college freshmen and tested for computer attitude, aptitude and involvement. They found differences in gender. Women were more fearful and negative toward computers than men. The women in the sample did not have as many prerequisite math courses, or as much computer experience, as the men. Dambrot performed correlation analyses and found "computer attitude was related to math anxiety, computer aptitude, and computer experience. For males, computer aptitude and math anxiety were related to computer attitude, while for females only math anxiety was related to computer attitude" (Dambrot, et al., 1985, p. 83).

Math anxiety has been found to be a predictor of computer anxiety. Many studies show the link between the two to be consistent (Collis, 1987; Konvalina, Wileman & Stephens, 1983; Parasuraman & Igbaria, 1990). One such study by Fariña, Arce, Sobral, and Carames compared measures of different forms of anxiety in a sample of college students. "The effects of the variable anxiety towards mathematics on anxiety towards computers appear to be well substantiated. Anxiety towards mathematics is a good predictor of anxiety towards computers" (Fariña, et al., 1991, p. 266).

In contrast, Kramer and Lehman (1990) disagree with research results such as Fariña's which associate women's math skills and attitudes with their attitudes toward computers. They argue that while most research shows that women's computer attitudes are correlated with women's math avoidance tendencies, the connection is not one of cause and effect. Instead they attribute both to the same cause: instruction using a linear model. They note that computer education parallels mathematics education at many institutions. Most computer instruction in schools is the responsibility of either the math or the science department. Students learning higher-level computer skills are most often programming mathematical problems in classes frequently taught by men. Other types of computing such as word-processing, spreadsheeting and graphics are taught in stereotypically female-oriented classes such as secretarial/vocational skills, creative writing programs and graphic arts activities. The approach to this instruction is non-linear and depends more on context and creativity (Kramer & Lehman, 1990) and the result is a separation between the two realms.

Research completed by Parasuraman and Igbaria (1990) concurs with comments by Kramer and Lehman. Parasuraman and Igbaria studied the causes of computer anxiety and attitudes in a population of managers. While they did not find differences in computer anxiety between genders, they did find differences in another area. For men, computer anxiety was the variable most related to computer attitude. In the sample, most men scored positively on computer attitude and computer aptitude scales. But for women, math anxiety and cognitive style were most related to computer attitude. The authors suggest that women perceive more of a connection between math and computers than men. Parasuraman and Igbaria recommend the creation of separate types of training programs in computing for men and women. Women need to learn to use the computer in an applied manner, emphasizing actual situations, not abstract programming (Parasuraman & Igbaria, 1990). Badagliacco (1990) reported that women computer scientists "expressed much stronger disagreement than men with the statement that math was necessary to succeed in computing" (Badagliacco, 1990, p. 52).

The importance of mathematics to computers lies in the connection to programming. Sherry Turkle has studied programmers and their patterns of cognitive processing at M. I. T. since the early 1980's. Her book, The Second Self (Turkle, 1984) describes the differences in programming style and attitudes toward computers which she recorded from interviews with students at a large university. Turkle proposes, using a psychoanalytic model of development, that styles of mastery, or methods used to perform tasks successfully, are formed by early childhood experiences. Turkle contrasted patterns of computer interaction in two ways: "hard mastery" that was objective and distant with "soft mastery" that was subjective and close

(Turkle, 1984, p. 109). She found that males tended to exhibit hard mastery, and females soft, when they were describing how they thought about using computers. The adoption of each of these different styles is supported, says Turkle, by the culture in which children are raised. "In our culture girls are taught the characteristics of soft mastery -- negotiation, compromise, give-and-take -- as psychological virtues, while models of male behavior stress decisiveness and the imposition of will. Boys and girls are encouraged to adopt these stances in the world of people. It is not surprising that they show up when children deal with the world of things" (Turkle, 1984, p. 109).

The influence of culture on sex-role stereotypes plays an important role in the determination of many behaviors, from leisure activities to career choice. The present study considers the social nature of sex-role stereotypes and the impact they have on computer attitudes. Perry and Greber's (1990) comments below reiterate these connections.

> What changes in the definitions of masculinity and femininity might arise from the reconceptualization of human beings in terms of the computer? Gender roles, in contrast to biological sex are quite plastic, and the particular traits considered to define the sexes vary considerably over cultures and over time. The common wisdom which

> associates computers with masculinity in Western culture arises partly from modeling computers as logical, linear and objective -- traits positively correlated with masculinity. In addition, the pedagogical conflation of computers with science/math/technology, all masculine domains, contributes to this impression. As computers permeate our culture and we define ourselves as a species as both like and unlike these 'information processors' we may drastically redefine our conceptions of masculinity and femininity (Perry & Greber, 1990, p. 94).

The stereotypical differences between the sexes -- males are linear and objective, females are subjective, and non-linear -- are reflected in the two main methods of interaction with a computer, traditional command-line linear structures versus newer "icon" or object oriented interfaces. Object oriented interfaces offer alternatives to stereotypical ways of thinking about and relating to computers (Perry & Greber, 1990; Turkle, 1995). These new methods of interacting with a computer may provide opportunities for non-linear thinkers, whether male or female, to succeed with technology where they might not have under the traditional method.

Computer Attitudes:

Studies of computer attitudes in relation to gender have not produced consistent evidence to show either similarity, or difference, between the sexes. The studies published in the literature have been, for the most part, descriptive and not experimental. The studies use a survey instrument, usually given to college students, that asks for responses to questions about using, learning, and understanding computers. Studies finding differences between the sexes often find women at a disadvantage (Arch & Cummins, 1989; Badagiacco, 1990; Colley, Gale, & Harris, 1994; Collis, 1985; Dambrot, et at., 1985; Igbaria & Chakrabarti, 1990; Meier, 1991; Parasuraman & Igbaria, 1990; Robinson-Staveley & Cooper, 1990; Wilder, Mackie & Cooper, 1985). There are also studies that report no difference between the sexes in relation to computer attitudes (Glass & Knight, 1988; Loyd & Gressard, 1984; Pope-Davis & Twing, 1991; Pope-Davis & Vispoel, 1992).

The studies also often include survey questions on related topics such as attitudes toward math (Albert, 1988; Dambrot, et al., 1985; Fariña, et al. 1991; Gressard & Loyd, 1984; Konvalina, Wileman, & Stephens, 1983; Marcoulides, 1988; Parasuraman & Igbaria, 1990; Rosen, Sears & Weil, 1987; Wilder, Mackie, & Cooper, 1985), self-efficacy (Miura, 1987), amount of experience with a computer (Gutek & Bikson, 1985; Honeyman & White, 1987; Mandinach & Linn, 1986; Pope-Davis & Twing, 1991; Pope-Davis & Vispoel, 1992; Wilder, Mackie & Cooper, 1985), level of expertise with computers (Collis, 1985; Hess & Miura, 1985; Loyd & Gressard, 1984; Marcoulides, 1988), and demographic information including for example: age, area of major study, parental involvement with computers, and grade point average.

The studies included in the following discussion are grouped as follows: studies using samples of elementary and secondary level students, studies using college students, and studies of adults in the workforce.

Elementary and Secondary Student Samples

Wilder, Mackie and Cooper (1985) surveyed elementary and secondary level students on their views of the "appropriateness" of using computers and video games. The students were asked if it was more appropriate for boys to use a computer than girls, and whether they themselves liked to use a computer. The results showed some sex-typing of attitudes toward the computer. The boys tended to have slightly more sex-typed attitudes than the girls and saw the computer as more masculine. Wilder, Mackie and Cooper report, "The most striking finding with respect to attitudes toward the computer, however, was one of decreased liking by all students over time. While the slight sex differences remained -- with girls always more negative than boys in their attitudes toward the computer -- a steady decline in liking for the computer by both sexes started in the sixth grade" (Wilder, Mackie & Cooper, 1983, p. 218). However, the authors make no suggestion as to the reason for such a decline. It is possible that in 1983 older students would have had less experience with computers, and hence did not have positive attitudes toward them.

The question of how females and males respond to computer learning environments was studied as a part of the Assessing the Cognitive Consequences of Computer Environments for Learning (ACCCEL) project at the University of California at Berkeley in the early 1980's (Linn, 1985a, 1985b). The result of the research, which included programming designed to foster cognitive development in a computer enriched environment, showed that fewer females participated in the computer activities than males. Content was one possible explanation given for the difference in participation. Males were more interested in the entertainment aspect of computers and gained early comfort with use of computers. The difference in computer experience was a critical one for this study.

Linn (1985b) found patterns in behavior and attitude among the students which were distributed along gender lines. Girls were more likely to seek excuses for failures in their performance and boys sought explanations.

Girls attributed their success to luck and not to the strength of their skills; boys attributed their success to task difficulty, then to strategy. Girls were more likely to seek help with problems they encountered using the computers. Females "appear to be more likely than males to follow instructions completely -- even when following the instructions becomes counter-productive" (Linn, 1985b, p. 26). The conclusion from the study was that the learning environment must be enhanced to accommodate these differences.

When asked about their attitudes toward computers, high school student replies differed by sex in several areas (Chen, 1986). There was a strong contrast between girls' own confidence and anxiety about computers, and their reported positive feelings that computers should be used by males and females equally. "The findings present a contrast between girls' strong feelings that females are and should be as competent with computers as men and their more negative feelings regarding personal involvement with computers. This ambivalence concerning females' strong beliefs in social equity but diminished personal interest and confidence has been described as a 'We can but I can't' attitude" (Chen, 1986, p. 274). Males in the study participated more in programming classes than the females. More male students than females reported having access to a computer at home. Of those students owning computers, males reported higher levels of computer usage than females.

Chen (1986) reported a significant peer influence among students in the sample. Same sex peers appear to share similar interests. Students using computers encouraged their friends to use them as well. According to Chen, "The development of skill with computers is more socially approved and offers more social incentives in the culture of adolescent males than females. These stronger male bonds surrounding computer use may also act to develop and reinforce males' greater self-confidence with the technology" (Chen, 1986, p. 279). The variable of computer experience is repeated throughout much of the published research. As in Chen's investigation, others have found computer experience related significantly to computer anxiety, in some cases for males only, not females (Arch & Cummins, 1989; Badagliacco, 1990; Colley, Gale, & Harris, 1994; Collis, 1985; Gutek & Bikson, 1985; Igbaria & Chakrabarti, 1990; Marcoulides, 1988; Miura, 1987; Ogletree & Williams, 1990).

Collis (1985) observed that by age 13, students held very strong attitudes toward computers. Female students held more stereotypical attitudes than males and associated computers with people who were not very social. Female students in the study did not change their attitudes over time. In the study female students expressed ambivalence in attitudes, supporting female use of computers in general, but expressing negative feeling about their own experiences. Again, the "We can, I can't" attitude toward computer use was expressed by women. The female students in the Collis study did not change their negative attitudes, even after they had taken computer classes. "Grade 8 females in this study who had participated in a required computer literacy course were less confident about their abilities with computers than were their female peers who had not yet taken the course, a finding that was reversed for males" (Collis, 1985, p. 212).

Shashaani (1993) likewise found that while girls held positive views about females succeeding in the area of computer science, boys held much more negative views. The influence of teachers, parents and society on these views was demonstrated by responses to a survey of 9th and 12th grade students. A strong positive correlation was found between a student's interest in computers and the amount of encouragement they reported receiving from teachers, parents and counselors. Students were asked to agree or disagree with statements such as, "My teacher believes that computer science is mostly for males than for females" or "My parents encourage me to learn about computers" (Shashaani, 1993, p. 177).

Eccles and Jacobs (1986) suggested that the influence of social forces such as parents and teachers, has more of an effect on the achievement of girls and boys than inherent, or biological traits. Their work with attitudes toward mathematics demonstrated a connection between parents', and particularly mothers' perceptions about the importance and probable success or failure of their child with math, and math achievement or computers, and computer achievement.

College Student Samples

Clarke and Chambers (1989) study of Australian college students showed female students had lower perceptions of their computing abilities than male students, despite having higher achievement levels in computer classes than did males. Their study also found that previous computer experience, more than mathematics experience, predicted computer achievement. However, perhaps more significantly, factors influencing a student's decision to declare a major in computing in college differed between males and females. For females, previous mathematics experience at the upper levels in secondary school and attitudes toward statistics were the most significant predictors. "These attitudes essentially reflected student's beliefs about the difficulty of this area of study, their ability in this area, the time likely to be required by these studies relative to their other studies and their expected success in this area of study relative to the other areas of study" (Clarke & Chambers, 1989, p. 424).

Wilder, Mackie and Cooper (1985) found similar patterns of perceived ability in their study of college freshmen. Males consistently rated themselves as more skilled in computer skills than females even though both groups had equivalent backgrounds. Not only did the females underestimate their abilities, they commonly overrated the abilities of male students in classes with them. Female students did not feel comfortable with their abilities using computers until they had completed programming classes. They did not value the non-programming experiences they may have had in high school. In contrast, male students did not base their perception of ability on what they had done, word-processing versus programming, but upon how much exposure they had had.

Another study also reports similar findings and is often cited as a critical source. Dambrot, Watkins-Malek, Silling, Marshall and Garver (1985) found that there were differences between men and women in the variables that predicted computer aptitude. "For women, math aptitude, high school grades and computer attitudes predicted computer aptitude. For men, math aptitude and computer experience predicted computer aptitude" (p. 81). The study of 600 women and 350 men at a midwestern university considered differences between the sexes on a number of variables. Computer aptitude, computer experience, math ability, math experience and computer attitudes were measured and relationships between these variables were explored.

The results indicated differences between sexes. Men in the sample had taken many more computer classes than the women and had knowledge of at least one computer language. Women had fewer math courses and more negative attitudes toward computers. "Correlational analyses indicated that computer attitude was related to math anxiety, computer attitude and computer experience. For males, computer attitude and math anxiety were related to computer attitude while for females only math anxiety was related to computer attitude" (Dambrot, et al., 1985, p. 83). The authors considered math avoidance or anxiety to be critical factors in the computer attitudes, computer aptitudes, and subsequent career choices to select, or reject computer science.

Miura's (1987) study of college students found that there were differences between male and female students in perceived need for computer skills when planning for a career. Students completed questionnaires to measure background demographic information such as number of computer courses taken, microcomputer ownership and age. Students were also asked if they could complete a number of computer tasks and to state their confidence in their ability to successfully complete those computer tasks. Men rated themselves higher than women in the sample in terms of computer ability. Men also considered the relationship between computer knowledge and career selection to be more important than did women. These differences were not as strong when computer self-efficacy was held constant for both sexes.

Miura (1987) considered computer self-efficacy a critical predictor of future successful computer study. "It is reasonable to suggest that those who perceive themselves as efficacious in computer-related tasks would be more likely to attempt a computer science class and to persist despite difficulties encountered. For women, persistence may be encouraged if efforts to increase perceived self-efficacy are incorporated into computer science courses" (Miura, 1987, p. 309).

Data gathered from Australian students (Clarke & Chambers, 1989) support the view that female students are reluctant to pursue computer science and that computer achievement is not a significant predictor of a computer science career choice. Data from the study provided evidence to support the concept that computer science careers are sex-typed by both males and females. According to Clarke and Chambers, computer attitude was the factor most related to career choice. "The data clearly show that the tendency of the women to doubt their own ability to study computing and to perceive computing as a difficult area of study is not supported by their performance. Yet although these attitudes are unrelated to students' actual success, the women's attitudes are leading to the selection of alternative areas of study" (Clarke & Chambers, 1989, p. 425).

Workplace Studies

The findings of research on the topic of computer attitudes and gender within sample populations outside of academia are similar to those using students. There are inconclusive results for both groups. Studies of the business arena often include analysis of reactions to technological change. For example, Gutek and Bikson (1985), in an often cited study, found that men and women's attitudes differ toward the introduction of computers in the workplace. Men, they reported, had greater interest in determining how computers were used in their work, were more involved in making computer-related decisions and came to the computer with more relevant experience. Compared with men, women used computers more, and for more routine tasks, and were more satisfied with the training and support they received. Their study was criticized for its sampling techniques and the use of women from clerical positions and men from middle-management (Parasuraman & Igbaria, 1990). However, Gutek and Bikson stated that the nature of employment patterns in the private sector at the time of the study were discriminatory toward women, and the reactions of women reflected their true positions.

The difficulty of analyzing computer attitudes from a heterogeneous population are demonstrated in the study by Parasuraman and Igbaria (1990). They investigated the possible relationships between personality traits and computer anxiety. The study used instruments to measure computer anxiety (Raub, 1981), locus of control (Valecha & Ostrom, 1974), trait anxiety (Bendig, 1956), math anxiety (Fennema & Sherman, 1976) and cognitive style (Briggs & Myers, 1983). The results showed that differences in age, education and personality traits were better predictors of computer anxiety than gender alone.

A study of part-time M.B.A. students with full-time jobs investigated the relationship between demographic variables, training and experience with computers and computer anxiety (Igbaria & Chakrabarti, 1990). The data indicated a strong relationship between training and reduction of computer anxiety. The study reported evidence of a relationship between gender and computer anxiety and not between other demographic characteristics such as age or professional status.

Experimental Research

There is a noticeable lack of experimental research investigating gender differences and computer technology. Mandinach and Linn (1987) created new programming methods for students and observed their patterns of thought. Mandinach and Corno (1985) created games to observe strategies used by each gender in computer problem-solving. Robinson-Stavely and Cooper (1988) found that the presence of another person appears to have an influence on the anxiety of women who were learning computer skills. These three studies were the only examples of recently reported experimental research. There were no investigations of sex-typing and computer attitudes, using experimental research methods, in the literature.

The results of the study done by Robinson-Stavely and Cooper (1990) demonstrated that the presence of another person in the room during an experimental situation had an impact on some of their subjects. Reactions of the student learning the computer task varied according to gender, level of computer experience and presence or absence of another person. Females with little computer experience performed less well in the presence of another individual. They reported significantly more negative attitudes toward computers and higher levels of anxiety. Males with little computer experience had much higher scores than women when tested in the presence of another person. Robinson-Stavely and Cooper's findings might be interpreted to show that women are unwilling to try to learn something new on a computer in front of another person, or that they lack self-efficacy.

In an attempt to identify the nature of the anxiety of women in the low experience phase of computer learning, a second slightly different set of trials was run. In the second set, support was provided to half of the group by a series of responses from the instructor. These responses were designed to give the impression that the student was assured of success before the task began. The second half of the group received negative feedback. Again, a second person was in the room, this time not working on a computer, but writing notes on paper. The change from computer to paper was to eliminate the immediate feeling of comparison between the student and someone who appeared at ease with computers. In the second trial, the positive intervention of an instructor had a positive effect on both men and women with little computer experience and the negative intervention, a negative effect.

The results of this study show how some women may be influenced under circumstances in which they feel anxious. Females were apparently insecure in themselves and their abilities and were swayed by the comments of an instructor and the presence of an observer. The results also show the critical importance of providing supportive environments in computer studies, especially to female learners. There are serious implications to be considered in the selection of computer instruction methods demonstrated by this research. There is a commonly held belief that cooperative learning is beneficial for teaching women about computers, but it may not be an appropriate approach for all women, particularly those who are anxious about using computers.

The method of computer instruction, and its subsequent impact on computer attitudes and achievement, is discussed by Marcoulides, (1988) who stressed the connection between computer anxiety and its negative impact on students. According to Marcoulides, the computer attitude of a student may be positive, but computer anxiety is negatively related to successful learning. He therefore suggested the inclusion of stress-reducing and anxiety-reducing methods in the practice of teaching with and about computers. A non-threatening environment was recommended to promote the reduction of computer anxiety and thereby increase computer achievement.

Gardner, Dukes and Discenza (1993) used a causal relationship model proposed by Fishbein and Ajzen (1975) to provide a theoretical basis for the connection between computer attitudes and beliefs. The Gardner, Dukes and Discenza study examined the effect of computer experience on computer beliefs, which they hypothesized affected attitudes about computers. They concentrated on the first experiences of students with computers. They found that there was a direct relationship between experiences and attitudes. The researchers recommended that instruction be done by teachers comfortable with computers and in such a way as to eliminate early negative experiences. Those negative experiences might later result in negative attitudes and poor computer achievement. Gutek, Winter and Chudoba (1992) also found evidence to support the claim that attitudes predict patterns of computer use.

Arch and Cummins (1989) found that women at a coeducational college tended not to use a computer, even in with technical support and assistance available, unless required as a part of their curriculum. Half of the students in a first year writing program were strongly encouraged to take advantage of computer instruction outside of the classroom. The other half of the students taking the class were required to take the instructional classes and to turn in assignments using the computer. Arch and Cummins found that women with previous computer experience were more likely to seek computer instruction, but level of experience made no difference for men. The male students participated at a greater level in the computer program and had more positive computer attitudes. "This suggests that at the college level, in order to get women to participate in computer activities, they need to be specifically instructed and encouraged, in fact required, to use the machines. Once this occurs they operate and feel no differently than the males" (Arch & Cummins, 1989, p. 252).

Pope-Davis and Vispoel (1993) found instruction about computers improved student attitudes toward computers, but did not find large differences between male and female attitudes. The study created two groups, one receiving computer instruction and a control group not taking a computer class. Both groups completed the Computer Attitude Scale (Loyd & Gressard, 1984a) at the beginning and end of the semester. The attitudes of the control group students did not change over the term, but the attitudes of the students taking the computer class did change. Students were generally more positive about computers after taking the class than before. There were small differences between male and female attitudes in the pre-test results. Males appeared to be less anxious than females, but the differences were considered small. At the end of the course, there were no significant differences between measures of male and female computer attitudes. The results, according to Pope-Davis and Vispoel, are not generalizable to the population at large since the sampling techniques used were not completely random. However, Pope-Davis and Vispoel suggest that their findings indicate "that regardless of gender, it seems possible to improve attitudes through systematic instruction" (p. 90).

Evidence of the relationship between the learning environment and the instruction of technology are presented by the work of Marcoulides (1988), Arch and Cummins (1989), Gardner, Dukes and Discenza (1993), and Pope-Davis and Vispoel (1993). The importance of their findings lies at the heart of the question to be investigated by this study, i.e. whether a difference in an educational setting has an effect on computer attitudes.

Research on the topic of computer attitudes and gender differences presents varying and at times conflicting, results. Only three articles and one dissertation describing the interaction between sex-role stereotypes or gender schema, and computer attitudes were found in the literature (Albert, 1988; Colley, Gale, Harris, 1994; Ogletree & Williams, 1990; Rosen, Sears, & Weil, 1987).

Rosen, Sears and Weil (1987) investigated the interaction between computer attitudes, computer use, trait anxiety, age and other factors that led individuals to experience "computerphobia." Among the factors studied was sex-typing. Students from classes requiring extensive computer interaction completed instruments to measure computer anxiety, sex-typing by using the BSRI, trait anxiety and math anxiety. Demographic information was also obtained from the students. The results indicated relationships between computer anxiety and math anxiety for those students identified as possessing the feminine sex-role identity traits. A combination of physical discomfort, certain computer attitudes and possession of feminine sex-role personality traits are reported to predict computer anxiety. In addition, computer anxiety and possession of masculine sex-role identity traits appear to predict computer attitudes.

Similar results were found by Ogletree and Williams (1990) who studied 125 undergraduate students. The Bem Sex Role Inventory (Bem, 1974) was administered along with the Computer Attitude Scale (Dambrot, et al., 1985) and the Self-Efficacy Questionnaire (Miura, 1987). Their findings indicated that femininity was negatively associated with attitudes toward completion of computer studies. Masculinity as a sex-role stereotypical behavior "significantly related to more positive computer attitudes for females" (Ogletree & Williams, 1990, p. 710). Computer experience appeared to be unrelated to either masculinity or femininity. However, computer attitudes, computer anxiety and self-efficacy followed sex stereotypical patterns. "Women in the current study had more negative attitudes toward computers than men even after the effects of computer experience and BSRI masculinity/femininity were removed. This may imply that aspects of being reared as a female vs. a male other than those operationalized here may impact sex differences in attitudes toward computers" (Ogletree & Williams, 1990, p. 711). These results appear to indicate differences, by sex type, in measures of computer attitudes. The implication of these findings is that for some individuals, computer attitudes follow a pattern of behavior determined by masculine and feminine traits.

Albert's (1988) study used a sample of high school students and examined sex-role identity, computer attitudes, math attitudes and computer experience. Other significant variables included socio-economic status and parental encouragement. The findings showed an association between gender role and measures of computer confidence. Albert reported no significant differences between sexes in computer attitude scores. However, there was a significant relationship between masculinity scores for girls and their scores on a computer confidence scale. Girls' high masculinity scores predicted higher scores on the computer confidence scale. Math anxiety and computer experience were also predictor variables in the Albert study.

Colley, Gale and Harris (1994) also tested the possible relationship between sex-typing and computer attitude. Their findings confirm those of Albert (1988), Ogletree and Williams (1990), and Rosen, Sears and Weil (1987). "Statistically significant associations between masculinity and the computer attitude measures were found for females only, supporting the notion that the sex difference in the expression of male-stereotyped traits makes a major contribution to the way in which computers are perceived by males and females" (Colley, Gale, & Harris, 1995, p. 135). These studies support the concepts of the present research and suggest a direction for the hypotheses to be tested, i.e. that individuals who are strongly sex-typed react in predictable patterns to stereotypes about computers and see them as male-dominated.

On the topic of computer attitudes and single-sex education, only one study could be identified (Jones & Clarke, 1995). The females in that sample were at the secondary level, not in college. This article presents evidence to support the hypothesis that a female single-sex environment is beneficial to computer instruction. Students at coeducational and single-sex schools were compared to each other on measures of computer attitudes and computer experience. The female students at the single-sex school were found to have had more computer experience and exposure, and to have more positive attitudes than those at the coeducational school. There was no difference between students at each type of educational environment if computer experience was withdrawn as a comparison characteristic. Computer experience between the two groups did differ in an important way, however, in that the girls' school students had more diverse computer use than those at the coeducational school.

The study "goes beyond those in the literature by showing that the relationship between educational setting and computing attitudes is due to the effects of the covariate of computing experience, indicating that girls attending single-sex schools did not hold more positive attitudes toward computers as a function of their educational setting per se, but rather, that these attitudes developed as a function of the computing experience gained within that environment" (Jones & Clarke, 1995, p. 59).

Single-Sex Educational Environment

The literature on the advantages and disadvantages of women's colleges concentrates on two general areas -- the academic achievement of students, and the professional or lifelong achievements of women. Information gathered on a national scale by Alexander Astin (1992) on student attitudes, accomplishments, involvement in social issues and skills demonstrates the advantages of a single-sex environment. Others (Hall & Sandler, 1982; Kim & Alvarez, 1995; Miller-Bernal, 1989; Pascarella & Terenzini, 1991; Riordan 1994; Smith, Wolf & Morrison, 1995) have found similar results. Lifelong achievement has been measured most commonly by counting occasions of inclusion in the Who's Who directories. Elizabeth

Tidball (Aug. 1976, 1976, 1980, 1989) has done extensive research and is most often cited for her analysis showing high achievement rates for women's college graduates. More recent studies of long-term achievement have shown varying results (Oates & Williamson, 1978; Rice & Hemmings, 1988; Stoecker & Pascarella, 1991; Tidball & Kistiakowsky, 1976). Pascarella and Terenzini's (1991) exhaustive review of the effects of college on students considered the impact of "institutional gender" on women. They reported that women's colleges support non-sex-stereotypical career roles for women, and that women's colleges graduate larger numbers of high achievers than coeducational colleges.

The number of women's colleges in the United States has fallen from 233 in 1960 to 84 in 1995 (Smith, Wolf & Morrison, 1995). Questions about the validity of a women's college education have spurred investigations on the nature of the unique environment. The possibility of negative experiences by women in coeducational settings (Hall & Sandler, 1972) formed the basis for studies to measure student activities, leadership and achievement in colleges. Interaction in the classroom was reported to favor male students and discriminate against females (Hall & Sandler, 1982; Holland & Eisenhart, 1990; Lasser, 1987). Alexander Astin's research uses data from the annual Cooperative Institutional Research Program (CIRP). Using data from the 1985 first-year survey and the 1989 follow-up data, Astin found "that women at women's colleges were more likely to persist to graduation, to trust the institution's administration, to have a strong diversity orientation, to exhibit a concern for social change, to enhance their leadership and academic skills, and to want to attend graduate school when compared to women at coeducational institutions" (Smith, et al. p. 248).

Kim and Alvarez (1995) used data obtained from students completing the CIRP survey in 1987 and 1991 to investigate differences between students at coeducational and "women-only" colleges. Their findings included:

- "attending women-only colleges advantageously affects student's academic ability," (p. 661);
- "despite earlier research findings to the contrary, "students at women-only colleges appear to provide students better opportunities to be actively involved in student organizations, to exercise leadership, and thus to improve their social self-confidence" (p. 661);
- "percent of female faculty as a variable was not a significant positive predictor for any dimension of women students' development" (p. 661);
- "women seniors at coeducational institutions appear more likely to have acquired job related skills with which to initiate their careers. Seniors at women's colleges have no advantage over coed seniors in preparation for entry into graduate or professional schools" (p. 661).

Kim and Alvarez suggest that although seniors at women's colleges may have the same skill preparation for career development as seniors in coeducational colleges their experiences in school, particularly in leadership roles, will make a difference in the long run. They have a high level of social self-confidence that "may provide a long-term foundation for higher proportions of career achievers among their graduates, compared to their coeducational counterparts" (Kim & Alvarez, 1995, p. 661).

Single-sex colleges and career achievement

Career choice, and subsequent success or achievement may be influenced, to a small degree, by the type of institution the student attends. Bressler and Wendell (1980) also used data from the CIRP survey (1967- 1971) to determine the timing and nature of college student career choices at single-sex (both male and female) and coeducational colleges. Their findings indicate a difference between the two types of colleges for women. At entry into college they report that women entering single-sex colleges are slightly "less oriented to masculine careers (16.9 percent) than their peers in coeducational institutions (18.4 percent)" (Bressler & Wendell, 1980, p. 660). By the time they graduate, however, these trends have reversed. "Significant gains in the proportion of women enrolled in single-sex schools who aspire to careers as professors (2.7 to 8.5 percent) and lawyers (2.4 to 7.3 percent) contribute to an overall net increase from approximately 17 to 29 percent who are oriented to masculine vocations -- more than 10 percentage points higher than the corresponding gain among females attending coeducational colleges" (Bressler & Wendell, 1980, p. 660).

An updated study (Stoecker & Pascarella, 1991) using similar data, obtained from the CIRP survey in the years 1971 to 1980, found there was little difference between career aspirations of women at single-sex colleges and those attending coeducational institutions. They suggested that previous studies, including Tidball, found differences that were the result of differences in recruitment rather than socialization within a unique environment. But, they also suggested that "the environment of a women's college may not have a net influence on the occupational status of the job obtained, but, as suggested by Tidball, it may socialize women in ways that enhance self-confidence, drive for success and prominence within occupational strata" (Stoecker & Pascarella, 1991, p. 403).

The influence of the social context of a women's college on women's self-confidence could be related to more positive computer attitudes held by women at these colleges. If a student has confidence in her academic abilities, as several of these studies indicate, there may be positive differences in her computer abilities and attitudes.

Miller-Bernal (1989) collected data on students attitudes toward academic goals, participation in college activities and future goals. The results indicated that "at the coed college academic goals are not related to women students' participation in college activities; students participate at about the same level regardless of their academic goals. At the women's college, on the other hand, academic goals are directly related to participation levels, so that students planning on getting their Ph.D. are the most active, even more active than their counterparts at the coed college. Thus campus leadership and academic pursuits are compatible at the women's college but not at the coed college" (Miller-Bernal, 1989, p. 377).

Single-sex colleges and sex-role attitudes

Another aspect of career choice was explored by Miller-Bernal (1989) through the means of sex-role attitudes. The study was intended to explore the attitudes about women's experiences while in college. Miller-Bernal used the Attitudes Toward Women Scale (AWS) (Spence, et al. 1973) to measure the extent of sex-role differences between women at two similar single-sex and coeducational colleges. The hypothesis to be tested was whether women attending single-sex colleges had more liberal (less stereotypical) attitudes toward gender. "Contrary to what was predicted, students at the women's college do not appear to have more liberal sex-role attitudes than students at the coed college in either 1974 or 1982" (Miller-Bernal, 1989, p. 381).

Bem Sex Role Inventory

Individuals with sex-typed identities, that is strongly masculine or feminine, are more likely to select activities, have preferences and hold beliefs that follow the socially held stereotypes associated with a particular sex (Spence, 1993). "Gender serves as an organizing principle for sex-typed individuals that they use in processing information about themselves and the external world" (Spence, 1993, p. 625). The Bem Sex Role Inventory (BSRI) (Bem, 1974) is used to measure an individual's degree of sex typing. If an individual scores at either end of the scale he or she is said to be sex-typed or gender schematic, that is, he or she is influenced more by social gender stereotypes than those with lower, or aschematic scores. The BSRI employs terms such as "dominant," "childish," "sympathetic" and "competitive" to describe how an individual sees him or herself (Bem, 1974). A complete list of the terms is presented in Chapter 3. The list of these traits was devised over 20 years ago, was tested extensively to determine which terms best describe traits of a female and traits of a male, and is considered a standard tool for measuring sex-role perceptions. Other non-discriminatory "filler" terms are also included in the instrument to offer alternatives and diffuse the contrast between the masculine and feminine trait lists.

BSRI: Instrument Design

The Bem Sex Role Inventory was created using samples of undergraduates who rated personality characteristics as being socially desirable for either men or women. Items or characteristics that were identified as being more socially desirable for one sex or the other were selected. The list of over 400 items was reduced to 20 masculine items, 20 feminine items, and 20 social desirability items that are gender-neutral. According to Bem, (1974) "the BSRI was founded on a conception of the sex-typed person as some one who has internalized society's sex-typed standards of desirable behavior for men and women" (Bem, 1974, p. 155). "The BSRI characterizes a person as masculine, feminine or androgynous as a function of the difference between his or her endorsement of masculine and feminine characteristics" (p. 156).

Janet Spence created an instrument similar to the BSRI, the Personal Attributes Questionnaire, to measure social desirability of sex-stereotypical attitudes. The two instruments are often used together or interchangably. Spence (1985, 1991, 1993) disputes the validity of the BSRI, and contends that the instrument is more appropriate for distinguishing between expressive and instrumental behaviors than gender typing. Spence also contends that gender typing is more complex than the simple bipolar structure that Bem's sex-role identity scale allows (Spence, 1993).

Bem's response to Spence's criticisms acknowledges that gender schema theory cannot predict all facets of gender-related behavior. Bem suggests that gender schema can be used to predict specific types of behavior. "The theory of [gender schema] thus predicts that individuals identified as sex-typed on the BSRI should differ from others not on every possible dependent measure related to gender, but in highly specific ways. In particular, they should have a lower threshold for spontaneously organizing information -- including information about the self -- into gender-based equivalence classes, and they should be more motivated to conform to the culture's definitions of masculinity and femininity" (Bem, 1985, p. 197).

In the present study gender is considered to be key in the formation of computer attitudes for some female students. The BSRI is used in the present study to measure the extent to which sex-typing is related to computer attitudes and to investigate the influences of educational cultures organized by sex on those computer attitudes. The nature of the educational environment is also considered to play a role in the development of interest and positive attitudes toward certain areas of study, in the present study, toward computing.

Computer Attitude Scale

The Computer Attitude Scale (Loyd & Gressard, 1984a) was used in the present study to measure individual's attitudes toward computers. Loyd and Gressard (1984a) developed the Computer Attitude Scale (CAS) as an instrument to aid instructors in the assessment of potential problem areas as they attempted to introduce more technology into the curriculum. The scale was developed on the premise that there is a relationship between computer attitudes and subsequent computer learning and achievement. The scale was chosen for the present study for its emphasis on the instructional aspect of computer usage. It was also chosen for its discrimination of different types of computer attitude, its reported reliability and validity and the consistent suggestion in the literature of its research value (Bandalos & Benson, 1990; Gardner, Discenza, & Dukes, 1993; Kay, 1992; Kernan & Howard, 1990; LaLomia & Sidowski, 1993).

CAS: Instrument Design

The instrument was designed to explore the attitudes of students toward computers. Loyd and Gressard based their suppositions on the work of Fennema and Sherman (1978) who showed that math anxiety inhibited math achievement. Loyd and Gressard proposed a parallel argument that computer anxiety would inhibit computer learning, use and achievement. Their work did not project, nor support the idea that there would be differences in computer anxiety between the sexes. Results showed that computer experience was a strong predictor of computer anxiety, but sex was not related.

Math Anxiety Scale

Math anxiety was measured in the present study by the Fennema-Sherman Math Anxiety Scale (1976). Fennema and Sherman studied many aspects of attitudes toward mathematics including confidence in learning math, math as a male domain, usefulness of math, parental influence on learning math, and math anxiety. Math anxiety was found to be associated with women's negative attitudes toward computers in a number of studies and is considered as a possible influential variable in the present study (Clarke & Chambers, 1989; Collis, 1985; Dambrot, et al., 1985; Fariña, Arce, Sobral & Carames, 1991; Konvalina, Wileman & Stephens, 1983; Marcoulides, 1988; Parasuraman & Igbaria, 1990; Rosen, Sears & Weil, 1987). The instrument was chosen for this study because of its frequent use in other related research investigations and for its reliability and validity. The instrument is simple to administer and to score.

Summary

The present study centers on the question of whether sex-role stereotypes influence women's perceptions and attitudes toward computers. In the 1990's it may not seem reasonable to think that such stereotypes persist. Women have become leaders in many fields, including computing. However, social change is slow, and there are strong patterns to be broken. The present study is based on the concept that there are women who hold sex-stereotyped perceptions and whose computer atititudes are negatively influenced by the fact that the computer is often seen as male-oriented (Dambrot, et al, 1985; Frenkel, 1990; Kiesler, Sproull, & Eccles, 1983; Perry & Greber, 1990; Turkle, 1984, 1995). The study also examines the possible positive influence of the women's college on computer attitudes for those stereotypical women.

Research on computer attitudes has failed to produce consistent evidence on the presence or absence of differences in computer attitude between the sexes. The present study does not suggest that a difference exists for all women, or all men. Rather, the study suggests that an interaction of personality and cognitive traits may combine with elements of a social context to influence individual computer attitudes. The particular social contexts under investigation are single-sex and coeducational college environments. Sex-role stereotypical perceptions, as personality and cognitive traits, form the framework for the investigation of individual differences in this study. The study separates women who identify themselves as having more stereotypically feminine and fewer stereotypically masculine traits into a group and examines the interaction of their attitudes toward computers, and their educational surroundings.

As an educational setting, women's colleges have unique features to support women's scholarship and accomplishment. The non-competitive environment of a women's college, in which both challenge and support are key features, leads to the development of increases in self-confidence, leadership and social activity (Tidball, 1976, 1980, 1989). Research has shown, in some cases, that students who attend women's colleges are more likely to pursue further education, to become leaders in their fields and to have higher self-esteem (Kim & Alvarez, 1995). The present study suggests that the positive aspects of this educational milieu may have an influence on the computer attitudes of those women who are in its midst. Further, results may indicate that the single-sex educational climate offers a model for an instructional setting where women can overcome stereotypes associated with computing.

Chapter Two - Literature Review

Promoting models of learning and instruction that foster personal and intellectual growth are the goal of most educators. Barriers, perceived and practical, surrounding computers and computer instruction can be removed if their sources are understood. This study examines sex-roles as one possible component of a social barrier to computing. The study also considers the possibility that single-sex educational settings, which support self-confidence and promote individual learning styles for women, may contribute to improving women's computer attitudes.

Chapter Three -- Method

Introduction

This chapter presents the research methodology for the study. This includes the research questions, the definition of concepts, the operational definitions, and the hypotheses tested in this study. Other aspects of the methodology include the identification of the target population, a discussion of the sampling methodology and a description of the sample. The analysis process and statistical techniques employed in this research are also included.

Research Questions

The research questions investigated by this study are:

Do female college students who are identified as being sex-typed, ie., those holding sex-role stereotypical views and perceptions, have more negative attitudes toward computers than those who are not identified as being sex-typed?

Does the relationship between gender schema and computer attitudes differ significantly between female college students attending coeducational institutions and female college students attending a women's college?

After controlling for the effects of math anxiety and computer experience, are there significant differences between the computer attitude scores of the female college students who are identified as being sex-typed, and those who are not identified as being sex-typed?

Hypotheses

The first set of hypotheses tested involves the nature of the relationship between strongly held sex-typed perceptions and four dimensions of computer attitudes of female college students.

H_{0a}: Female college students who have strongly held, feminine sex-stereotyped perceptions will not have significantly different scores on measures of computer anxiety than will female college students who are identified as not having strongly held sex-stereotyped perceptions.

H_{1a}: Female college students who have strongly held, feminine sex-stereotyped perceptions will have significantly higher scores on measures of computer anxiety than will female college students who are identified as not having strongly held sex-stereotyped perceptions.

H_{0b}: Female college students who have strongly held, feminine sex-stereotyped perceptions will not have significantly different scores on measures of computer confidence than will female college students who are identified as not having strongly held sex-stereotyped perceptions.

H_{1b}: Female college students who have strongly held, feminine sex-stereotyped perceptions will have significantly lower scores on measures of computer confidence than will female college students who are identified as not having strongly held sex-stereotyped perceptions.

H_{0c}: Female college students who have strongly held, feminine sex-stereotyped perceptions will not have significantly different scores on measures of computer liking than will female college students who are identified as not having strongly held sex-stereotyped perceptions.

H_{1c}: Female college students who have strongly held, feminine sex-stereotyped perceptions will have significantly lower scores on measures of computer liking than will female college students who are identified as not having strongly held sex-stereotyped perceptions.

H_{0d}: Female college students who have strongly held, feminine sex-stereotyped perceptions will not have significantly different scores on combined measures of computer attitude than will female college students who are identified as not having strongly held sex-stereotyped perceptions.

H_{1d}: Female college students who have strongly held, feminine sex-stereotyped perceptions will have significantly lower scores on combined measures of computer attitude than will female college students who are identified as not having strongly held sex-stereotyped perceptions.

This set of hypotheses proposes that female college students who hold feminine sex-stereotyped perceptions are influenced in their perspectives toward computers because social conventions portray the computer as having a male-orientation (Dambrot, et al., 1985; Frenkel, 1990; Kiesler, Sproull, & Eccles, 1983; Perry & Greber, 1990; Turkle, 1984, 1995). In this study it is proposed that sex-typed female students have negative attitudes toward computers.

The second hypothesis proposes that there is a difference in computer attitudes between female college students attending coeducational colleges and women's colleges.

> H_0: There is no statistically significant difference between computer attitudes of women with strongly held, sex-stereotyped perceptions who attend coeducational colleges and computer attitudes of women with strongly held, sex-stereotyped perceptions who attend women's colleges.

> H_1: There is a statistically significant positive difference between computer attitudes of women with strongly held, sex-stereotyped perceptions who attend single-sex colleges and computer attitudes of women with strongly held, sex-stereotyped perceptions who attend coeducational colleges.

The second hypothesis is based on evidence (Tidball, 1989) showing differences between the career outcomes of women attending single-sex colleges and those at coeducational colleges. There is also evidence that other attitudes, such as interest in social issues, are influenced by attendance at a women's college (Kim & Alvarez, 1995; Smith, Wolf, & Morrison, 1995). This study proposes that positive computer attitudes are influenced by the single-sex environment.

Other significant predictors of computer attitude are math anxiety and computer experience. These variables have been discussed in the review of literature, Chapter 2. The third hypothesis in this study addresses the effect of these variables as covariates.

> H_0: Controlling for the factors of math anxiety and computer experience, there is no statistically significant difference between measures of gender schema and measures of computer attitude.

> H_1: Controlling for the factors of math anxiety and computer experience there is a statistically significant difference between measures of gender schema and measures of computer attitude.

Definition of Concepts

Major Concepts

The three major concepts addressed in this research are: gender schema, computer attitudes, and math anxiety.

As used in this study, gender schema is a learned process that is part of an individual's method of assimilating and interpreting information about the world, on the basis of social definitions of gender. These perceptions, or filters use sex as an important criterion on which to evaluate every-day actions, other people and the self. Gender schemata are the actual cognitive structures through which these perceptions are filtered and arranged. The manifestations of gender schema were measured in the present study by using the Bem Sex Role Inventory (BSRI) which contains two subscales: femininity and masculinity.

This study defines sex-typing as the process by which an individual learns or takes on the characteristics of each sex, and develops an internal cognitive structure called gender schema. These characteristics are determined by society and usually do not influence decision-making and judgement. However, for some individuals sex-typing is stronger and structures of gender schema develop into a significant cognitive framework. For these individuals, gender schema becomes a primary means for judging the world along stereotypical lines of masculinity and femininity. The extent to which sex influences cognitive processes, or the degree of sex-typing, varies with each individual.

The present study uses Bem's definitions for the "four gendered personality groups to describe the manner in which sex-roles and stereotypes influence thought and action: sex-typed (masculine men and feminine women), androgynous (those who are both masculine and feminine), undifferentiated (those who are neither masculine nor feminine), and cross-sex-typed (feminine men and masculine women)" (Frable, 1989, p. 95).

In the present study, masculinity is defined as the degree to which individuals feel that they possess the socially defined characteristics of men. These characteristics include such instrumental attributes as aggression, physical strength, and outward appearance. Femininity is defined, for this study, as the degree to which individuals feel that they possess the socially defined characteristics of women. These characteristics include such expressive attributes as nurturance, patience, softness and outward appearance.

The present study defines computer attitudes as dispositions, positive and negative, about the computer itself; fear or confidence toward using computers; and interest or ambivalence regarding the things computers can do. In this study computer attitudes were measured by the Computer Attitude Scales (Loyd and Gressard, 1984a). Within that instrument the elements of computer attitudes include the following dimensions:

- computer anxiety-- nervousness, fearfulness or apprehension using a computer;

- computer confidence-- security in the use and manipulation of computers;
- computer liking -- the degree of interest, curiosity, or perceived usefulness toward computers.

These three areas illustrate important distinctions within the broader concept of computer attitude. Most attitudes are complex and include positive and negative components. Attitudes toward computers may exist before an individual uses a computer and may change dramatically with more exposure. The combination of the three elements takes into account differences between an individual's perception about computers and their responses to previous computer experience.

Minor Concepts: Covariates

The minor concepts in this study include the two covariates of math anxiety and computer experience.

Math anxiety is defined, in this study, as the fear or discomfort an individual experiences when studying, performing or thinking about mathematics. These attitudes reflect negative self-assessments of an individual's ability to learn mathematics. The literature has demonstrated differences in these attitudes by sex (Fennema & Sherman, 1977). Math anxiety is included as a major concept in the study because it is frequently associated with women's negative attitudes toward computers and toward computer studies (Dambrot, et al., 1985; Farina, et al., 1991; Konvalina, Wileman, & Stephens, 1983; Kramer & Lehman, 1990).

Computer experience and its impact on computer attitudes are considered in the present study. In the present study, amount of time spent using computers per week was used to indicate computer experience. The amount of time spent using and learning about computers has been found to have a postitive influence on the attitudes an individual holds toward computers (Chen, 1986; Dambrot, et al. 1985; Gardner, Dukes, & Discenza, 1993; Loyd & Gressard, 1984a; Parasuraman & Igbaria, 1990; Pope-Davis & Twing, 1991; Shashaani, 1994). However, the amount of student computer experience was not a factor in the selection of students in the sample. Data on the extent and nature of the students' computer experience were collected through additional questions in the instrument asking students how many hours they spend per week working on computers. (See Appendix I)

Operational Definitions

The operational definitions for the three major concepts -- gender schema, computer attitudes, and math anxiety -- are presented in the following section.

<u>**Gender Schema**</u>

Gender schema is the degree to which learned, socially contructed, sex-role stereotypes are used to form perceptions at a deep cognitive level. Gender schema was measured in the present study by the Bem Sex Role Inventory which contains a masculinity and femininity scale.

There are four categories into which an individual may be classified. The classification depends upon the combination of his or her scores on the masculinity and femininity scales: sex-typed, androgynous, undifferentiated and cross-sex-typed. "Those who score above the median on the sex-congruent scale and below the median on the sex-incongruent scale are defined as sex typed. Those who show the opposite pattern are defined as cross-sex-typed. Those who score above the median on both scales are defined as androgynous. Those who score below the median on both scales are defined as undifferentiated" (Bem, 1985, p. 192).

The self-administered questionnaire contains 60 items. The items on the instrument describe socially positive masculine and feminine traits and other "filler" descriptors. The inventory consists of the items in Table 1 which are characterized as masculine or feminine. The items are listed in a repeating, but unstated, pattern of masculine, feminine and neutral items. The subject indicates on a 7-point scale the degree to which each of the 60 characteristics describes him or her. The scale ranges from 1 (strongly disagree) to 7 (strongly agree).

Scoring is accomplished by determining the mean of the masculinity scale item ratings, and the mean of the femininity scale item ratings for each individual. An individual will have both a masculinity score from 1 to 7 and a femininity score from 1 to 7. A group median score is calculated for each scale, using individual scores from the sample. Individual scores on each scale are then compared to the group median, and the individual is categorized into one of the four types, ie., sex-typed, androgynous, etc..

Table 1

Bem Sex Role Inventory Items

BSRI: Masculine Items	BSRI: Feminine Items	BSRI: Neutral Items
Has leadership abilities	*Gentle*	*Helpful*
Assertive	*Tender*	*Moody*
Dominant	*Compassionate*	*Conscientious*
Strong personality	*Warm*	*Theatrical*
Forceful	*Sympathetic*	*Happy*
Aggressive	*Sensitive to the needs of others*	*Unpredictable*
Willing to take a stand	*Eager to soothe hurt feelings*	*Reliable*
Independent	*Understanding*	*Jealous*
Defends own beliefs	*Affectionate*	*Truthful*
Willing to take risks	*Loves children*	*Secretive*
Individualistic	*Does not use harsh language*	*Sincere*
Self-sufficient	*Loyal*	*Conceited*
Makes decisions easily	*Feminine*	*Likable*
Ambitious	*Gullible*	*Solemn*
Self-reliant	*Yielding*	*Friendly*
Competitive	*Soft-spoken*	*Inefficient*
Athletic	*Flatterable*	*Adaptable*
Masculine	*Childlike*	*Unsystematic*
Analytical	*Shy*	*Tactful*
Act like a leader	*Cheerful*	*Conventional*

Table 2 shows the initial categories used to classify the results for female college students. The present study classifies subjects into the same four groups.

Table 2

Bem Sex Role Categories

Individual Scores: **Masculinity Score**

Femininity Score		Below Group Median	Above Group Median
	Below Group Median	Undifferentiated *(lo fem - lo masc)*	Cross-typed *(lo fem - hi masc)*
	Above Group Median	Sex-typed *(hi fem - lo masc)*	Androgynous *(hi fem - hi masc)*

(Bem, 1981, p. 9)

Reliability coefficients for the internal consistency of the Bem Sex Role instrument were reported to be Masculinity $\alpha = .86$, Femininity $\alpha = .80$, and the test-retest reliability coefficient was .90. These coefficients indicate that the instrument is highly reliable. (Bem, 1974, p. 160).

Computer Attitudes

The Computer Attitude Scale (Loyd & Gressard, 1984a) was used to measure computer attitudes in the present study. The elements of computer attitudes investigated are "computer anxiety, consisting of anxiety toward or fear of computers or learning to use computers; computer confidence, related to confidence in the ability to learn about or use computers; and computer liking, meaning enjoyment or liking of computers and using computers" (p. 68).

The Computer Attitude Scale (CAS) is comprised of three subscales: computer liking, computer confidence and computer anxiety. The specific items included in each of the subscales follow in Table 3.

Table 3

Computer Attitude Scales

A: Computer Anxiety Subscale

Computers do not scare me at all.
Working with a computer would make me very nervous.
I do not feel threatened when others talk about computers.
It wouldn't bother me at all to take computer courses.
Computers make me feel uncomfortable.
I would feel at ease in a computer class.
I get a sinking feeling when I think of trying to use a computer.
I would feel comfortable working with a computer.
Computers make me feel uneasy and confused.

B. Computer Confidence Subscale

I'm no good with computers.
Generally I would feel OK about trying a new problem on the computer.
I don't think I would do advanced computer work.
I am sure I could do work with computers.
I'm not the type to do well with computers.
I am sure I could learn a computer language
I think using a computer would be very hard for me.
I could get good grades in computer courses.
I do not think I could handle a computer course.
I have a lot of self confidence when it comes to computers.

C: Computer Liking Subscale

I would like working with computers.
The challenge of solving problems with computers does not appeal to me.
I think working with computers would be enjoyable and stimulating.
Figuring out computer problems does not appeal to me.
When there is a problem with a computer that I can't immediately solve, I would stick with it until I have the answer.
I don't understand how some people can spend so much time working with computers and seem to enjoy.
Once I start to work with the computer, I would find it hard to stop.
I do as little with computers as possible.
If a problem is left unsolved in computer class, I would continue to think

about it afterward.
I do not enjoy talking with others about computers.

(Loyd & Gressard, 1984a)

For each of the 29 items, the subject selects 1 of 6 response options ranging from strongly disagree to strongly agree. Scores are calculated by computing the mean for each subscale. Responses from the negative statements are reversed. Scores for each scale range from 1 to 6. For the Computer Anxiety subscale, a higher score indicates more anxiety. On the Computer Confidence and Computer Liking subscales, higher scores indicate more confidence and computer liking. A mean composite score, ranging from 1 to 6, is calculated for each subject. The higher the composite score, the more postitive the overall attitude toward computers.

Reliability coefficients of internal consistency for each of the three scales of the CAS are reported as follows: computer anxiety $\alpha = .86$, for computer liking $\alpha = .91$, for computer confidence $\alpha = .91$ and for the total score $\alpha = .95$ (Loyd & Gressard, 1984b).

Math Anxiety

Math anxiety is defined, in this study, as the amount of fear or apprehension felt by an individual when engaging in, or thinking about engaging in, the study of mathematics or while performing mathematical tasks. These perceptions were measured in the present study by the Fennema-Sherman Math Anxiety Scale (Fennema & Sherman, 1976). "The Mathematics Anxiety Scale is intended to measure feelings of anxiety, dread, nervousness and associated bodily symptoms related to doing mathematics. . . . The scale is not intended to measure confidence in or enjoyment of mathematics" (Fennema & Sherman, 1976, p. 4). The scale consists of the following twelve statements, the first six of which are positive, and last six of which are negative.

Table 4

Fennema-Sherman Math Anxiety Scale

Math doesn't scare me at all.
It wouldn't bother me at all to take more math courses.
I haven't usually worried about being able to solve math problems.
I almost never have gotten shook up during a math test.
I usually have been at ease during math tests.
I usually have been at ease during math classes.
Mathematics usually makes me feel uncomfortable and nervous.
Mathematics makes me feel uncomfortable, restless, irritable, and impatient.
I get a sinking feeling when I think of trying hard math problems.
My mind goes blank and I am unable to think clearly when working mathematics.

A math test would scare me.
Mathematics makes me feel uneasy and confused.

(Fennema & Sherman, 1976)

Individuals rate the statements on a 6-point Likert scale, ranging from 1 (strongly disagree) to 6 (strongly agree). Scores are obtained by adding the values for responses to each statement. Responses from the negative statements are reversed. The higher the score, the more postitive the attitude toward mathematics. The reported reliability score for the Mathematics Anxiety Scale was .89 (Fennema & Sherman, 1985).

Additional Survey Questions

In addition to the previously described published instruments, other descriptive questions were included in the survey and are listed in Appendix I. Specific questions and sample responses are classified in the following categories:

- Demographic -- date of birth, major, type of high school (single-sex or coeducational), and level of parental education; and
- Computer and Mathematics Related -- number of computer courses taken, number and type of mathematics classes taken, hours per week spent on computer activites (by type of activity), and self rating of computer competency level.

Finally, subjects were given the opportunity to write unstructured comments at the end of the survey. They had the option of responding to the following request for additional information: "We are most interested in obtaining your feedback on the instruction you have received on computers and mathematics and in knowing which aspects of that instruction you found most helpful and what aspects you think might be improved or strengthened for future students."

Target Population

The target population for this study was female students of traditional college age, eighteen to twenty-two. One segment of the students in the target population attend a women's college and the other a coeducational institution. The students represent a variety of disciplines and many different backgrounds. The students in the target population are in second to fourth year classes; there are no first year students. First year students are excluded to ensure that the students in the target population attending women's colleges have had at least one year of experience in the single-sex educational environment. First year students would not yet have experienced the effect, if any, of the unique single-sex college environment.

Sampling Methodology

A purposive sample was used for the present research study. The sample included female college students attending either the women's college or the coeducational college described below. Women's colleges are institutions whose exclusive mission and goals are established to furnish women with the opportunity for education (Tidball, 1989). The educational environment is a reflection of the mission and often offers women an empowering atmosphere for academic study and personal growth (Smith, Wolf, & Morrison, 1995). This environment and the potential difference it makes in educating women is also a focus of this study.

Sample Description

Two New England institutions were chosen as sites for this study. The colleges were selected for their common features. Both colleges are selective, academically challenging institutions offering arts and sciences undergraduate degrees. Both colleges have made significant commitments to technology on campus. Both colleges have been "networked" for some time and students have been exposed to computers in their classes and in their residence lives. Both colleges have support structures in place to assist students in their use of technology and have support personnel in place to meet this goal. Both colleges have a strong emphasis on the Macintosh computer as the "preferred" platform for most applications.[3]

The differences between the schools involve size, location, technology administrative/organizational structures and philosophies and missions. In addition to their common features, the selection of these colleges as sites for obtaining data is based on geographic convenience, on personal contact, and on previous knowledge of each campus' technology support structures. Practical limitations precluded broader geographic diversity.

The present study controlled for the possible influence of age and cognitive ability on computer attitudes. Age was controlled by selecting female college students within a narrow age range. The students ranged in age from approximately 19 to 24 years of age. Age is sometimes considered an

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[3] Sherry Turkle discusses the differences between the Macintosh and DOS/Windows environment in her book Life on the Screen (1995). There is a difference, according to Turkle in the way an individual "interacts" with the computer through the interface. Some individuals are more comfortable with the "tinker" type involvement demanded by the command structure of DOS and Windows machines, others with the "transparent" view of the Macintosh. Turkle contends that this division may fall, in some cases along gender lines, but clearly divides different cognitive styles. The fact that both colleges are primarily Macintosh holds that factor constant.

important factor in computer attitudes (Loyd & Gressard, 1984a; Morris, 1988-89; Pope-Davis & Twing, 1991). Cognitive ability was also controlled, as much as possible, by the selection of college students from highly competitive schools. Students attending competitive colleges have demonstrated academic abilities. These students have the potential intellectual capacity to acquire many computer skills.

Description of Procedure

Each student in the sample population received a total of four communications relevant to the study. A randomly selected pool of two hundred second through fourth year students were contacted at each college. First, a short letter notifying them of the study was sent. One week later, a cover letter describing the study and asking for participation accompanied a copy of the survey instrument. Third, a reminder postcard was sent two weeks after the distribution of the instruments. Finally, a letter asking for participation was included with another copy of the instrument and an incentive piece of candy. The final letter was only sent to those students who had not returned their surveys. Each letter sent was personalized with the student's name. (Copies of letter texts and the instrument are included in Appendix I). The response rates were 75 percent for the single-sex college, 52 percent for the coeducational college and 62.5 percent of the total with 252 out of 400 students participating in the study.

Analysis Techniques

The statistical analyses examined the relationship between gender schema and computer attitudes, and between computer attitudes and institutional setting. First, the mean computer attitude scores of the sex-typed and non-sex-typed students were compared to determine if there were statistically significant differences between them. Three different computer attitude measures were considered: computer anxiety, computer confidence, and computer liking.

The analysis also examined the same three computer attitudes of women attending the two different types of educational institutions. The means of the three computer attitude scores of sex-typed students attending a women's college, and sex-typed students attending a coeducational institution were compared to see if there are statistically significant differences between them.

Analysis of covariance was used to test whether there is a statistically significant difference between measures of gender schema and computer attitudes, controlling for the covariates of math anxiety and computer experience.

Open-ended comments were also considered in the analysis of the survey results. All comments were classified into topical groups. These categories were: expressed need for different forms of instruction; positive and negative experiences with computers or math; descriptions of methods of learning; gender-based issues and issues surrounding college computer facilities or computer access. In addition, notice was made of whether the student attended the single-sex or coeducational college and whether the student was classified as sex-typed or not. Representative comments are included in Chapter 4.

For each of the hypotheses tested in the present study, a description of the specific statistical method of analysis employed follows. A .05 level of significance was used in this study for all tests.

Gender Schema and Computer Attitude

A T-test of sample means was used to test whether female college students in the sample who have strongly held, sex-stereotyped perceptions have significantly lower scores on measures of computer anxiety than female college students in the sample who are identified as not having strongly held sex-stereotyped perceptions.

A T-test of sample means was used to test whether female college students in the sample who have strongly held, sex-stereotyped perceptions have significantly lower scores on measures of computer confidence than female college students in the sample who are identified as not having strongly held sex-stereotyped perceptions.

A T-test of sample means was used to test whether female college students in the sample who have strongly held, sex-stereotyped perceptions have significantly lower scores on measures of computer liking than female college students in the sample who are identified as not having strongly held sex-stereotyped perceptions.

A T-test of sample means was used to test whether female college students in the sample who have strongly held, sex-stereotyped perceptions have significantly lower overall computer attitude scores than female college students in the sample who are identified as not having strongly held sex-stereotyped perceptions.

Gender Schema, Computer Attitudes, and Institutional Setting

A T-test of sample means was used to test whether there is a statistically significant relationship between gender schema and computer anxiety for female college students who attend coeducational colleges and those who attend women's colleges.

A T-test of sample means was used to test whether there is a statistically significant relationship between gender schema and computer confidence for female college students who attend coeducational colleges and those who attend women's colleges.

A T-test of sample means was used to test whether there is a statistically significant relationship between gender schema and computer liking for female college students who attend coeducational colleges and those who attend women's colleges.

A T-test of sample means was used to test whether there is a statistically significant relationship between gender schema and overall computer attitudes for female college students who attend coeducational colleges and those who attend women's colleges.

Gender Schema and Computer Attitudes: Controlling for Math Anxiety and Computer Experience

An analysis of covariance was conducted to determine whether or not, after controlling for the effects of math anxiety and computer experience, there is still a statistically significant difference between measures of computer anxiety for female college students with strongly held, sex-stereotyped perceptions and measures of computer anxiety for female college students without strongly held, sex-stereotyped perceptions.

An analysis of covariance was conducted to determine whether or not, after controlling for the effects of math anxiety and computer experience, there is still a statistically significant difference between measures of computer confidence for female college students with strongly held, sex-stereotyped perceptions and measures of computer confidence for female college students without strongly held, sex-stereotyped perceptions.

An analysis of covariance was conducted to determine whether or not, after controlling for the effects of math anxiety and computer experience, there is still a statistically significant difference between measures of computer liking for female college students with strongly held, sex-stereotyped perceptions and measures of computer liking for female college students without strongly held, sex-stereotyped perceptions.

An analysis of covariance was conducted to determine whether or not, after controlling for the effects of math anxiety and computer experience, there is still a statistically significant difference between combined measures of computer attitude for female college students with strongly held, sex-stereotyped perceptions and combined measures of computer attitude for female college students without strongly held, sex-stereotyped perceptions.

Chapter Four - Results

Introduction

Results from this research study are presented in this chapter. The first section, Description of the Sample, presents characteristics of the sample population including: age, major area of study, and self-described computer skills. The second section, Results of Hypothesis Testing, includes results of statistical tests that examined the interaction between computer attitudes and sex-role perceptions, and between computer attitudes and institutional setting. In addition, results from analyses of the interaction between computer attitudes and sex-role perceptions, controlling for the influence of the covariates: math anxiety, and computer experience, are presented.

Section Three, Qualitative Data, summarizes the data obtained from a portion of the student sample and provides an overview of the opinions students expressed on computer instruction, their expressions of competency or inadequacy with computers, suggestions they made to improve computer instruction and access, and statements on gender as it relates to math and computers. The chapter concludes with a summary of the major findings.

Description of the Sample

The study sample included 252, or 62.5 percent, of the 400 students surveyed. Of this number, 148 attended the single-sex college, and 104 attended the coeducational institution. The response rates were 75 percent for the former, and 52 percent for the latter group.

Age

The study was designed to achieve a distribution across three academic years of students in each institutional setting. Students in the sample ranged in age from 19 to 24. Table 5 shows the frequency distribution of student ages.

Table 5

Frequency Distribution of Student Ages

Age	Frequency	Percent
24	1	0.4
23	2	0.8
22	17	6.7
21	75	29.7
20	75	29.7
19	81	32.1
missing	1	0.4
TOTAL	252	100.00%

Major Area of Study

Students in the sample population studied a wide variety of subject disciplines. The highest proportion, 15.9 percent of the sample, reported Psychology as their first or second major. Next in order, 13.8 percent of the sample reported Biology, and 10.2 percent of the sample indicated English as their major. Two majors of particular note, due to the subject under investigation in this study, are mathematics and computer science. Three percent of the students reported studying Mathematics and 2.4 percent majored in Computer Science. Thirteen percent of the sample listed majors other than those on the survey, including: Pre-Med, Communications, Women's Studies, Multicultural Studies, and Architecture.

Self-Described Computer Skills

Students were asked to select one of four categories describing their level of computer competency. The majority of students, 78 percent, described themselves as having adequate computer skills. Ten percent considered themselves as having limited computer skills, and another 10 percent ranked themselves as being very competent with computers. The remaining 2 percent rated themselves as having no computer experience. These students grew up in a time when personal computers were commonplace. The large number of students with computer experience provides evidence of the pervasive influence of computers. It is interesting to note that despite the degree of exposure to computers that these women have encountered in their lifetimes, only 10 percent considered themselves "very competent" computer users.

Results of Hypothesis Testing

Analysis of variance was used to test the three sets of hypotheses examined in this study. These hypotheses focused on three components of computer attitude: computer confidence, computer anxiety and computer liking, and the combination of the three attitudes together. The study investigated first, the interaction of these attitudes with sex-role perceptions and second, the interaction of these attitudes with institutional setting. Finally, sex-role perceptions were paired with computer attitudes again, but were tested controlling for the covariates of mathematics anxiety and amount of computer experience.

Hypothesis I: Computer attitude and Sex-Role Categories

Table 6 presents T-test results of the first set of research hypotheses, which postulated that women who held strong sex-role perceptions had more positive computer attitudes than women who did not hold these perceptions. Four separate areas of computer attitude were tested: computer anxiety, computer confidence, computer liking and combined computer attitudes.

Twenty-seven percent, or 68 out of 252, of the entire sample were classified as sex-typed, that is, as having a Femininity score above the institutional setting group median on the Bem Sex Role Inventory Scale (Bem, 1974), and a Masculinity score below the institutional setting group median. The other 184 subjects in the sample were classified as non-sex-typed.

Computer Anxiety

The mean score on the Computer Anxiety Scale (Loyd & Gressard, 1984a) for the total sample was 3.96 on a seven-point scale, with higher scores indicating higher levels of computer anxiety. The t-value of -.92 was not statistically significant, resulting in a failure to reject the null hypothesis. This finding documents no statistically significant difference between the means of the Computer Anxiety scores of women in the sex-typed group, and women in the non-sex-typed group.

The results showed that women in the sample who were classified as sex-typed were not more anxious about computers than women who were not classified as sex-typed.

Computer Confidence

The mean score on the second computer attitude scale, Computer Confidence, was 4.45 for the entire sample. The mean score for women who were classified as sex-typed was 4.22, compared with 4.53 for women in the sample who were classified as non-sex-typed. A higher score on the

Table 6

Sex-Typed and Non-Sex-Typed Differences in Computer Attitudes

Group	Mean	Standard Deviation	Mean Difference	t-value
		A. Computer Anxiety Scale		
Sex-Typed (n=68)	2.45	.86	.12	-.92
Non-Sex-Typed (n=184)	2.33	.88		
Total (n=252)	2.36	.87		
		B. Computer Confidence Scale		
Sex-Typed (n=68)	4.22	.82	.31	2.55**
Non-Sex-Typed (n=184)	4.53	.89		
Total (n=252)	4.45	.88		
		C. Computer Liking Scale		
Sex-Typed (n=68)	3.82	1.07	.19	1.40

Non-Sex-Typed (n=184)	4.01	.94		
Total (n=252)	3.96	.98		
D. Combined Computer Attitude Scales				
Sex-Typed (n=68)	4.16	.78	.22	1.93
Non-Sex-Typed (n=184)	4.38	.82		
Total (n=252)	4.32	.82		

** $p \leq .05$

Computer Confidence Scale indicates higher levels of confidence in using computers. The t-value of 2.55 was statistically significant indicating a statistically significant difference between the mean computer confidence scores of women in the sample who were classified as sex-typed and those who were not classified as sex-typed. The findings permit the rejection of the null hypothesis. The results of this test indicated that the women who were classified as sex-typed had significantly more negative attitudes, as seen by lower mean scores for the group, regarding their computer confidence than other women in the sample.

Computer Liking

The third computer attitude scale was Computer Liking. The mean score for the entire sample on the scale was 3.96. Higher scores on this scale indicate more positive feelings toward computers and the use of computers. Women in the sex-typed category had a mean score of 3.82, lower than the 4.01 mean score for the non-sex-typed group. However, the t-value 1.40 was not statistically significant, resulting in a failure to reject the null hypothesis. These results indicated that women in the sex-typed group did not like or dislike computers significantly more than women in the other, non-sex-typed group.

Combined Computer Attitude Scores

The mean computer attitude score for the three scales combined was 4.16 for students in the sex-typed group, and 4.38 for students in the non-sex-typed group. The t-value 1.93 was not statistically significant. However, the results showed a pattern of more positive computer attitudes among women in the non-sex-typed group, and less positive attitudes to the sex-typed, or more stereotypical, group.

Hypothesis II: Computer Attitude, Gender Schema and Type of Institution

Table 7 shows T-test results of the second research hypothesis which proposed that women who attended single-sex colleges, and who were categorized as having sex-typed perceptions, had less positive computer attitudes than those women at coeducational colleges in the same sex-role category. In this analysis, only the scores of women in the sample within the sex-typed category, 68 out of 252, were tested. Thirty-nine students from the single-sex college were included in the sex-typed category, and 29 students from the coeducational college. Each of the three computer attitude scales;

Table 7

Institutional Differences in Computer Attitudes of Sex-Typed Students

Group	Mean	Standard Deviation	Mean Difference	t-value
		A. Computer Anxiety Scale		
Single-Sex (n=39)	2.17	.78	.65	-3.31 **
Coeducational (n=29)	2.82	.83		
Total (n=68)	2.45	.86		

		B. Computer Confidence Scale		
Single-Sex (n=39)	4.40	.65	.42	2.15**
Coeducational (n=29)	3.98	.95		
Total (n=68)	4.22	.82		
		C. Computer Liking Scale		
Single-Sex (n=39)	3.82	.98	.006	-.02
Coeducational (n=29)	3.82	1.20		
Total (n=68)	3.82	1.07		
		D. Combined Computer Attitude Scales		
Single-Sex (n=39)	4.28	.73	.83	1.55
Coeducational (n=29)	3.99	.83		
Total (n=68)	4.16	.78		

** $p \leq .05$

computer anxiety, computer confidence and computer liking, were tested, as well as the composite computer attitude score.

Computer Anxiety

Women at the coeducational school had a higher mean computer anxiety score, 2.82, which indicated a higher level of computer anxiety. Women who attended the single-sex school had a lower mean score of 2.17, which indicated less computer anxiety. The t-value of -3.31 for this test indicated a statistically significant difference between the means of these two groups. The results showed that women in the sample who had more stereotyped views, and studied in a coeducational environment had more anxiety about computers than women with similar sex-role perceptions in a single-sex college environment.

Computer Confidence

The mean score on the Computer Confidence subscale for sex-typed women at the single-sex school was 4.40, and 3.98 for sex-typed women at the coeducational school. The t-value of 2.15 indicated a statistically significant difference between the scores of the women in each group on this subscale. The results showed that women in the single sex environment had significantly more confidence in dealing with computers than women in the coeducational environment.

Computer Liking

The mean score on the Computer Liking Scale for women at the single-sex institution was 3.82 and for women at the coeducational college, 3.82. The t-value -.02 on this test indicated that there was not a significant difference in the attitude of computer liking between the two groups.

Combined Computer Attitude Scores

The mean score on the Combined Computer Attitude Scales for the women who attended the single-sex college was 4.28, and the mean score for women who attended the coeducational college is 3.99. A higher mean score on the Computer Attitude Scale indicated more positive computer attitudes in general. Although women who attended the single-sex school had higher scores on the combined scales, the difference between their scores, and those of the coeducational students in the sex-typed group, was not statistically significant as indicated by the t-value of 1.55.

Hypothesis III: Computer Score by Sex-Role Category with Covariates

The third research hypothesis proposed that there was no statistically significant difference between measures of gender schema and measures of computer attitude, after controlling for the factors of math anxiety and computer experience. The analysis of gender schema, each of the three computer attitude scales, and combined computer attitude measure with covariates are presented.

Table 8 presents the results of the analysis used to determine whether or not sex-role perceptions had a significant effect on computer attitudes after controlling for the effects of math anxiety and computer experience.

As shown in Table 8, four separate analyses of covariance consistently identified math anxiety and computer experience as significant predictors of computer anxiety, computer confidence, computer liking and the overall measure of computer attitudes. After controlling for the effects of these covariates, statistically significant differences were found in computer confidence and overall computer attitude between women in the sex-typed and non-sex-typed groups. However, after controlling for math anxiety and computer experience, no statistically significant differences were found in terms of computer anxiety and computer liking between women in the sex-typed and non-sex-typed groups.

Table 8

Sex-Typed and Non-Sex-Typed Differences in Computer Attitudes -- Controlling for Math Anxiety and Computer Experience

Source of Variation	Variable	F Ratio	Significance
	A: Computer Anxiety		
Covariate (n=252)	Math Anxiety	13.10	.000**
Covariate (n=252)	Computer Experience	16.20	.000**
Main Effect (n=252)	Sex-Typing	.50	.40
	B. Computer Confidence		
Covariate (n=252)	Math Anxiety	37.20	.000**
Covariate (n=252)	Computer Experience	22.80	.000**
Main Effect (n=252)	Sex-Typing	4.88	.005**

C. Computer Liking			
Covariate (n=252)	Math Anxiety	18.57	.000**
Covariate (n=252)	Computer Experience	14.91	.000**
Main Effect (n=252)	Sex-Typing	1.89	.14

D. Combined Computer Attitudes			
Covariate (n=252)	Math Anxiety	33.42	.000**
Covariate (n=252)	Computer Experience	22.46	.000**
Main Effect (n=252)	Sex-Typing	4.42	.04**

** $p \leq .05$

Qualitative Data

A total of 108 students, out of 252, wrote comments in addition to completing the survey instrument. The comments were not required and were open-ended. Fifty-one of the coeducational students added comments, as did 57 of the single-sex college students. The content of the comments ranged from offers for further personal discussion on the issue of computer instruction and computer use, to critical remarks about the format of the survey instrument, and included many personal experiences, both negative and positive, with computers or with mathematics.

Comments are classified into the following categories:

- Expressed need for different forms of instruction
- Positive and negative experiences with either (or both) Math and Computers
- Descriptions of methods of learning
- Gender-based issues
- Issues surrounding college computer facilities or computer access

Expressed Need for Different Forms of Instruction

The largest number of comments in one category centered on students' needs for different types of computer instruction. Thirty-four students described courses they felt would be helpful to themselves and to others. Most of these comments suggested courses of a practical, and elementary nature. Many students believed their colleges should offer non-credit, or non-competitive courses in word processing, spreadsheets and World Wide Web software. Some students were critical of introductory Computer Science classes, or were reluctant to take them because of the programming content. Examples of comments within this category follow:

Comment 1:

"I desperately want to learn more about computers, but all [my college] offers is comp sci which is programming which I don't feel fully comfortable doing right now. I even tried to find non-credit courses here but didn't have much success. My other plan was to try to get a job with [the college computer center] but that is pending. I really do want to learn more about computers -- basic stuff that goes a little deeper than just word processing or e-mail, more about how applications work and how to manipulate commands and files." [single-sex, sex-typed]

Comment 2:

"I think that the classes the computer science department currently offer are too much geared towards majors and minors. The department should offer more introductory level classes that are more on the word processing level rather than programming. There should be a class that teaches how to use word, Excel, PowerPoint, etc. many people are afraid of computers and don't even know how to utilize these programs. This kind of class would help people get over their fear. It would also be useful for students to know how to use these since these programs are widely used in the 'real world.'"[single-sex, sex-typed]

Comment 3:

"An Intro. to Computers as pass/fail, 1 credit course would be great -- how to use Mac/IBM, Internet, Lotus, spreadsheets -- just the basics -- on a voluntary basis. Computers are so much a part of today's jobs, yet they are

only a course requirement in management, math and CS. The average non-math, non-science student needs the skills on a much more basic and user-friendly level. A course in the basics would be much appreciated!" [coeducational, non-sex-typed]

Another aspect of improvements for instruction that students suggested, included the addition of more interactive, or "hands-on" components in classes. Many students suggested group work for problem-solving, and more interaction between faculty and students by using computers during class time. Examples of comments within this category follow.

Comment 4:

"I think that group work, and collaboration is the best way to learn. This rings true particularly because the computer and mathematics fields have encouraged such individualistic work and lifestyles in the past. Learning, exploration and experimentation are facilitated by team learning and might strengthen the future of our computer usage and users." [single-sex, non-sex-typed]

Comment 5:

"The ideal situation to learn computers is to have several people doing the problem/assignment on their own sitting next to each other. This way

glitches can be worked out immediately. Learning computers or math is active learning -- and learned effectively by doing." [coeducational, non-sex-typed]

Positive And Negative Experiences With Math and/or Computers

The second major category of student comments involved personal experiences with computers or math. Comments were both positive and negative on these issues. Fourteen students described negative math experiences, and eleven positive math experiences. Nine students depicted positive computer experiences, and four negative computer experiences. Students gave specific examples of classes they enjoyed, and classes they disliked. They described teaching methodology problems, as well as class activities that excited them. Examples of these comments follow:

Comment 6:

"The use of computers in Physics and Chemistry intro labs (data analysis & graphing tools) both helped in making me "not afraid" of using computers. But the two courses I took in college contained really useful information & allowed me to program -- something I didn't think I could do or would be interesting to do." [single-sex, non-sex-typed]

Comment 7:

"I took calculus. . . Sometimes it was frustrating trying to do problems involving graphing, etc. on the computer, but overall it was interesting in that it provided another aspect to the processes involved in Calculus. It might be helpful, however, to have a student affiliated with a computer mathematics class who was familiar with the computer class who could help students working with the program (like other classes that have specific tutors assigned to them)." [single-sex, non-sex-typed]

Comment 8:

"I feel like I learned absolutely nothing in the Calc I and II classes that I took last year. I now do not ever want to take Math again. I liked math until I took Calc classes here." [single-sex, sex-typed]

Comment 9:

"The professor had assumed we already knew a lot about computers. He didn't take the initiative to see what each person already knew. He also constantly made the students feel like we should know how to do the problems given to us by saying how easy they were. He did a poor job of making us feel like we were capable of learning and that we were unreasonable if we had questions." [coeducational, non-sex-typed]

Descriptions of methods of learning

A group of students described their methods of learning how to use a computer. A large number of those who shared their learning experiences were self-taught. A practical, and goal-oriented view toward computers was reflected in many comments. Students mentioned their need to complete a task and the necessity to use the computer to do so. Several remarked on the positive influence their fathers had had on their attitudes toward learning about computers.

Comment 10:

"What I do know about computers has come from self-teaching or friends. I would like to take a computers class, but the ones that are open to and pertain [to my major] are few to none. My experience in lab with computers is that the instructions and the program don't match, the TA has little knowledge of what to do." [coeducational, sex-typed]

Comment 11:

"I have worked at my Dad's office for about 8 years and have had significant exposure to computers. I hate reading computer manuals, so my skills have been acquired from what others have shown me or trial and error. I have not had technical training, but I can do a lot with word processing and graphic design programs. People sometimes ask me for help

but I really have no interest in computer talk or taking classes unless it was for a specific goal." [coeducational, non-sex-typed]

Comment 12:

"The only computer instruction I had was in high school by a nun on an old IBM computer. I have used mostly word-processors my whole life. I tried to take a computer course but dropped it because I felt it was too hard. The teacher's knowledge of computers was limited." [coeducational, sex-typed]

Comment 13:

"I have received a large amount of instruction on computers based on the fact that I took a computer science class in college, a computer math course in high school, and I worked in the computer department at a mortgage company for two summers. I think exploration is a major part of the learning process. It also helps keep students interested in what they're doing and what possibilities are there. Practice problems on the computer could definitely strengthen one's confidence concerning both math and computers." [single-sex, non-sex-typed]

Comment 14:

"Most of the things I know about computers I've either figured out myself, or had a friend who is more computer literate show me how. My

computer literacy has increased tremendously since high school but hasn't been a result of instruction on the college level as much as being forced out of necessity to figure things out. It would be nice to go through the basics of running a computer with an option to find out more about what programs are available for different needs as well as a class on how those programs work. The tutorials that come with some applications (i.e. Excel) are very helpful, but there aren't always learning aides (or helpful "helpfiles") for programs." [single-sex, non-sex-typed]

Gender-based Issues:

Four students expressed views that specifically addressed issues of gender bias toward math and computers, or about their positive experiences in a single-sex environment. One comment, from a student at the coeducational college, expressed frustration at a negative bias toward women who study or want to study math and science.

Comment 15:

"Math and science classes have a distinct gender bias toward men. Especially in high school I was discouraged from taking calculus and pushed toward advanced English and French classes, despite my professed interest in Math and Science." [coeducational, non-sex-typed]

Three other single-sex college students made remarks on the topic of gender. Two students described the advantages they saw to single-sex instruction for computer science, and math, in particular. Their views suggested that a possible outcome of the single-sex environment was students' self-confidence in their abilities to achieve in the study of Math and Computer Science.

Comment 16:

"I can honestly say that all-female computer classes are definitely less daunting than coed computer classes. If I had gone to a coed institution, I probably wouldn't have taken as many comp sci courses as I have. The smaller classes and the intimate size of the department also helps." [single-sex, non-sex-typed]

Comment 17:

"In terms of math courses, I have always felt quite comfortable in them. I love math and especially calculus, and I find math very logical and nice and easy, always with a right answer. Additionally, I think taking math in an all-girls school helped. I never was intimidated by the boys (obviously, since there were none), and I always had confidence in my math abilities." [single-sex, non-sex-typed]

The last comment, also from a student at the single-sex college, expressed frustration with what she called "simplified math" for women. Her comment is important to note as it suggested that there was not an advantage to studying math at a women's college, and that negative attitudes persist, in her opinion, even in that environment.

Comment 18:

"I think the general attitude towards using math is weak. As an Econ and Psych major, I feel that we are disadvantaged by how little and simplified math is used in the classes. I think the prevailing attitude is that as women we are less mathematically inclined and scared of math. The PSYC stats course I am taking is also very simplistic. I think we should incorporate more math in the higher level courses, especially for classes specifically for majors" [single-sex, non-sex-typed]

Issues Surrounding College Campus Facilities

Twelve comments were written to complain about lack of computer access, lack of assistance in labs, and lack of support by faculty and teaching assistants. These comments are very specific to the individual institution, and they do not provide information relevant to the hypotheses tested in this study, therefore, they are not quoted in this report.

Overall the comments indicated a strong desire for practical instruction on computers. Many students, from both the coeducational and single-sex settings, expressed interest in gaining more information on computer applications. Students also expressed frustration at the traditional structure of computing instruction. A number of students stated that computer science classes were too intense for their needs. They also described their interest in learning more about computers, through non-traditional means, such as workshops. There were also several students who presented their positive computer instruction experiences. Several had learned about computers on the job, others through computer science classes.

Summary

Major findings

Statistical analyses of the first set of hypotheses in this study examined differences between three measures of computer attitude and combined computer attitudes, for women classified into two groups: sex-typed and non-sex-typed. Results indicated that of the three measures; computer confidence, computer anxiety and computer liking, only computer confidence was significantly related to, or influenced by, sex-role perception. Measures of computer anxiety and computer liking were not significantly different between the two groups of women in the sample.

The second set of hypotheses proposed that among sex-typed women, there was a positive difference in computer attitudes for women who attended a single-sex institution. Measures of computer confidence and computer anxiety were significantly different for women at the single-sex college. Their attitudes were more positive than those at the coeducational college. Measures of computer liking showed no statistical difference.

The third hypothesis considered two other factors -- math anxiety and computer experience -- as potential determinants of differences in computer attitude between women who were classified as sex-typed and women who were non-sex-typed. Four separate analyses of covariance consistently identified math anxiety and computer experience as significant predictors of computer anxiety, computer confidence, computer liking and combined computer attitudes. After controlling for the effects of these covariates, statistically significant differences were found in computer confidence and combined computer attitude between women in the sex-typed and non-sex-typed groups. However, after controlling for math anxiety and computer experience, no statistically significant differences were found in terms of computer anxiety and computer liking between women in the sex-typed and non-sex-typed groups.

Chapter Five - Discussion

This chapter is comprised of four sections. In the first section, Substantive Findings, results from tests of the three hypotheses in the present study are compared and contrasted with previous published research. Methodological Limitations are reviewed in the second section. The third section, Implications of Research Findings presents policy and instructional considerations based upon the research results. The fourth section, Practical Recomendations suggests changes in educational practice, while the final section, Recommendations for Future Research describes areas for further investigation.

Substantive Findings

Analyses of the data for the present study support four significant findings. First, sex-role perceptions influence computer attitudes. Women in the sample who were classified as sex-typed were less confident about computers than other women. Second, educational setting has an impact on computer attitudes. Women in the sample classified as sex-typed, who attended the single-sex college, were less anxious about and more confident about computers than sex-typed women attending the coeducational college. Third, math anxiety and computer experience are significant influences on the computer attitudes of sex-typed women. Four separate analyses of covariance consistently identified higher math anxiety and more computer experience as significant predictors of greater computer anxiety, greater computer confidence, greater computer liking and greater combined computer attitude measures. Fourth, after controlling for the effects of these covariates, there are statistically significant differences in computer confidence and overall computer attitude between women in the sex-typed and non-sex-typed groups.

Hypothesis One: Computer Attitudes and Sex-Roles

The present study examined stereotypical sex-role perceptions, and their influence on computer attitudes. It was proposed that women who held stereotypical views of sex-roles would have negative attitudes toward computers. The literature review revealed four major studies of the relationship between sex-role perceptions and computer attitudes: Albert (1989), Ogletree and Williams (1990), Colley, Gale and Harris (1994) and Rosen, Sears and Weil (1987). Those studies differ from the present study in three major respects.

First, other researchers used the Bem Sex Role Inventory Masculinity and Femininity scales separately to measure the strength of masculine and feminine attributes. They did not classify subjects into composite sex-role categories such as sex-typed, androgynous or undifferentiated. Sex-typed women are those whose scores on the Femininity scale were above the group median and scores on the Masculinity scale were below the group median. Second, each group of researchers used different instruments to measure computer attitudes. Therefore, it was not possible to conduct equivalent comparisons of other research and the present study on specific aspects of computer attitude, such as computer confidence or computer anxiety. Third, the samples in other studies were composed of both men and women, while the sample in the present study consisted solely of women.

Three of the studies found that certain sex-role attributes significantly influence computer attitude. The Albert (1989), Ogletree and Williams (1990) and Colley, Gale and Harris (1994) studies indicate sex-role perceptions, as demonstrated by measures of either masculine or feminine attributes, to be significantly related to computer attitudes. These three studies found masculine attributes to be the significant predictor of positive computer attitudes. Unlike those studies, the present study did not investigate whether masculine attributes themselves had a significant influence on computer attitudes, instead, this study investigated the influence of various combinations of feminine and masculine attributes on computer attitudes. The present study found computer attitudes of women classified as sex-typed, having high measures of feminine and low measures of masculine attributes, to be different from those classified as non-sex-typed. Sex-typed women had less confidence, liked computers less and had more computer anxiety than non-sex-typed women.

Each of the studies compared in this section used different instruments to measure computer attitudes. Only the Colley, Gale and Harris study used the same instrument as the present study, the Loyd and Gressard Computer Attitude Scale (1984a), to measure computer attitudes.

Each of the major studies show a significant relationship between sex-role attributes and computer attitudes, and are consistent with the results of the present study. None of the major studies, however, investigate the relationship between sex-typing and computer attitudes in the same manner as the present study.

The study by Rosen, Sears and Weil (1987) was the only one that used the Bem Sex Role Inventory (Bem, 1974) to determine sex-role categories. It examined differences between sex-role categories and scores on the Computer Anxiety Ratings Scale (Raub, 1981). There are two approaches to the comparison of Rosen, Sears and Weil's study and the present study. First, using sex-role categories, Rosen, Sears and Weil found no differences in computer attitudes between men and women in their sample grouped according to four Bem Sex Role categories: androgynous, sex-typed, undifferentiated or cross-typed. Results of the present study indicate significant differences between women classified as sex-typed and women classified as non-sex-typed. Using this method of comparison the Rosen, Sears and Weil results are not consistent with the findings of the present study.

However, the second method of comparison, using separate masculine and feminine scores, shows the Rosen, Sears and Weil study results consistent with the findings of the present study. Rosen, Sears and Weil found students with high scores on the Bem Sex Role Inventory Femininity Scale to have higher levels of computer anxiety and more negative computer attitudes than students with high scores on the Masculinity Scale. The same pattern was found in the present study. Sex-typed women in the present study, those with high femininity and low masculinity scores, also had higher levels of computer anxiety than those who were classified as non-sex-typed. In the present study computer confidence was the only computer attitude that was significantly different for sex-typed and non-sex-typed women. Unfortunately, the Rosen, Sears and Weil study did not have a compatible computer confidence scale.

Albert (1988) studied sex-role perceptions and computer attitudes of high school students using the Bem Sex Role Inventory (1974) and the

Computer Aptitude, Literacy and Interest Profile (Poplin, Drew & Gable, 1984). Results of Albert's study show computer confidence to be significantly related to sex-role perceptions. "For female students Confidence in Learning Computer Skills scale correlated significantly for both masculine and feminine scores" (p. 101). In Albert's study, confidence in computers was associated with masculinity, and not femininity. Albert's findings that sex-role perceptions were significantly related to computer attitudes are consistent with the results of the present study which show computer confidence to be significantly related to sex-role categories. Women who were sex-typed had significantly less computer confidence than women who were classified as non-sex-typed.

Ogletree and Williams (1990) analyzed undergraduate student computer attitudes and sex-typing, as well as the effects of variables such as computer aptitude and computer experience on computer attitude. Their study found statistically significant differences between computer attitude scores, using the Computer Attitude Scale (Dambrot, 1985), and separate femininity and masculinity scores on the Bem Sex Role Inventory. According to Ogletree and Williams, "Bem Sex Role Inventory masculinity was associated with more positive computer attitudes and higher expectations for succeeding in computer courses, while Bem Sex Role Inventory femininity was negatively associated with these expectations for success" (p. 708). Ogletree and Williams' study is consistent with the proposal that sex-role perceptions have an influence on computer attitudes.

A comparison of overall computer attitudes between the present study and the Ogletree and Williams study is not possible due to methodological differences between the studies. Ogletree and Williams presented comparisons of overall computer attitude scores between men and women in their sample and did not use sex-role perceptions. The present study compared differences in overall computer attitude scores between women who were classified as sex-typed and those who were non-sex-typed. Despite the different methods of analysis, both the Ogletree and Williams study and the present study found sex-role perceptions to be significantly related to computer attitudes.

The fourth study included in this discussion, by Colley, Gale and Harris (1994), used the same instrument (Loyd & Gressard, 1984a) as the present study to measure computer attitudes of confidence, anxiety and liking. However, Colley, Gale and Harris did not test for relationships between combined masculinity and femininity scores and computer attitudes, as did the present study. They also administered the Bem Sex Role Inventory to both men and women in their sample population. Colley, Gale and Harris found that the masculinity score on the Bem Sex Role Inventory, not the femininity score, had an impact on computer attitudes. "Masculinity was associated with lower anxiety, higher confidence and higher liking among females" (p. 133). The Colley, Gale and Harris study results are consistent with the concept proposed in the present study that certain sex-role perceptions have an influence on computer attitudes. In the present study sex-typed women had significantly lower levels of computer confidence than did non-sex-typed women, however, computer anxiety and liking scores were not significantly different for the two groups of women.

Computer attitude and sex-role perceptions were found to be significantly related in the present study and in the four studies reviewed in this section. The Rosen, Sears and Weil study is most similar to the present study in the use of sex-role categories as a means of analysis. Rosen, Sears and Weil found strong femininity measures to be related to computer anxiety and negative overall computer attitudes. These results are similar to those of the present study. Results of the present study show significant differences between computer attitudes of sex-typed women and non-sex-typed women, however, the Rosen, Sears and Weil results did not show significant differences between sex-role categories.

The pattern of higher masculinity scores demonstrating significant positive influence on computer attitude was found in the Colley, Gale and Harris, Albert and Ogletree and Williams studies. The results of the present study show a complementary pattern. Strong femininity and weak masculinity were associated with negative computer attitudes, particularly in computer confidence.

Hypothesis Two: Computer Attitude and Institutional Setting

The second set of hypotheses in the present study examined student computer attitudes in coeducational and single-sex college settings. It was proposed that female college students at single-sex colleges would have more positive computer attitudes than students in traditional coeducational colleges. In the present study sex-typed students attending the single-sex college had more positive computer attitudes than sex-typed women at the coeducational college. The single-sex students were more confident and less anxious about computers than the coeducational students. A review of the literature found one study that examined computer attitudes and single-sex settings specifically, and several other studies that examined the broader, but related, issue of confidence in women who attend single-sex colleges.

Jones and Clarke (1995) examined computer attitudes and students in single-sex and coeducational schools. Their findings illustrate the position that students in single-sex schools have more positive computer attitudes than students in coeducational schools. "Educational setting had a significant effect on three of the four attitude measures. Girls from a single-sex setting had higher scores on the affective component, the cognitive component, and the general attitude measure. No significant difference was found for the behavioral component of attitudes" (p. 55-56). These findings are consistent with the findings of the present study; significant differences in computer attitude occur between educational settings.

Miller-Bernal (1989) investigated differences between college experiences of women attending single-sex and coeducational colleges. Her findings indicated that academic goals were not related to participation in college activities at the coeducational college, but were directly related for women attending the single-sex college. "Thus campus leadership an academic pursuits are compatible at the women's college but not at the coed college. Women students' academic ambitions may not be as respected and rewarded by election to leadership positions at a college where men are present" (p. 377).

Rayman and Brett (1995) concur with Miller-Bernal's finding and suggest that the supportive environment of the single-sex college allows women the opportunity to persist in studies within scientific disciplines. "It is possible that by providing encouragement and support during the college years and earlier, students, especially female students, will develop sufficient self-confidence in their abilities so that they are able to persist in the face of the "chilly climate" and the greater competitiveness of graduate school and the market place. The relatively high retention rate in our study lends credence to previous studies, which contend that single-sex women's colleges offer an advantage in women's pursuit of science and increased resiliency in facing obstacles" (p. 402)

It is important to note that in the present study results revealed that the single-sex environment had a significant positive influence on the computer confidence attitudes of women. Research has shown self-confidence to be higher in women at single-sex colleges than in women at coeducational colleges (Kim & Alvarez, 1995). In fact, much of the research on single-sex settings is focused on achievement and confidence (Miller-Bernal, 1993; Rice & Hemmings, 1988; Stoecker & Pascarella, 1991; Tidball, 1976, 1980, 1989).

Hypothesis Three: Computer Attitudes and Sex-Role, Controlling for Math Anxiety and Computer Experience

A review of published research on computer attitudes identified a pattern in which stereotypical attitudes toward computers are similar to stereotypical attitudes toward math (Chen, 1986; Dambrot, et. al., 1985; Konvalina, Wileman & Stephens, 1983; Kramer & Lehman, 1990; Marcoulides, 1988; Parasuraman & Igbaria, 1990). Computer experience has also been found to be a significant predictor of computer attitudes by many researchers (Arch & Cummins, 1989; Chen, 1986; Jones & Clarke, 1995; Marcoulides, 1988; Weil, Rosen & Wugalter, 1990). Therefore, math anxiety and computer experience were included as covariates in the present study.

Results from the present study showed that math anxiety and computer experience were statistically significant predictors of computer attitudes. After controlling for the effects of math anxiety and computer experience, there were significant differences in computer confidence and overall computer attitude between sex-typed and non-sex-typed women.

Results of other studies, however, indicate that computer experience does not improve all aspects of computer attitudes (Marcoulides, 1988; Weil, Rosen & Wugalter, 1990). For example, Marcoulides (1988) found that computer experience was not a statistically significant predictor of computer anxiety, although it was highly correlated. "Students who have a lot of computer experience tend to have less computer anxiety, but this relationship is not as high as expected. It appears that some computer anxiety is present regardless of prior computer experience" (p. 155). There were no significant differences in computer anxiety and computer liking when computer experience was introduced as a covariate in the present study.

It is important to note that in the present study sex-typing was still a significant influence on computer attitude, even after controlling for two major factors. Sex-typed women had significantly less computer confidence and less positive overall computer attitudes than non-sex-typed women in the present study. Therefore, it is clear that sex-role stereotyping is an essential component of computer attitudes, particularly for women who hold strong stereotypical views.

Implications

The first major finding of the present study is that sex-role stereotypes of women college students have a significant impact on their views toward computers. Women in the present study who hold stereotypically feminine views have less computer confidence than women who do not have stereotypical views. Other computer attitudes, computer anxiety and computer liking, were not significantly related to sex-typing in the present study. These results support Janet Spence's view that "gender phenomena are multifactorial" (Spence, 1993, p. 624). Spence contends that gender identity is complex, and is not simply bipolar in terms of femininity and masculinity. Femininity and masculinity may be critical factors in determining computer attitudes, but there are many other factors involved in this complex phenomenon that also have significant influence on them. The differences between the results of the present study and the Rosen, Sears and Weil study provide evidence of the ambiguity present in the research. Race, social class, personal preferences, geographic location and parental education are examples of such influences (Badagliacco, 1990).

The second major finding of the present study concerns the differences found between computer attitudes of women at the single-sex college, and at the coeducational college. Sex-typed students attending the single-sex college had more positive computer attitudes than sex-typed women at the coeducational college. The single-sex students were more confident and less anxious about computers than the coeducational students.

The third major finding of the present study relates to the complexity of the formation of computer attitudes. After controlling for the effects of math anxiety and computer experience, there were significant differences in computer confidence and overall computer attitude between sex-typed and non-sex-typed women. These findings demonstrate that sex-typing remains an essential element in determining computer attitudes, even after statistically controlling for the strong influence of math anxiety and computer experience.

The results of the present study show that educational setting has a significant influence on women's computer attitudes. This finding demonstrates a positive impact of a single-sex environment on women's confidence. Confidence is perhaps the most critical factor in improving women's education. The single-sex environment creates an educational setting in which accomplishment and success may be achieved, offering women the opportunity to gain confidence. At a women's college students are free to experiment with computers, to enjoy computers, and to gain experience and self-confidence with computers without male competition or intimidation. In particular, the study and use of computers can be supported and enhanced by the lack of traditional social behaviors in learning situations where computers may be perceived as being part of the male domain (Pearl, et al., 1990; Perry & Greber, 1990).

The discipline of Computer Science itself is also seen by many as being male-dominated, as is the study of Mathematics. Previous research has also shown that there is a significant link between math anxiety and computer attitudes. This link is a barrier for some women, particularly those who have strong stereotypical views. The present study found that sex-role stereotypes are a significant factor even after controlling for the effects of computer experience and math anxiety. Sex-typed women may not see computers as something within their realm, but as a masculine domain. To increase the number of women studying computer science and using computers with confidence, a connection must be made between computer use and students' studies, futures, and interests. For women especially, the use of computer technology should not be an "add-on," but an integral part of learning and instruction across all disciplines.

Practical Recommendations

There are three areas, based upon the results of the present study, in which recommendations for change may be made. First, the climate around computing may include perceptions of computer "hackers" and male role models which may be unwelcoming for some women. Second, the methods of teaching computer science and related subject areas may be improved to include more participation by women. Third, the understanding of sex-typed behaviors can lead to improvements in classroom interactions and create an inviting atmosphere for women.

The climate around computing may be improved by implementing the following suggested changes.

1. Create programs for women to become peer trainers and consultants for computing on campus.
2. Create "women-only" computer labs for students, staffed by women.

3. Establish training programs for all computer support personnel that includes:
   - practical approaches to helping reluctant or inexperienced users;
   - instruction to heighten awareness of sex-based issues;
   - instruction on the use of non-jargon-based terminology in assisting users.
4. Offer a variety of approaches to using and learning about computers that address different learning styles.
5. Provide one-on-one consultation opportunities and locations for students who may be reluctant to ask computer questions in a public laboratory setting.
6. Avoid creating computing areas where small groups of students may establish their own climate of computing and exclude the participation of others.

Methods of teaching computer science may be improved by implementing the following suggested changes.

1. Examine the prerequisites for all computer courses and evaluate the importance of mathematical requirements. Eliminate all unnecessary requirements.

2. Provide opportunities for women to teach as many computer classes as possible.
3. Offer non-credit classes that introduce students to computers.
4. Provide opportunities for women to audit computer classes.
5. Offer courses that are at an elementary level that do not require significant mathematical experience.
6. Offer courses that are application-based throughout the curriculum that provide students with computer experience relative to the current employment marketplace.

The understanding of sex-typed behaviors may improve educational settings by the following methods.

1. Search for examples of negative sex-role stereotypical behavior in classroom settings and try to reduce it. For example, male-dominated classroom discussions could be eliminated.
2. In coeducational settings, provide opportunities for female leadership and achievement, for sex-typed and non-sex-typed women, within and outside of the classroom.
3. Establish opportunities for mentoring female students. Role models should include sex-typed and non-sex-typed women.

Methodological Limitations

The methodological limitations associated with the present study include sampling considerations and scope of analysis. As indicated earlier, the sample for the study was purposive and therefore somewhat limited. The survey instruments did not gather information on student demographics such as race, economic background or transfer status. Different and expanded results might have been obtained if such factors were controlled.

The instruments selected for the study were chosen for their prominence in the literature. It should be noted that the Computer Attitude Scales (Loyd & Gressard, 1984a) although generic and applicable to current computing behaviors, lacked questions on recent computer developments. If questions were added to the Computer Attitude Scales that included new technological developments, the reliability and validity of those instruments might have been compromised. Instead, students were asked to report on the nature of their personal computing habits, and in that way information was obtained on new computer innovations such as the Internet.

The Bem Sex Role Inventory was also chosen for its prominence in the literature on sex-role stereotypes, and for its usefulness in quantifying the magnitude of social stereotypes. The instrument, created in 1974 and the most recent scale for this type of measurement, could have been updated to incorporate contemporary views for use in the present study. However, reliability and validity would have been compromised if such changes were made. In addition, the exact constructs the instrument was designed to measure are themselves extremely complex.

More information could also have been gathered from students in the sample by means of individual interviews. However, practical considerations of time and resources prohibited such additional investigation. Those constraints also limited the study sample to one institution of each type, coeducational and single-sex. The following recommendations for future research are offered to supplement the limitations of the present study.

<u>Future research</u>

1. The present study should be replicated with the following modifications.
    a) Use additional colleges and universities to obtain a larger, and more representative sample. The sample could include schools in diverse geographic areas and include institutions of various sizes.
    b) Use additional categories of sex-role perception. The present study considered only two divisions, those who were sex-typed and those who were not. The Bem Sex Role Inventory classifies individuals into four groups. Analysis could be undertaken to investigate patterns of computer attitude for each group.

c) Use an updated version of the Bem Sex Role Inventory to address the issue of contemporary social changes.

d) Use supplemental questions in the survey instrument. These questions could seek more structured information on student use of more recent technological developments and their views on computer science courses and computer instruction.

e) Include a proportion of males within the sample population. A comparison sample of males attending the coeducational college would have added depth to the investigation. Comparisons between the women and men in the sample may have provided additional insight into computer attitudes in general.

f) Use information on computer skill levels gathered through supplemental questions as additional covariates, and investigating any relation between student computer attitudes or computer use habits and self-rating on computer skills.

3. More research is needed to determine how women use computers and how to make computers more appealing and accessible to women. Extensive analysis of the patterns of computer interest, self-ratings and academic achievement as separated by sex-role perceptions may provide information that would be useful for educators and computer designers.

4. Additional research on the learning styles of women in relation to their computer attitudes would add an important dimension to findings already established in the literature. The findings of the present study demonstrate that sex-role perceptions are a significant influence on computer attitudes. Understanding the interaction between sex-role perceptions as a social context and the learning style as a cognitive component of computer attitude would be helpful in designing courses and educational opportunities for women.

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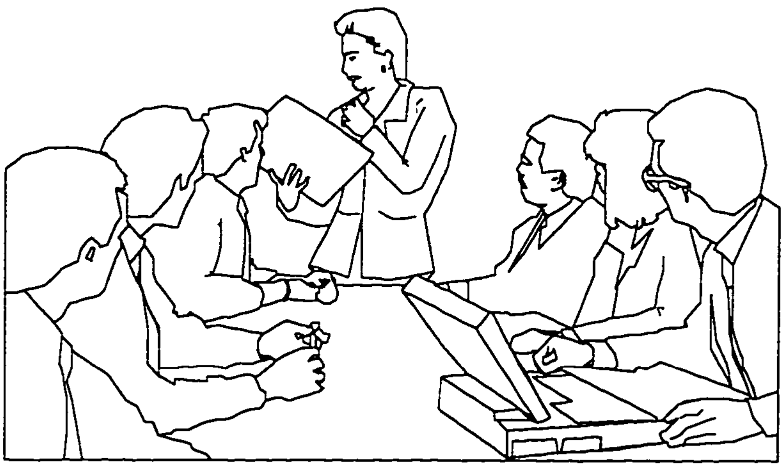
APPENDIX

Survey of Student Attitudes Toward Technological Instruction

Prepared for students of XXXX College



Fall 1996

Survey of Student Attitudes toward Technological Instruction

This questionnaire is organized in four sections relating to the following areas: A. Attitudes toward Computers, B. Attitudes toward Mathematics, C. Self-rating on specific personality characteristics and D. General Information Questions. Your responses to each question are important to our study. In this survey you will be asked to think about your own experiences with computers, with the related subject of mathematics and about your own personality traits.

A. Attitudes toward Computers

The following questions are designed to elicit your feelings toward your recent experiences with computers for educational and personal use. (Circle one number for each statement below.)

	STRONGLY AGREE	AGREE	MILDLY AGREE	MILDLY DISAGREE	DIS-AGREE	STRONGLY DISAGREE
1. Computers do not scare me at all	1	2	3	4	5	6
2. Working with a computer would make me very nervous	1	2	3	4	5	6
3. I do not feel threatened when others talk about computers	1	2	3	4	5	6
4. It wouldn't bother me at all to take computer courses	1	2	3	4	5	6
5. Computers make me feel uncomfortable	1	2	3	4	5	6
6. I would feel at ease in a computer class	1	2	3	4	5	6
7. I get a sinking feeling when I think of trying to use a computer	1	2	3	4	5	6
8. I would feel comfortable working with a computer	1	2	3	4	5	6
9. Computers make me feel uneasy and confused	1	2	3	4	5	6
10. I'm no good with computers	1	2	3	4	5	6
11. Generally I would feel OK about trying a new problem on the computer	1	2	3	4	5	6
12. I don't think I would do advanced computer work	1	2	3	4	5	6
13. I am sure I could do work with computers	1	2	3	4	5	6
14. I'm not the type to do well with computers	1	2	3	4	5	6
15. I am sure I could learn a computer language	1	2	3	4	5	6
16. I think using a computer would be very hard for me	1	2	3	4	5	6
17. I could get good grades in computer courses	1	2	3	4	5	6
18. I do not think I could handle a computer course	1	2	3	4	5	6
19. I have a lot of self confidence when it comes to computers	1	2	3	4	5	6
20. I would like working with computers	1	2	3	4	5	6
21. The challenge of solving problems with computers does not appeal to me.	1	2	3	4	5	6

Survey of Student Attitudes Toward Technological Instruction

A. Attitudes toward Computers (Continued)

	STRONGLY AGREE	AGREE	MILDLY AGREE	MILDLY DISAGREE	DIS-AGREE	STRONGLY DISAGREE
22. I think working with computers would be enjoyable and stimulating.	1	2	3	4	5	6
23. Figuring out computer problems does not appeal to me.	1	2	3	4	5	6
24. When there is a problem with a computer that I can't immediately solve, I would stick with it until I have the answer.	1	2	3	4	5	6
25. I don't understand how some people can spend so much time working with computers and seem to enjoy it.	1	2	3	4	5	6
26. Once I start to work with the computer, I would find it hard to stop.	1	2	3	4	5	6
27. I do as little with computers as possible.	1	2	3	4	5	6
28. If a problem is left unsolved in computer class, I would continue to think about it afterward.	1	2	3	4	5	6
29. I do not enjoy talking with others about computers.	1	2	3	4	5	6

B. Mathematics Attitude Scale

The following questions describe feelings toward experiences with mathematics and mathematics instruction. For each statement please indicate the degree to which the description matches your experience. (Circle one number for each statement below.)

	STRONGLY AGREE	AGREE	NO OPINION	DISAGREE	STRONGLY DISAGREE
1. Math doesn't scare me at all	1	2	3	4	5
2. It wouldn't bother me at all to take more math courses	1	2	3	4	5
3. I haven't usually worried about being able to solve math problems	1	2	3	4	5
4. I almost never have gotten shook up during a math test	1	2	3	4	5
5. I usually have been at ease during math tests	1	2	3	4	5
6. I usually have been at ease during math classes	1	2	3	4	5
7. Mathematics usually makes me feel uncomfortable and nervous	1	2	3	4	5
8. Mathematics makes me feel uncomfortable, restless, irritable, and impatient	1	2	3	4	5
9. I get a sinking feeling when I think of trying hard math problems	1	2	3	4	5

	STRONGLY AGREE	AGREE	NO OPINION	DISAGREE	STRONGLY DISAGREE
10. My mind goes blank and I am unable to think clearly when working mathematics	1	2	3	4	5
11. A math test would scare me	1	2	3	4	5
12. Mathematics makes me feel uneasy and confused	1	2	3	4	5

C. Self-Rating on specific personality characteristics.

The following statements may describe characteristics you feel you possess. This self-rating will be extremely helpful in interpreting your attitudes toward computer instruction, mathematics, and education in general. For each statement please indicate the degree to which the description matches your experience. (Circle one number for each statement below.)

	STRONGLY AGREE	AGREE	MILDLY AGREE	MILDLY DISAGREE	DISAGREE	STRONGLY DISAGREE
1. self-reliant	1	2	3	4	5	6
2. yielding	1	2	3	4	5	6
3. helpful	1	2	3	4	5	6
4. defends own beliefs	1	2	3	4	5	6
5. cheerful	1	2	3	4	5	6
6. moody	1	2	3	4	5	6
7. independent	1	2	3	4	5	6
8. shy	1	2	3	4	5	6
9. conscientious	1	2	3	4	5	6
10. athletic	1	2	3	4	5	6
11. affectionate	1	2	3	4	5	6
12. theatrical	1	2	3	4	5	6
13. assertive	1	2	3	4	5	6
14. flatterable	1	2	3	4	5	6
15. happy	1	2	3	4	5	6
16. strong personality	1	2	3	4	5	6
17. loyal	1	2	3	4	5	6
18. unpredictable	1	2	3	4	5	6
19. forceful	1	2	3	4	5	6
20. feminine	1	2	3	4	5	6
21. reliable	1	2	3	4	5	6
22. analytical	1	2	3	4	5	6
23. sympathetic	1	2	3	4	5	6
24. jealous	1	2	3	4	5	6
25. has leadership abilities	1	2	3	4	5	6
26. sensitive to the needs of others	1	2	3	4	5	6

C. Self-Rating on specific personality characteristics. (Continued)

	STRONGLY AGREE	AGREE	MILDLY AGREE	MILDLY DISAGREE	DISAGREE	STRONGLY DISAGREE
27. truthful	1	2	3	4	5	6
28. willing to take risks	1	2	3	4	5	6
29. understanding	1	2	3	4	5	6
30. secretive	1	2	3	4	5	6
31. makes decisions easily	1	2	3	4	5	6
32. compassionate	1	2	3	4	5	6
33. sincere	1	2	3	4	5	6
34. self-sufficient	1	2	3	4	5	6
35. eager to soothe hurt feelings	1	2	3	4	5	6
36. conceited	1	2	3	4	5	6
37. dominant	1	2	3	4	5	6
38. soft-spoken	1	2	3	4	5	6
39. likable	1	2	3	4	5	6
40. masculine	1	2	3	4	5	6
41. warm	1	2	3	4	5	6
42. solemn	1	2	3	4	5	6
43. willing to take a stand	1	2	3	4	5	6
44. tender	1	2	3	4	5	6
45. friendly	1	2	3	4	5	6
46. aggressive	1	2	3	4	5	6
47. gullible	1	2	3	4	5	6
48. inefficient	1	2	3	4	5	6
49. act like a leader	1	2	3	4	5	6
50. childlike	1	2	3	4	5	6
51. adaptable	1	2	3	4	5	6
52. individualistic	1	2	3	4	5	6
53. does not use harsh language	1	2	3	4	5	6
54. unsystematic	1	2	3	4	5	6
55. competitive	1	2	3	4	5	6
56. loves children	1	2	3	4	5	6
57. tactful	1	2	3	4	5	6
58. ambitious	1	2	3	4	5	6
59. gentle	1	2	3	4	5	6
60. conventional	1	2	3	4	5	6

Survey of Student Attitudes Toward Technological Instruction

D. General Information Questions

Please complete the following questions. All replies will be held in strict confidence.

1. What is your date of birth? (DD-MM-YY) ________________

2. What is your major or probable major? (Circle one number, or two if you are a double major.)

1	ANTHROPOLOGY	6	CHEMISTRY	11	GEOLOGY	16	PHYSICS
2	ART	7	COMPUTER SCIENCE	12	HISTORY	17	POLITICAL SCIENCE
3	ASTRONOMY	8	ECONOMICS	13	MATHEMATICS	18	PSYCHOLOGY
4	BIOCHEMISTRY	9	ENGLISH	14	MUSIC	19	RELIGION
5	BIOLOGY	10	FOREIGN LANGUAGE	15	PHILOSOPHY	20	SOCIOLOGY

OTHER:____

3. Have you ever taken any computer courses in college? (Circle one number.)

1 YES HOW MANY COURSES? ________________________________
2 NO

4. How would you describe the typical teaching method you have experienced in computer classes? (Circle one number.)

1 TRADITIONAL LECTURE
2 PRIMARILY SMALL GROUP
3 SMALL GROUP AND LECTURE
4 SELF-DIRECTED STUDY

OTHER: ____

5. What categories(y) best describe(s) the mathematics courses you have taken in college? (Circle all that apply.)

1 INTRODUCTORY MATHEMATICS
2 ALGEBRA
3 CALCULUS
4 STATISTICS
5 ADVANCED MATHEMATICS

OTHER: ____

6. For each category below, please indicate how many hours per week you spend using a computer.

1 WORD PROCESSING ________________
2 ELECTRONIC MAIL ________________
3 WORLD WIDE WEB ________________
4 LIBRARY RESEARCH ________________
3 DATA ANALYSIS ________________
6 PROGRAMMING ________________

OTHER: (PLEASE DESCRIBE:) ____

____

____

7. What type of high school did you attend? (Circle one number.)

1 COEDUCATIONAL 2 SINGLE-SEX

8. What best describes your skills in using computers and computer technology? (Circle one number.)

   1 I HAVE NO EXPERIENCE WITH COMPUTERS.

   2 I HAVE VERY LIMITED SKILLS.

   3 MY SKILLS ARE ADEQUATE FOR MY NEEDS.

   4 I AM VERY COMPETENT USING COMPUTERS.

9. What level of education have your parents attained? (Please circle one for each parent.)

MOTHER	FATHER	
1	1	PH. D OR OTHER ADVANCED DEGREE
2	2	MASTER'S DEGREE
3	3	BACHELOR'S DEGREE
4	4	ASSOCIATE DEGREE
5	5	HIGH SCHOOL GRADUATE
6	6	SOME HIGH SCHOOL
7	7	OTHER: ______________________

Further Comments

We are most interested in obtaining your feedback on the instruction you have received on computers and mathematics and in knowing which aspects of that instruction your found most helpful and what aspects you think might be improved or strengthened for future students. Please use this space for your comments. (Should you need additional space, please feel free to use the blank space on the back of the final page.)

Thank you for your assistance in completing this survey.

October 1996

Dear:

Within the next few days you will receive a request to complete a brief questionnaire seeking your assistance with an important research project. We are mailing the survey to a select sample of XXX College students to learn more about computer instruction and the ways in which computer resources can be designed to meet student needs.

The survey is being conducted at XXX College, and at another institution, to better inform teachers, researchers and others who must make decisions related to the instructional uses of technology in higher education. Information discovered by this study will be used to explore the ways in which computer resources and instruction can best meet student needs, and enable each student to fulfill his or her goals for developing computer competencies.

We would greatly appreciate you taking the time necessary to complete and return your questionnaire and share your experiences with us.

Thank you in advance for your help.

Sincerely,

Tracey Leger-Hornby

October 1996

Dear :

In an earlier letter, we informed you of a study on computer instruction and student uses of technology. XXX College, and one other institution, is participating in this important research project and we are now writing to request your assistance. As you may know, the use of computers on college campuses has been increasing rapidly. Information gathered in this study will be used to explore the ways in which computer resources and instruction can best meet student needs, and enable each student to fulfill his or her goals for developing computer competencies.

With your assistance, this study will potentially enable future educators to design more student-centered computer instruction and to provide appropriate types of computer resources and training. As a member of the group of students chosen for participation in this study, you are an extremely valuable resource. By completing the enclosed questionnaire, you will provide crucial information to further the study of computer instruction. The entire process will take a short time to complete.

You may be assured of complete confidentiality. Although there is an identification number on each form, it will be used solely to keep track of returned questionnaires. All information will be presented in summary form only. No single individual will be identified. Results from this research will be made available to those participants who request them. You may receive a summary of the results by writing "copy of results requested" on the back of the return envelope, and printing your name and address below it.

If you have any questions regarding the survey, please contact Tracey Leger-Hornby at (999) 999-9999.

Thank you in advance for your assistance.

Sincerely,

Tracey Leger-Hornby, Principal Investigator
Ph. D. Candidate,
Boston College School of Education

Just a Reminder . . .

About a week ago a questionnaire seeking your opinion about instructional uses of computer technology was mailed to you. Please accept our sincere thanks if you have already completed and returned it. If not, would you take a few minutes now to fill out the questionnaire and mail it to us?

Because the questionnaire was sent to only a select number of students, it is extremely important that yours be included in the study. We are especially grateful for your help because we believe your response will be beneficial to educators and future students.

Sincerely,

Tracey Leger-Hornby
Principal Investigator

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