NETWORKS AND THE PERPETUATION OF DOMINANT CULTURE ROLES: THE TECHNOLOGY GENDER GAP AND THE IMPACT OF TEACHERS

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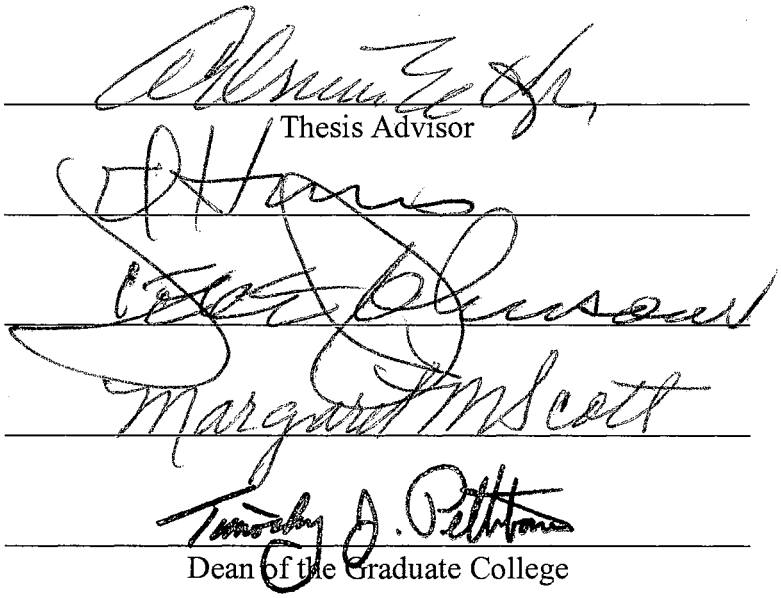

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DEDICATION

To all of the members of the cohort who have had the courage to share the joy and frustrations of seeing this challenge to its conclusion. It is my sincere hope that we have all grown in the process of this challenge and that this growth will reflect in our personal lives as well as the lives of others that we touch.

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CHAPTER I

Design of the Study

Gender gap research begun in the late 1980's and early 1990's attempted to explain the continuing difference in achievement between women and men in particular academic areas. Gender gap research focused primarily on achievement in mathematics and science (Association of American University Women, 1999); however, the perpetuation of the gap into computer science and engineering was also identified (Suchat-Sanders & Stone, 1986). Three main indicators that the gender gap was occurring in technological fields were a decline in enrollment in computer science courses, a decline in the employment of women in technological careers, and a departure of women from the technological careers that previously attracted women (Wright, 1997; AAUW, 1999).

In the mid 1980s, the enrollment of women in computer science courses and college programs was on the rise in the United States, Japan, and several other industrialized countries (Gadalla, 1995). Statistics in the late 1980's indicated a decline in enrollment in these same programs, despite increased enrollment of women in university programs in general (Furger, 1998; Wright, 1997). Additionally, during the same time frame, a decline in employment of women in the computer science and programming

careers indicated a further gap in employment as well as educational areas. Statistics showed that women were not seeking employment in computer science careers, but were in fact leaving the field at an increasing rate (Siann, 1997; AAUW, 1999).

The gender gap in enrollment in computer science education affected the business world (Wright, 1997; Chaika, 1995). The numbers of women who were involved in the computer industry employment explosion in the 1980's had decreased rapidly in the early 1990's (AAUW, 1999) and women were not selecting the courses that would prepare them for entrance into computer industry jobs. More women are projected to play a major role in the computer-related aspects of industry (AAUW, 1999; Chaika, 1995). The growth in the use of computers in today's world is phenomenal. If this gender gap in training and employment continues, the United States could lose out to other industrial nations that are using their workforce more fully (AAUW, 1999). As a world industrial leader, America could lose its foothold at the top (National Council of Teachers Mathematics, 1989).

Many have researched possible explanations for the decline in women's interest in technology. Researchers have examined theories ranging from computer access (Atwell & Battle, 1999; DeBare, 1996; Dorman, 1996; AAUW, 1999) to software design (Berselli, 1998; Chappell, 1997, Furger, 1998). Additionally, course offerings at the high school level (Shashanni, 1994; Akbaba & Kurubacek, 1998; Bennings, 1998; AAUW, 1999; Gooler, 1999) and the societal expectations of women compared to men in business and education (Kantor, 1997; Roberts, 1997; Siann, 1997; Wright, 1997; Paris, 1999) were offered as explanations for the anomaly.

Three reoccurring themes seem to exist in the literature on eliminating the gender gap in technology use, education and employment. One of the themes is self-efficacy of the students regarding the use of computers and technology (Brosnan, 1998). Self-efficacy, or the belief that one has the power to produce or accomplish the task, seems critical to perseverance in computing. Students who are provided equal access to computers appear to have equal interest in using computers until they begin to reach adolescence (Brosnan, 1998). As students approach adolescence, they are also making choices regarding the types of courses they will take. In studies on the change in attitude toward computer use that occurs during adolescence, Brosnan (1998) emphasizes peer approval and self-efficacy as major concerns in the development of children at this stage of their lives. Students' view of their ability to use computers and how others perceive them as users of technology is a critical part for continued use of technology at this age (Brosnan, 1998; Joiner, Messer, Littleton & Light, 1998).

Students' perception of their self-efficacy and the societal impact of sex role development of children at the emergence of adolescence provide researchers with evidence that success in technology is linked not only to self-perception, but also to cultural bias (Bennings, 1998; Williams, Ogletree, Woodburn & Raffield, 1993; Dorman, 1996). Students' views of their abilities to use computers and how others perceive them as users of technology is a critical part of continued use of technology beyond the adolescent years (Brosnan, 1998; Bandura, 1986; Muira & Muira, 1984). If their self-efficacy is challenged, they may turn away from the source of the challenge.

At the same time, parents and teachers may view the computer as a male oriented piece of equipment. Sex role development research indicates that this view may influence

the use of the computer by the student (Shashanni, 1994; Wright, 1997). In addition to the genderization of the computer, how computers are used has an impact on acceptance and continued use of the computer by students during the adolescence (Brosnan, 1998; Pohl, 1997). Students who are willing or enthusiastic about using computers as a curiosity, a toy or a challenge are more willing to try out new things (Brosnan, 1998; Furger, 1998). Playing on a computer, treating it as a toy more than a tool is one of the secrets to successfully overcome the gender gap (Furger, 1998; Chaika, 1995; Fletcher-Finn & Suddendorf, 1996).

Success in increasing the use of technology and interest in technology-related courses and careers is also affected by mentorship. This is the second theme in research designed to understand and potentially increase the numbers of women into technology careers by linking young students with adults in technology using career fields and offering opportunities for these role models to interact with students. This mentoring may encourage students to try new facets of the computer technology fields and maintain their interest in the use of computers during the critical developmental years of early adolescence and high school (AAUW, 1999). Mentorship by corporate business employees, particularly women, has been successful in increasing the number of women who enter and stay in corporate business. The impact of technology-using mentors or role models in education and industry greatly affects the interest that a student has in pursuing technology related careers (Richardson & Kavanagh, 1997). Mentorship has taken many forms. Business people have created programs which involve visiting schools and speaking specifically to girls about technology usage in their jobs (Furger, 1998). Universities have organized weekend and summer seminars aimed at girls and young

women to encourage interest in technology related courses (AAUW, 1999). These are particularly popular in urban areas. Schools have opened their computer areas in the evenings and on weekends to not only students but also parents to encourage the use of technology in communities where the socio-economic levels may not warrant access to computers in the homes of students (Sanders, 1986; AAUW, 1999).

Last but not least, students are exposed, daily, to teachers and computers in the classrooms and laboratories. Attitudes of these teachers toward the integration of technology into their curriculum have significantly impacted the use of technology by students (Dupagne &Krendl, 1992; Todman & Dick, 1993; Akbaba & Kurubacak, 1998; Christensen, 1998). They may perpetuate the "dominant culture" role development standards that have existed for generations. That is teachers support the idea that males, traditionally the white, heterosexual male, project the standards for job choice, career choice and sex role model to which all other persons must be compared (Bandura, 1986; Williams, Ogletree, Woodburn, & Raffield, 1993; Philbin, Meier, Huffman, &Boverie, 1995; Fletcher-Finn & Suddendorf, 1996). With a new developing career such as computing, the role of male and female job appropriateness had to be redefined (Dupagne & Krendl, 1992). Since many of our elementary teachers are female and since many of these women do not have positive attitudes toward computers or technology (Todman & Dick, 1993; Brosnan, 1998), the roles that they model may be affecting students use of technology. Unfortunately many teachers express anxiety over the use of technology and assume that the role of instruction on the computer will come from the computer technology teachers at the school (Hignite & Echternacht, 1992).

At the same time, the role models that are being projected are those of women or men who are hesitant to use computers or indeed may even be technophobic. That is they may exhibit fear, express a lack of confidence or disdain at having to use computers and technology in the presence of their students. The messages that we may be sending our students daily may be counter- productive to all the other interventions to reduce the gender gap in technology (AAUW, 1999).

Statement of the Problem

Future requirements for employment of all will require literacy not only in the traditional sense, but also computer literacy (NCTM, 1989; AAUW, 1999; Chaika, 1995). "To have an edge in America's job search, it used to be enough to be well educated. Now it's critical to be digital" (Hancock, 1995, p 27). According to Sanders (1999) in her work with Center for Gender Equity, nine out of every 10 women will work for pay during their lives. Most of these jobs will require the use of technology and 90 percent of the jobs that today's kindergartners will be doing when they reach adulthood do not even exist today (Furger, 1998).

Despite this need for computer literacy and work for women, women are not pursuing the courses in high school and further education that lead to employment in computer technology (Furger, 1998, Wright, 1997). Additionally, instead of the number of women working in computer related industries increasing as projected in the 1980s, the number of women seeking employment in these fields was decreasing at the end of the 1990's (AAUW, 1999). This problem is further exacerbated by the fact that women

already employed in the industry are choosing to leave (Siann, 1997; Wright, 1997; Paris, 1999).

Granovetter (1986) and Wells and Crain (1994) would explain this anomaly though social network theory and the underdevelopment of "weak" ties linking girls and women to exposure to and pursuit of technology education and careers. Their educational studies link social network theory and "strength of ties" to the perpetuation of social and educational isolation of minority high school and college students.

Perpetuation Theory (Braddock & Mc Partland, 1987), developed in response to research done on the effects of desegregation, further explains the anomaly of under-representation of woman in technology. Teacher role models may be perpetuating the culturally dominant male role in the study and use of technology. Teachers may be dissuading rather than encouraging girls and women into technology related careers, thereby perpetuating the under representation of women in technology related careers. Factors that would cause girls to respond more negatively than boys to technology may still be perpetuated in many classrooms, despite teachers' attempts at gender equity. Factors in the work place or institutions of higher education that would cause women to disengage from computer technology could also be attributed to the same traditions and attitudes.

The Purpose of the Study

The purpose of the study is to explore, through the lenses of perpetuation theory (Braddock & Mc Partland, 1987), "strength of ties" (Granovetter, 1986), and social

network theory (Wells & Crain, 1994), female students' perceptions of the factors influencing their enrollment in computer course work. The same framework was used to assess factors that influence the same students' choice of technology-related careers.

Research Objectives

This study found and provided information about the following:

1. The factors which impacted female students' enrollment in computer coursework and their choice of technology as a career.
2. Analyzed those factors through the lenses of perpetuation theory, "strength of ties" and social network theory.
3. Described realities revealed that are inconsistent with theories
4. Assessed the usefulness of perpetuation theory, "strength of ties" and social network theory in understanding the impact of teachers on female students' perspectives.

Orienting Theoretical Frames

Three related theoretical frames will guide this study: perpetuation theory, "strength of ties" and social network theory. Based on the research, perpetuation theory attempts to explain how cultural elements, such as racial, ethnic, or gender ties, deny minority groups the confidence to interact and compete with the dominant cultural structure of the society (Braddock, 1980; Hoetler, 1982; Braddock & Mc Partland, 1987;

Wells & Crain, 1994). The original research explained how desegregation gave Blacks the experience and confidence of interacting with the Whites enabling them to compete in higher educational settings and employment situations. The theory states that success within a mixed group at an early stage of a child's life would then provide the confidence for them to pursue interactions with other cultures at a later point in their lives (Braddock, 1983).

Carrying perpetuation theory into the technology and gender gap arena, the concept of perpetuating the dominant cultural acceptance of careers that are only for women and those that are only for men, could impact the success of women entering technological careers and education. In school settings, the role of the teacher in the transmission of or the challenging of traditional technological roles appears pivotal.

Braddock and Mc Partland (1987) would explain the impact of this pivotal role in terms of social network segregation. From the technological gender gap studies, we know that the exclusion of women has many dimensions (AAUW, 1999; Furger, 1998). First, women lack the social network in schools to encourage entering technology courses (Braddock & Mc Partland, 1987; Furger, 1998; Gadalla, 1995). Second, they lack the social network that makes them part of the job recruitment pool (Kantor, 1977, AAUW, 1991; Furger, 1998). Third, women do not find the social network that supports them in higher education or employment where the majority of the members of their social network are male (Wells & Crain, 1994; Furger, 1994). Additionally, the social network theory supports the explanation of the gender gap at the job promotion level. "Several researchers have argued that the exclusion of women and minorities from positions that

are likely to lead to promotion is a major explanation for sex and race gaps in occupational attainment..." (Braddock & McPartland, 1987, p 22).

Granovetter (1983) explains social network theory through the concept of "strong ties" and "weak ties." Strong ties are formed by close relationships and usually are supported by small groups of people. Weak ties on the other hand are usually indicative of relationships that are defined by acquaintances. Weak ties are better for developing the kind of network that increases experimentation and a broadening employment base, but are not usually the kind of relationships that women prefer. The more intimate and close relationships that women find comfortable with are those usually exemplified by the "strong ties." The ideas of "strong ties" versus "weak ties" will be used to explain how teachers can be important in creating an atmosphere that encourages students to enter a technology related field of study.

Procedures

Using a case study method, the research will reveal the factors which impact on enrollment of students in technology education courses and their choice of technology careers. Qualitative methods will be employed to gather data regarding the factors that encouraged women students' entry into computer courses and careers.

Researcher

Mathematics has always been a part of my life. My father who was an accountant for one of Chicago's major banking systems always assumed that mathematics would be a critical element to anyone's life and education. Much to his dismay, I chose education as a career, rather than accounting.

My educational experience has been as a middle school/junior high teacher. It is the area that I had actually been trained in at Illinois State University in the years 1965 through 1969. Basically, I have always been interested in the middle school aged student and also in the field of mathematics and science. For many years, I served as a substitute teacher while raising a family and moving around the world with a military spouse. As a female in the mathematics/ science career, I originally found myself in a minority, but as the years have progressed, I am in the interesting position of being a member of a predominantly female mathematics department. Of the eight mathematics teachers at our school, only one is male and he is teaching at the sixth grade level.

I have been a reluctant user of technology until recently. In the process of working on my EdD it became necessary to use technology to gain research and submit course materials to the university. Living in England has necessitated the use of with the Internet to accomplish much of this research.

Additionally, our school has made a great commitment to incorporate technology into the students' curricula as much as possible. I have been responsible for maintaining a Mac computer lab for our math department for the past eight years. Investigating the math software and attempting to become familiar with the various math programs that were

considered appropriate for middle school students has encouraged me to become more of a technology user. I have also been part of a project with University of Northern Iowa aimed at incorporating technology, through computers and calculators into the existing mathematics curriculum. Designing lessons that incorporate technology has opened my eyes to the way some teachers embrace the use of technology in the classroom, while others do not.

Data Needs and Sources

Given the problem, data needs included students' perceptions of the factors influencing their enrollment in computer coursework and choice of technology-related careers. Needed as well were data documenting enrollments of students.

Data sources were students who are choosing to enter careers that are technology related. I drew my sample from a college in East Anglia that offers an introductory college program in technology for young adults and more mature returning students.

Data Collection

The data were collected through interviews. I visited the college and met with the dean of the technology department. She recommended speaking with the department chairperson, who helped me contact students that would be interested in taking part in this study. All who agreed were contacted formally upon receipt of IRB approval. Because the case study involved long interviews, a small number of students comprised

the sample. Additionally data on the number of women who have been part of the program were obtained through the records department of the college, with the help of the administrative staff.

Interview Questions

The interview questions were semi-structured to allow for expansion depending on the interviewee's situation. The interview protocol was guided by two sets of very general questions:

1. What do you think about computers? Why?
2. In what ways do you see yourself in a future with computers? Why?

If needed, follow up questions include the following:

1. Describe the kind of computer user that you are: that is when and for what purposes do you use the computer?
2. How confident are you about using a computer?
3. Of the connections or ties that you have with members of your technology education courses or careers, describe the time, intensity, intimacy and reciprocal services that this connection has.
4. How important is confidence to your continued interest in computer technology education?
5. Who influenced you to start computing? How? When? Why? Where?
6. Where do you use the computer the most?
7. Why are you enrolled in a computing course at the moment?

8. Is there a particular incident or person that influenced you to enroll in computer technology courses?
9. Do you feel that women should do computing more than men or vise versa? Why?

Data Analysis

From interview transcripts, I looked for patterns of influence that have made students either head toward or shy away from technology related fields. I will see in what ways these patterns or trends link to the pre-established research regarding gender and determine in what ways the descriptions of the students support or refute the principles of Perpetuation Theory, "strength of ties" and Social Network Theory. Because of the semi-structured nature of the questions, the analysis of the data needed to be concurrent with the data collection. Also, data collected from enrollment records were analyzed for patterns and trends (Merriam, 1998).

Implications of the Study

Much has been done to ensure that equity in technology education is available for both males and females. Self-efficacy and role models seem to have a significant impact on students choosing to study computer technology. The study was undertaken to examine the ways in which the perpetuation of societal roles and expectations,

particularly those exhibited by teachers, was impacting on students' decisions to pursue a technological career or education.

Research

Some research on the impact of teacher attitude on the use of technology has been conducted. This study has added to the body of knowledge on integration of technology in the classroom and the role of the classroom teacher in this integration process. As the role of technology has changed dramatically in the past 15 years, this research added a more current look at how teachers are facilitating students' computer use and choice of technology as part of their future.

Practice

In regards to the self-efficacy issue and the impact that self-efficacy has on the success of students at the crucial "middle school years," reviewing the image that teachers are projecting to their students of computers in their classroom provided essential knowledge to the implementation of technology in education. With an awareness of their personal attitudes toward computing, in-service instruction for teachers could be changed. In-service instruction often comes in a one-size-fits-all package that most of us have come to realize is inappropriate, especially in an area where the entry level skills of the trainees is so varied. Additionally pre-service training for teachers in the incorporation of computer skills into lessons as well as implementation of lessons that involve technology

could be addressed at the university level and continued as part of the standard in-service part of any educators program.

Theory

This study has added to and/or augmented the theory of network analysis (Granovetter, 1983) and perpetuation theory (Braddock & Mc Partland, 1987), and "strength of ties" by extending the theory to include groups that are isolated by gender. Extending this theory to the area of technology studies could help to explain difficulties in assimilation into a dominant culture occupation based on gender.

Summary

This study presents the problem of gender differences in pursuit of technology education and careers and explores the reasons for the differences. The purpose of the study was to look at the factors that female technology students feel impact on their choice of career and the type of computer course work that they have selected. Three theoretical frames guided data collection and analysis.

Reporting

Chapter II reviews the literature. Chapter III presents the data collected. Analysis and interpretation of the data will comprise Chapter IV. Chapter V includes the summary, conclusions, recommendations, implications and commentary.

CHAPTER II

Review of the Literature

This chapter provides a review of the literature on: 1) the gender gap; 2) the technology gender gap and attempts to close it; 3) social role development and its impact on computer education and careers; 4) self-efficacy, mentoring, and teachers' attitudes regarding technology; and 5) Perpetuation theory, social network analysis and "strength of ties" theory. The first section examines the gender gap in achievement and its impact on mathematics and science. The second section investigates the perpetuation of the gender gap into computer and technology education and careers. Multiple attempts have addressed the technology gap. An analysis of the effectiveness of these attempts will be included. The third section will look at social role development, the perception of computing as a male domain and the impact of this perception on the technology gender gap. The next section will concentrate on two themes currently being studied as successful measures to close the gap: self-efficacy and mentoring. Additionally, the impact of teachers' attitudes toward the implementation of technology into the curriculum and its impact on students' use of technology will be developed as a theme. The last section, Perpetuation theory, and its link with social network theory and strength of ties

will be used to look at possible explanations for the difficulty in closing the gap in technology based on dominant cultural role studies.

Gender Gap

Since the passage of Title IX in 1972, the affect of schooling and equal opportunities for females and males has impacted on educational practices and its extension into the employment (http://www.ed.gov/pubs/TitleIX/part4.html). The study of gender gaps: the differences in academic achievement between females and males across all areas of the curriculum and in teacher student interaction, has become a focus of intense study by many research groups. The American Association of University Women (AAUW) raised the issue of the "invisibility of girls in the current educational debates" (1992, p.1). In the report "*How Schools Short Change Girls",* the AAUW points out that even following *America 2000* report, the 1991 plan of the President and the U.S. Department of Education, girls continue to be left out of educational debates.

> Schools must prepare both girls and boys for full and active roles in the family, community, and the work force. Whether we look at the issues from an economic, political, or social perspective, girls are one-half of our future. We must move them from the sidelines to the center of the education-reform debate. (AAUW, 1992, p.1)

In what ways do schools silence girls? Based on Gilligan's (1982) research into the different voices that women have in expressing themselves, schools affect the ways that women speak in educational situations and their feelings toward the males in those

situations. Orenstein (1994) presents ways that schools have repressed girls. She exposes an American culture as "ambivalent toward female achievement, proficiency, independence, and right to a full and equal life. Our culture devalues both women and the qualities, which it projects on to us, such as nurturance, cooperation, and intuition" (1994, p. xix). In looking at girls' experience, Orenstein describes the self as strands of life that are intricately interwoven. They include school, family, treatment of boys toward girls, and reaction of girls' to emergent sexual desire as well as a new consciousness to sexual exploitation. In response to silencing, she says

> Girls' hesitance to speak out relative to boys is not mere stylistic difference; speaking out in class and being acknowledged for it – is a constant reinforcement of a student's right to be heard, to take academic risks. Students who talk in class have more opportunity to enhance self-esteem through exposure to praise; they have the luxury of learning from mistakes and they develop the perspective to see failure as an educational tool. (1994, p.12)

Sadker and Sadker (1994) emphasize the attention getting methods such as 'calling out' that boys use are reinforced by teachers. These same methods do not create the same response when used by girls. Instead of reinforcement, reprimand is usually the course of action. Additionally methods of responding, self-esteem building, and 'wait time' differ when teachers deal with boys than they do with girls. This tendency, begins as early as pre-school when educators often choose classroom activities that appeal to boys' interests rather than girls' (AAUW, 1999). Traditionally, teaching methods foster

competition that appeals to males, rather than cooperation that appeals to females (Brosnan, 1998; Robin & Harris, 1998).

Dorney and Flood (1995) report on methods that help teachers break the gender silences. They posit that teachers are in a strong position to respond to this problem of silencing. However, teachers, both male and female have been socialized in a culture where they have experienced and observed silencing.

> Given the charge that the teaching profession itself has historically been an occupation "suited to silence." In order for teachers to be critical of patterns and habits of silencing and to take actions to disrupt them, teachers need opportunities for deep reflection and a community of colleagues who can support and challenge each other. (Dorney & Flood, 1995, p. 72)

In response to the gender gap in mathematics and science, Orenstein (1994) posits the following:

> Although the skewed equations of voice and silence are not the exclusive province of math or science, they are arguably the most damaging in those classes, where the tradition of male dominance is most entrenched. It is important to note that the confidence drop often precedes the competence drop. (p. 18)

As girls progress toward adolescence their self- confidence levels decrease. Orenstein (1994) and Fennema and Sherman (1976) emphasize that the decrease in self-confidence is usually followed by a decrease in academic performance, but it is always the decrease in self-confidence that comes first.

> At the time of puberty, girls are experiencing many changes at once. They are caught in bodies that swell and expand in puzzling ways and when they look ahead to options that are mysteriously shrinking, they must also deal with the shift to middle school. It is a larger, more complicated place and many critics' charge, harshly out of touch with the needs of adolescence. In this more chaotic and alienating school, with new rules and uncharted social norms, it is easier to become both physically and emotionally lost. The trauma experienced by girls in dealing simultaneously with a metamorphosis of puberty and the adjustment to a new, more difficult school can be seen as a major contributor to the shattering of their fragile self-esteem. (Sadker & Sadker, 1994, p. 79)

Girls do not think adults expect them to be able to do things because throughout school they are interrupted in attempts to accomplish things on their own. Sadker and Sadker (1994) describe these phenomena as short-circuiting. Short-circuiting occurs when a teacher "does" for a girl instead of teaching her how to accomplish things on her own. The result of this short circuit is that education is turned off. Independence and self-esteem are short-circuited as well.

In the second AAUW executive report *Shortchanging Girls, Shortchanging America,* the research of David and Myra Sadker is summarized:

- Teachers typically initiate more communication with boys than with girls in the classroom, strengthening boys' sense of importance.
- Teachers tend to ask boys more complex, abstract, and open-ended questions, providing better opportunities for active learning.

- In class projects and assignments, teachers are more likely to give detailed instructions to boys, and more likely to take over and finish the task for girls, depriving them of active learning.
- Teachers tend to praise boys more often than girls for the intellectual content and quality of their work. They praise girls more often for neatness and form.
- When boys perform poorly, teachers often blame failure for lack of effort. Girls receive a different message; the implication is that effort would not improve their results.
- All too often teachers and counselors track girls away from courses of study that lead to high-skilled, high-paying, high-technology careers. (AAUW, 1994, p. 14)

Other pertinent results of the 1994 study, which concentrates on self-esteem, indicate that although peer influence is thought to be strong in adolescence, school and family have a stronger effect especially on girls.

> For girls, feelings about academic performance correlate strongly with relationships with teachers. Teachers are important role models for girls. Nearly three out of every four elementary school girls and more than half of high school girls want to be teachers. Thus, teachers have a special opportunity to affect the self-esteem of their female students, and, by instilling confidence, to shape their interests and aspirations. (AAUW, 1994, p 10)

More recently, David Sadker (1999) reviewed the gender equity problem. Although great strides have been made in the areas of access to school, courses and

careers, the persistence of inequity is still a salient gender issue. Sadker lists an update of the top 10 gender equity issues of concern at the end of the 1900's. He claims that (10) "Segregation still thrives in the U.S. schools" (1999, p. 23), predominantly in the area of course selection and career development. (9) "Public schools are now creating single gender classes and schools" (1999, p. 23) which he feels are at the expense of equitable courses. (8) "Gender-related safety and health concerns continue to plague females" (1999, p. 24). The main concern here is sexual harassment which he claims is reported by 80 percent of schoolgirls. This links to the drop in self-confidence as reported by the AAUW. The culturally accepted value that "boys will be boys" allows sexual harassment to be treated casually. Unfortunately, "both boys and girls get a dangerous, damaging message: girls are not worthy of respect; appropriate behavior for boys includes exerting power over girls" (AAUW, 1992, p. 2).

Sadker's next two issues deal with dropping out of school and of special programs. (7) "Boys drop out with a 'crash', whereas girls drop out more quietly, more quickly, and more permanently" (1999, p. 24). Additionally in reference to gifted programs (6), he comments that most reinforce gender segregation through course selection and that most girls begin dropping out of those programs by 10^{th} grade.

Sadker's fifth issue concerns the effect of gender bias on males. Boys are stereotyped into gender roles earlier and more rigidly than females. Researchers (Helwig, 1999; Warington & Younger, 2000) support Sadker's proposition. In research on gender-role stereotyping, they found that males choose traditional career expectation early in life and although their perspectives broadened, as they became older, their expectations did not expand as the females did. Female gender-role options for occupational aspirations

were more diverse than males and continue to diversify whereas the males begin traditionally and tend to remain that way.

Of particular concern to the AAUW is research on course taking patterns among students for middle school on through high school. The initial gap was observed in the area of mathematics and science. Research into the course taking patterns of boys and girls at the middle and high school level has indicated that girls need to be encouraged to take the "gatekeeper courses of Algebra I, Geometry, and Algebra II" (AAUW, 1999, p. 31). Biology, chemistry and physics also need to be emphasized in order to open options for career development and educational opportunities at the post secondary level. The limitation of males to traditional courses may impact on the future course decisions that in turn limit the career aspirations. Research conducted by Trusty, Robinson, Plata and Ng (2000) confirms the research of the AAUW. In study on gender, socioeconomic status and early academic performance, they found that gender and early academic performance were primary contributors to post secondary career choice and education. They posit that after allowing for gender, the next most significant dynamic was performance in eighth grade academic courses.

> When comparing the nontraditional choices of males and females, research has generally shown that females are more nontraditional. Over the last three decades, the number of women choosing high-skilled fields such as engineering and business has increased...high school girls were more likely than boys to express interest in gender-nontraditional occupations. (Trusty, Robinson, Plata & Ng, 2000, p. 463)

Sadker's top four concerns relate to teacher interaction with students, the gap in science and mathematics, the new gender gap in technology and political forces that are intent on reversing the gains in educational equity made during the past decade (1999, p. 25). According to research conducted in the AAUW report, *Gender Gaps Where School Still Fail Our Children,*

> Girls received less teacher attention than boys, girls received less complex, challenging interaction with their teachers than boys, girls received less constructive feedback from their teachers than boys, girls' responses received less wait time that boys' responses and gender bias in teacher-student interaction varied across subject areas, with math and science still showing the largest inequities. (1999, p. 61)

The Technology Gender Gap

The new gap in technology achievement was identified by Jo Sanders (1986) in her studies for the New Moon corporation, the Computer Equity Expert Project and her book, *The Neuter Computer*. She noted that in 1982 women represented 33 percent of the bachelor degrees, 23 percent of the masters' degrees, and 10 percent of the doctorate degrees in computer science. By 1986, those reports indicated the greatest relative decline in representation based on enrollment in computer courses was surpassed only by the study of law. The big concern was why this was occurring. When technology careers first developed, it was thought that this would be an ideal career for women. It was clean, did not involve manual labor and could be done from the home. In the 1950's and 1960's

women comprised almost half of all system analysts and programmers, but by the 1980's they only accounted for 20 percent (Chaika, 1995). Gadalla (1995) supports this by reporting

> The gender gap in computer science enrollment is particularly puzzling. Computer technology is a new field with no long history of sexism to overcome, and the expansion in this field occurred in the early seventies almost at the same time as the birth of the feminist movement. At the beginning, the field was open to women but quickly became male dominated. In 1984, women constituted 28 percent of the bachelor degree enrollment (Canadian), in 1987 they constituted 20 percent. And, although computer science programs suffered a decline in enrollment of both sexes during this period, men's enrollment quickly bounded back, while women's enrollment never returned to the 1984 level (Gadalla, 1995, on line).

Instead, Wright (1997) published some interesting statistics. In her cross-national analysis, she found that UNESCO data from 71 countries indicated an interesting pattern of development. Nineteen of those countries including the United States, the United Kingdom, Japan and other European countries all were following the same patterns. The American data from the National Science Foundation indicated a start of 32.3 percent in 1975 to a rise of 39.7 percent in 1985. A drop occurred in the data for 1990, at 36.4 percent and a continuation of the drop in 1994 to 28 percent. Of significance is Wright's further research.

> To summarize that analysis, we tend to consider the relationship between graduating from program [me]s in computer science and working in the computer workplace. Based on data from the U.S. Department of Education and Labor, women's representation among graduates of American program[me]s in computer and information science has risen from 14 percent in 1971 to 37 percent in 1984, from which it has fallen to 28 percent in 1994. Women's proportion of American computer work has followed as similar, but later pattern. In 1971 women were 15 percent of all such workers, which rose to a high of 36 percent in 1990 but fell back to 31 percent in 1995. (1997, p 76)

Why has women's progress in the work force reversed? The change actually effects two points of time in the employment cycle; entry and exit. In the U.S., women are both choosing not to enter computer work and are more likely than men to leave it. Research conducted by the National Science Foundation in the 1980s shows that "controlling for background, education, experience, period, specialty and industry, women are more likely to leave computer work than men" (Wright, 1997, p.76). The main factors cited for women not choosing to enter computer work are 1) avoidance of mathematics and science; 2) software mainly male oriented and produced by males; 3) computer training programs designed mainly by and for men; and 4) a common perception that computer work is a male domain. The main factors that account for women exiting from computer work are male backlash and women's attraction to other male-dominated careers such as business. Additionally lack of networks that allow women access to informal information in the industry and the association of computer work and anti-social characters account for some of the withdrawal (Wilson, 1997).

Following these analyses, researchers looked into a myriad of solutions to eliminate the technology gap. In education, access to computers was the first issue addressed. Jo Sanders, the coordinator of Computer Equity Expert Project from 1990 to 1993, worked to develop a series of suggestions that were available to schools and parents through web sites (Sanders, http://www.wri-edu.org/equity/menu.cgi) as well as standard printed materials (Furger, 1998).

At schools, suggestions were made for access in computer labs or the classroom. Once again, the recommendation was to schedule times when only girls were allowed to use the computers for free time. When computer lab projects were done, groups need not be heterogeneous. Girls often worked better together, where they felt less competition from boys (Sanders, 1985; Dorman, 1996; Bennings, 1998; Joiner, Messmer, Light & Littleton, 1998). Other access techniques recommended by Dr. Anita Borg, founder of SYSTRS, an on-line web site for women in computing include computer clubs, girls-only after school or weekend sessions, and role model participation in classrooms from women who are working in the industry (Furger, 1998).

The suggestions for parents included locating the home computer in a central part of the home, so that both boys and girls had access to the computer, instead of placing then in the boys' bedrooms (De Bare, 1996; Attwell & Battle, 1999). Other suggestions were to ensure that girls saw both mother and father using the computer. In families, time allocation was also suggested to ensure that girls could use the computer without competing with other family members for computer time (Attwell & Battle, 1999). Other recommendations include showing girls that adults have to struggle to learn computing

and that effort and perseverance are important (DeBare, 1996). Exploring web sites and software that would appeal to girls could also be useful (Furger, 1998).

However access alone did not eliminate the gap. Girls still did not pursue technology course work. The next emphasis was on software. In research, the use of the computer by males and females began to differ (Furger, 1998). It was noted that those students that looked on the computer as a toy, something to have fun and investigate with were more inclined to use the computer more (Chaika, 1995; Berselli, 1998). It was also noted that girls viewed the computer more as a tool to accomplish a task whereas boys viewed them as toys (Dorman, 1996). How could computers be made more appealing to girls? Software design was investigated. Software in the 1980s was designed by men for men (Furger, 1998). The aggressive competitive nature of the games did not appeal to many girls (Chaika, 1995; Chappell, 1997; Cassell & Jenkins, 1998; Littleton, Joiner, Messer, & Barnes, 1998).

Gooler (1999) raised four gender questions in regard to introducing computers into the classroom. What is the extent of gender discrepancy? Gooler feels that society encourages boys to be more interested in computers resulting in more self-confidence among boys than girls and their ability to work with computers. The second question delves into the importance of gender discrepancy. His response concerns the elimination of females from career choices by negative attitudes. Because of the pervasiveness of computers in business and service sectors of the economy, females may be limiting their career options (NCTM, 1999). He further pursued the source of gender discrepancy finding that male dominated associations existed in multiple locations; advertising,

computer software and teacher role models. He questions methods for counteracting the gender discrepancy by recommending the following:

- Encourage women to use computers
- Discuss the potential value of computing
- Be aware of the bias against women and minorities in software
- Have prerequisites that are irrelevant for computer access and instruction
- Limit access to computers for females during non-course or non-class time
- Look for ways to change under-representation of females in computer leadership roles
- Watch for dominance of one student over another in computer time
- Watch for peer pressure that discourages participation in computer activities and clubs
- Provide training for teachers, to help eliminate teachers' inability to recognize and deal with problems in computer learning
- Eliminate the shortage of qualified personnel for computer teaching.

Social Role Development

Though much has been said about both access and software, neither of the changes recommended by the expert turned the tide in the gender gap. What was still keeping girls from achieving parity with boys in computer education? Further research

into societal expectation and sex role dominated the next phase of proposed "fixes" for the gender gap. Psychological sex role typing is responsible for much of the gender gap research. The phenomena, describes the way children develop an understanding of male and female-ness and the traditional expectations that direct the careers, education and choices of entertainment that dominate each of these genders. Adler, Kless and Adler (1992) researched the nature of gender differences in society. Where do they begin, where are they supported and how do they become entrenched?

> Children create their own norms, values, and styles within the school setting that constitutes their peer culture. Within this culture is where they do their identity work, learning and evaluating roles and values for their future adult behavior, of which their "gender regimes" are an important component further stratified by gender. (Adler, Kless, &Adler, 1992, p. 169)

Between the ages of two and seven, children strive to determine the behaviors appropriate to his or her gender according to social prescription (Williams, Ogletree, Woodburn & Raffield, 1993). This development is further supported by gender consistency around the age of five to six years old and is reinforced in early adolescence when gender stability is formed (Helwig, 2000). Researchers (Alder, Kless & Adler, 1992; Williams, et al., 1993; Shashanni, 1994; Philbin, Meier, Huffman & Boverie, 1995; Silverman & Pritchard, 1996; Bjorkman & Christoff, 1997; Sian, 1997; Wilson, 1997; Davies-Netzky, 1998; & Helwig, 2000) followed the impact of this social role development in relation to computer usage and interest. Philbin, Meier, Huffman and Boverie (1995) express concern regarding social role development because "conceptions of knowledge and truths that are accepted and articulated today have been shaped

throughout history by a male-dominated majority culture" (p. 486). Additionally men's experiences and competencies have been used to determine the base lines for education. The association of computing with mathematics and science led to implications that computing was a male domain.

Both Adler, Kless and Adler (1992) and Fletcher-Finn and Suddendorf (1996) refer to segregated sexual cultures that begin as early as pre-school. The play styles of boys tending to be large-scale and goal directed while girls' play styles are small group and discussion centered. These and the exploratory behaviors of boys and girls impact the usage of computers by both groups. Individuals that feel more comfortable during initial computer interaction and view computer usage as a problem-solving challenge as opposed to an anxiety producing experience are likely to continue using computers (Saunders, 1993). As gender differences appear they link with computer involvement. As the schools and societal values change, "women lose interest in computers, downplay their computer abilities and chances of success, and avoid careers in computer sciences" (Shashanni, 1994, p. 350). Shashanni claims the amount of computer use positively relates to all aspects of computer attitude.

School educators play an important role in perpetuating gender role socialization. These experiences of "subtle discrimination at school...through the 'hidden curriculum' teach in an implicit way, meanings and behaviors associated with femaleness and maleness" (Shashanni, 1994, p. 362). Children will perceive that computing is a genderized activity by an anxious female role model and gender-biased classroom procedures will give unintentional signals that this is the case (Saunders, 1993). Social learning theory supports differential reinforcement by parents and teachers as boys and

girls are taught to do the 'gender appropriate' subjects and occupations (Bandura, 1986). Bandura also emphasizes that observational learning through imitation and modeling would perpetuate stereotypical culture.

In all the research on the computer gender gap, three reoccurring positive themes continued to present themselves. Self-efficacy, mentoring and role models, and teachers' attitudes toward computer integration were three themes that seemed to make the most impact toward eliminating the technology gender gap. These three themes will be the focus of section four of the literature review.

Self-efficacy, Mentoring and Teachers' Attitudes

Women have been described as having a preference toward learning styles that exhibit connected learning. In this situation they learn better from experiences and hands on experiments. In *Woman's Ways of Knowing: the Development of Self, Voice and Mind,* the transition of women from silence through the five stages of learning to constructed learner shows the development of self-efficacy (Belenky, Chinchy, Goldberger & Tarule, 1997).

Self-efficacy. Albert Bandura (1986) developed the theory of self-efficacy through social cognitive theory. Bandura claims that individuals possess an internal system that allows them to control their thoughts, feelings and actions. This system includes the ability to symbolize, to learn from others, to plan alternative strategies, to regulate one's own behavior, and to engage in self-reflection. Bandura's theory states that self-efficacy

comes from four sources: mastery experiences, vicarious experiences, social persuasion and self-feedback.

Parajes (1996) interprets Bandura's four sources in the following way. Personal mastery experiences allow individuals to interpret and evaluate their own experiences and thought processes. Individuals gauge the effects of their actions, and their interpretations of these effects help create efficacy beliefs. Success raises self-efficacy; failure lowers it. Vicarious experiences come from the effects produced by the actions of others. Modeling is relevant in this situation. Verbal persuasions involve judgments of others and are not a particularly good source of self-efficacy, but still play an important part of an individual's ideals. Lastly, emotional arousal such as anxiety, stress, arousal, and fatigue provide information about how individuals react in adverse conditions.

Self-efficacy beliefs influence individuals through (1) choice of activities, (2) level of effort expended, (3) persistence in difficulties and (4) overall performance (Ramalingan & Weidenbeck, 1998). People choose tasks that they feel competent and confident about and avoid those in which they do not.

> Experience is essentially what individuals choose to attend to,...Self-beliefs that influence those choices are instrumental in defining one's experience and providing an avenue through which people exercise a measure of control over the events that affect their lives. Self-efficacy beliefs also influence how much *effort* people will expend on an activity, how long they will *persevere* when confronting obstacles, how *resilient* they will prove in the face of adverse situations, whether their thought patterns and emotional reactions are self-hindering or self-aiding, how much stress and depression they experience in coping with taxing

environmental demands, and the level of accomplishment they realize (Pajares, 1996, on-line).

Although the construct of self-efficacy has had a brief history, beginning in 1977 (Pajares, 1996), the principles of self-efficacy have been tested in many different settings, from clinical to social to educational. In academics, the two main foci have been self-efficacy and college majors or career choice and self-efficacy and academic motivation and achievement. Both of these issues tie into the technology gender gap research. It has been shown that career choice and course taking is often dependent on self-confidence. Girls, particularly in middle school and high school, are not choosing courses that would be prerequisites for college majors because they doubt their competence. This is evidenced in mathematics, science and now technology. In the second area of academic motivation and achievement, self-efficacy has had a strong positive correlation with studies about goal setting, problem solving, self-regulation, teaching and teacher education, anxiety and self-concept as well as motivation and achievement across all academic areas (Pajares, 1996).

Pajares (1996) further suggests that the generality of self-efficacy beliefs should transfer to most academic domains. If students can be helped to realize that increased effort and perseverance result in academic progress and understanding in a particular discipline, such as mathematics, then there should be similar results in other academic areas. Some of these connections may transform other areas of the individual's life. For example success in completing a project may translate into self-perceptions of competence in totally other areas unrelated to academics.

Low self-efficacy produces the counter effect and encourages stress and anxiety. Researchers define this anxiety in terms of computer technology in various ways (Muira & Muira, 1987; Houle, 1996; Brosnan, 1998; Ma, 1999). Anxiety is a limiter of achievement. It leads to avoidance of courses, and eventually affects choice of careers (Houle, 1996).

Anxiety affects different levels of individual performance. Anxiety in attitude manifests itself as dislike, anxiety in the cognitive domain manifests itself as worry and anxiety in the emotional domain manifests itself as fear (Ma, 1999). Brosnan's (1998) definition of anxiety and computers, which he calls "technophobia," is a resistance to talking about computers, or even thinking about them. It includes fear of computers and hostile and aggressive acts and thoughts toward computers. It can extend to stress about current and future interactions with computers or their societal impact. It includes negative cognitions and self-critical internal conversations during actual computer use or in contemplating future computer interaction. Computer anxiety can cause fear, apprehension, immediate hostility, and worries that embarrassment will be caused. Looking stupid in the face of peers and fears of damaging the computer are common concerns of the technophobic. Brosnan relates the concept of self-efficacy to anxiety and technophobia. "Some of the courses computer anxiety identified include: perceived loss of control, fear of negative evaluation or lack of familiarity with computer language" (Brosnan, 1998, p. 18). Technophobia is increased when there is time urgency involved with the computing project.

In the literature published by the AAUW (1992) and Sadker and Sadker (1994), adolescence is identified as a time when both females and males experience a decrease in

self-esteem. Sadker and Sadker (1994) posit "self esteem is not only a vital sign of mental health, it is also a connection to academic achievement and a direct link to career goals and hopes for the future" (p. 77). They also link self-esteem with academic achievement especially in math and science.

> Girls and boys who enjoy science and math consider themselves more important, like themselves more, and feel better about their schoolwork and family relationships. They are most likely to hold professional goals. When girls lose confidence in their ability to learn math and science, they avoid these subjects; whey they believe they can't succeed, they become less willing to attempt new science and math tasks. As their competence withers so does their esteem and a vicious cycle continues. The plunge in confidence comes first, then a drop in competence (Sadker & Sadker, 1994, p. 97).

Many researchers (Krendl, 1992; Friedman, 1994; Brosnan, 1996; Houle, 1996; Joiner, Messer, Light, &Littleton, 1998; Sherry, Billig, Tavilin & Gibson, 2000) have defined perceptions of computer ability in terms of perceived difficulty and perceived competence. "Self-efficacy has been shown to be an excellent predictor of behavior. Individuals with a low sense of self-efficacy will, more often than not, shy away from the best alternative, and instead choose alternatives that they believe they can handle" (Houle, 1996, p. 31). If self-esteem is low or challenged then self-efficacy will be lowered.

The perception of self-efficacy is thought to have a direct relation to success in computing. Brosnan and Sadker and Sadker both emphasize the decrease in self-efficacy that occurs in the adolescent years. Furger (1998) reinforces previously mentioned

strategies to encourage self-efficacy in girls. One of the strategies that has been very successful in the business world is mentoring or role modeling.

Mentoring. Mentoring, the use of adults or older peers as models of behavior and support, has given women to opportunity to develop a network of persons with similar career aspirations and interests. Mentoring was first recognized in the business world (Kantor, 1977; Richardson & Kavanaugh, 1997) as one of the techniques for breaking through the "glass ceiling," that invisible barrier that kept women from attaining top managerial positions. Mentoring has been adopted in education, medicine and now computer studies (Saunders, 1993; Milone & Sakoeter, 1996; Furger, 1998; Bickel & Clark, 2000) as an acknowledged method of creating advantages for women. The availability of women already in universities and careers speaking directly to students to explain the requirements and opportunities that certain courses of study had to offer. Additionally, they could speak to the difficulties that might be encountered in applying for and accepting certain positions (Hochschild, 1989). In the AAUW (1995) publication *Growing Smart: What is working for Girls in Schools* the role of caring adults is emphasized. The ability to communicate with teachers and others that would spend time with them, listen to their ideas and help them learn to stretch and excel. This was further supported by the preference of females for female mentors to give them the kind of kindness and approachability they would expect. Women felt that they did not need to qualify when dealing with a woman. Furger further emphasizes the role of mentors and role models as being endorsed by Dr. Anita Borg whose slogan for the SYSTERS, her web based site for computing women is "50/50 by 2020." Dr. Borg realizes the

importance of the network that will continue to encourage women to try non-traditional careers.

The impact of mentoring gives students and most particularly girls an opportunity to experience anything from job shadowing, university weekends, elective fairs and career days with women from the field (Silverman & Pritchard, 1996; Fletcher-Finn & Suddendorf, 1996; Dorman, 1998). The impact of mentoring is also felt on students by their teachers' reactions to the use of technology. One of the earliest references to teachers' attitudes toward technology was a review of literature conducted by Dupange and Krendl (1992). At that time most classroom teachers were highly supportive of the need for technology but did not view it as their responsibility to be able to teach the computer literacy courses. The impact of their own ignorance and lack of ability or experience went against the philosophy of education, which was to pass on the knowledge of what you know to those you teach. Dupange and Krendl emphasized the importance of teacher education in the area of technology to alleviate this anomaly.

Teachers' Attitudes. It was also thought by other researchers that computer attitudes of teachers and the computer literacy of teachers would impact on the attitudes of their students (Hignite & Echternacht, 1992). They conducted a series of attitudinal surveys to determine the anxiety and acceptance levels of teachers toward computers in the classroom. At the time of their studies they were looking at the idea that computer education was taught as a separate class and not incorporated into the curriculum of the classroom. Robin and Harris (1998) found that teachers who integrated computers into classroom instruction were more likely to be teachers that preferred learner-centered

teaching. They preferred to learn from concrete experiences and were social constructionists in their world-views. Hadley and Sheingold (1993) support this with the ideas that these teachers preferred student involvement in active learning, cooperative learning, learner control, individualized learning and self-motivated learning. They also observed that teachers who were leaders in computer education had a developmental period of five to six years in which they incorporated more computing into their lessons. The switch from teacher centered learning to student centered learning did not happen overnight, but the transition was gradual. Sherry, Billig, Tavilin and Gibson (2000) developed a four- stage approach to adoption of computer-based classrooms. The first is the teacher as the learner, then the teacher as the adopter, next the teacher and student as co-learners and co-explorers, and finally the affirmation of computing as part of their personal vision of learning or a rejection of computing as part of their way of teaching. Evans-Andris believes "teachers shape the meaning of computer technology in their school through their styles of computing including avoidance, integration, and technical specialization" (1995, p. 15). She describes her findings in the following statement

> "...There are important implications for the ongoing process of computer implementation in elementary schools...educators need to establish the relevancy of computer training and encourage computing as part of the curriculum rather than itinerant role" (1995, p.30).

Perpetuation Theory

Braddock and McPartland (1980) researched the effects of school desegregation as a social intervention strategy for breaking down the self-perpetuating cycle of racial segregation in America. One concern previous researchers noted regarding racial segregation was the nurturing of social inertia and avoidance of learning which impacted the advancement of Black Americans (Pettigrew, 1965). The proposed contact-hypothesis states "exposure to interracial contact under certain specified conditions produces generally positive changes in inter-group attitudes and interaction patterns" (Braddock & McPartland, 1980, p. 179). The conditions included equal status, shared common goals, cooperative interaction, and environmental support.

In the study, five steps were investigated as links to the viability of Black Americans incorporating into society's mainstream, thereby breaking the bonds of segregation that prevented academic achievement and economic advancement. The five categories were socioeconomic level, sex, high school racial composition, high school grades, and college inducements such as financial aid and college reputation.

In the study the most significant indicator was the high school racial composition and its effects on the future attendance at a predominantly white college or university. The tendency for Black Americans who experienced success in a predominantly white high school was to continue to seek enrollment in similar college or university with positive expectations. They were less likely to anticipate overt hostility and were confident in their coping skills with interracial situations. Additionally in response to the

contact-hypothesis and structural assimilation, Braddock and McPartland's (1980) research found that

> Black students with high school desegregation experiences are more inclined than their segregated counterparts to continue their educational pursuits, in predominantly white settings, not the background factors, college qualifications, and college inducements, which suggests that desegregation practice does help to ameliorate the social inertia and avoidance-learning that racial segregation engenders. Blacks who attend desegregated schools may develop networks, select college major fields, and find jobs in non-traditional fields (p.185).

Later research conducted by Braddock and McPartland (1989) compiled a longitudinal study that supports their initial study. In a study conducted in the North and West, both Blacks and Whites attending desegregated schools were more likely to live in desegregated neighborhoods, have children who attend desegregated schools, and have close friends of other races. Additionally, Blacks from desegregated situations have a stronger sense of occupational opportunities available to them, more confidence to succeed in interracial situations, and more access to non-traditional jobs and informal networks to help them find those jobs. Like the earlier research, conducted in the South the primary influence was the early desegregation of Blacks.

Other research on The Perpetuation Theory looks at occupational aspirations of high school students, choice of integrated college and subsequent educational attainment, and occupational attainment and social networks of Blacks. Hoelter (1982) and Wells and Crain (1994) both agree that desegregation impacts on all three of these categories.

Occupational aspirations of high school students appear to be more rational in students who have had a desegregated experience. That is, they choose careers that are more in line with their academic abilities and regional opportunities for work. The choice of integrated college, as in the Braddock and McPartland study, implies that the educational opportunities offered at desegregated institutions would put Blacks on parity with similar White students and provide more access to occupational networks that are not traditionally Black. Lastly occupational attainment and social networks, studied by Wells and Crain (1994), revealed that desegregation provided Blacks with the social contacts, the credentials from educational institutions with higher social status and informal referrals to higher level jobs. In summary, three conclusions can be drawn from all of these studies. Desegregated Black students are more likely to have social and professional networks, which are also desegregated, in later life. Desegregated Blacks are more likely to find desegregated employment and desegregated Blacks are more likely to be working in professional employment in the private sector than segregated Blacks.

In relationship to this study, the minority group that is being addressed is not racial but gender-based. If the opportunity exists for women to integrate into the educational stream, mathematics, science and technology, at an early age, then the perpetuation theory that Braddock and McPartland propose could be extended to women in later educational life.

Although Braddock and McPartland's initial research originally centered on desegregation, later research extended to other minority groups including groups isolated by gender (Braddock &McPartland, 1987). This latest study concentrates on the way informal social networks provide or deny access to minority job seekers. The racial-

exclusion processes occurred at three distinct stages of employment and were linked to networks that were available to the minority groups under study. The three stages are the job candidate stage, the job entry stage and the job promotion stage. At all three stages, the network that surrounds a person was responsible for the ability to enter the employment field, to be prepared to remain there and be eligible for promotion. In all cases, access to good jobs was based on the network that a person was able to establish and the attitudes that they projected toward work rather than the education that they held, especially at entry level jobs. Employers report "they do expect basic literacy and computation skills and the ability to learn new things quickly on the job (Braddock & McPartland, 1987, p.13). Additionally coming to work regularly, exhibiting appropriate attitudes about work and supervisors, and the ability to get along well with work-team members are critical for employees in entry level work.

At the job promotion level, the candidate pool was mostly internal, so the network of job openings and job candidates available to fill the positions were again dependent on who was known within the company or educational system rather than who applied.

> The exclusion of women and minorities from positions that are likely to lead to promotions is a major explanation for sex and race gaps in occupational attainment; these arguments are almost always based on inferences from studies of general attainment models rather than from direct investigations of personnel practices (Braddock & McPartland, 1987, p. 22).
>
> Analysis of social networks is suggested as a tool for linking micro and macro levels of sociological theory. The procedure is illustrated by elaboration of macro implications of one aspect of small-scale interaction: the strength of dyadic

> ties...the degree of overlap of two individuals' friendship networks varies directly with the strength of their tie to one another. The impact of this principle of diffusion on the influence and information, mobility opportunity, and community organization is explored (Granovetter, 1973, p.1360).

Social networks are the interpersonal networks or connections that link persons to one another. Sociological studies of macro phenomena such as political structure or community organizations have concentrated on network analysis, but in Granovetter's study (1973) the focus is changed to the micro level of interpersonal networks. The application of phenomena such as diffusion, social mobility, political organization, and social cohesion can be applied at the personal level by looking at the "ties" that link persons to one another.

Granovetter defines the ties as either weak, strong or absent. The factors that determine the "strength of a tie is (probably linear) combination of the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services which characterize the tie" (1973, p.1361).

In the diffusion and social mobility aspect of the study, Granovetter posits that weak ties actually improve the dissemination of information and encourage social mobility because the relationships among the participants are more extensive. This extended network provides more opportunity for information to travel. Additionally the extended network opens opportunities for social mobility. Granovetter describes persons that hold weak ties more as acquaintances, and the persons that hold strong ties as relatives or close friends.

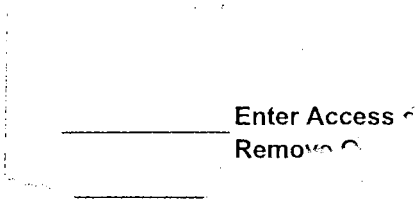
Wells and Crain (1994) compiled 21 studies on the long-term effects of school desegregation on occupational aspirations of high school students, choice of college and subsequent educational attainment and occupational attainment and adult social networks. The "strong ties" that existed were the ties in the segregated community, whereas the "weak ties" were the ties in the desegregated community. Three major conclusions were drawn

> Desegregated Black students are more likely to have desegregated social and professional networks in later life, desegregated Blacks are more likely to find themselves in desegregated employment, and desegregated Blacks are more likely to be working in white-collar and professional jobs in the private sector than Blacks from segregated schools (p. 552).

How does this apply to women in technological fields? Many researchers (Orenstein, 1994) describe women as nurturing, caring and in touch with each other or members of their social networks, in other words exhibiting "strong ties." Ironically this social role is detrimental for those women who want to move into career fields that are traditionally male domains. Lack of networks limit women in entering the job market, entering the educational programs that are traditionally male dominated and competing for job promotions.

Summary

The purpose of this study was to explore female students' perceptions of factors influencing their enrollment in computer course work and choice of technology-related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careers. The review of literature develops a series of perceptions that have been thought to deter women from choosing this career. The lens of perpetuation theory, strength of ties and network theory support a different reason for females' lack of participation in this area.

CHAPTER III

Methods

Using the lenses of perpetuation theory (Braddock, 1980; Mc Partland & Braddock, 1987), "strength of ties" (Granovetter, 1986), and social network theory (Wells & Crain, 1994), this study sought to identify female students' perceptions of the factors influencing their enrollment in computer course work. It further investigated these same students' choices of technology-related careers. The three theoretical lenses coordinate to explain how cultural elements deny minority groups the ability to extend their education and career choice. These theories also provide explanation of how difficult it is to challenge culturally dominant expectations and to look at ways that attempt to break the cycle of male domination in this career field.

What networks would be necessary to shift the trend for females to desire to enter the technology fields? How does strength of ties with colleagues and/or family affect the enrollment of women in technology-related careers? How does perpetuation theory deter this shift in career choice from happening or strengthen the desire for change among minority groups? Data obtained through semi-structured interviews and documentation of enrollments provided information used to analyze these factors.

Study Design

Based on the assumptions developed by Merriam (1988), a qualitative study was the most suitable paradigm of inquiry for the following reasons. A qualitative design is concerned primarily with process, rather than out comes or products. In qualitative research, the researcher is interested in meaning, which is how people make sense of their lives and experiences. Additionally the researcher is the primary instrument for data collection and analysis. Qualitative research involves fieldwork where the researcher physically goes to the people to record their behavior and responses in their own setting. Qualitative research is descriptive in that the researcher gains understanding through words and associations with the persons who are studied. Lastly, Merriam states that the process is inductive in that the researcher builds on abstractions and concepts.

This problem is well suited to the qualitative design because it focused on the participants' perceptions of their realities. The factors that they felt influenced their choices were based on their perceptions within their personal networks and limited by their perceptions of social roles. Morse (1991) supports this suitability when she states that qualitative research is characteristically employed when there is a need to explore phenomena and its relationship to pre-existing theory.

The research strategy for this study was the case study as it dealt with a specific group of females at a specific point in time. The students that were interviewed were all members of a course of study that began in August 2001 and will continue until 2003. The women had only known each other since the beginning of the course work. The case study style was descriptive as the women reported their feelings about the factors that led

them to pursue their course of study. They described their impressions about women's enrollment in technology courses at the college in general. Additionally they described their impressions of the trend of women in technology careers in the United Kingdom.

The technology instructors that were interviewed had been working with similar student groups for the past 10 to 12 years. They were concerned with the gap in enrollment in technology education courses. They had seen the decline in enrollment of female students that was occurring not only in England but, reportedly, throughout other major industrial countries.

Researcher

As a mathematics teacher at a middle school, I had the opportunity to set up the first computer lab designated for mathematics at our school. The lab was located in my classroom, a large rectangular area approximately 20 feet by 60 feet. The initial plan was that all the math teachers at the school would sign up to use the lab when it was appropriate to their curriculum and that both teachers would occupy the room at the same time. With the novelty of computing at the time, this procedure became unworkable. The incoming students distracted the regular students and they in turn socialized with the current students rather than attending to the tasks of computing. A decision was then made to subdivide the classroom and make a lab and classroom that were accessible to multiple classes. What in fact happened was that two of the nine teachers used the lab on a regular basis and the others used the lab rarely, relying on the fact that since the lab was

in my room. I would be available to consult with them and keep my classes going at the same time.

What I learned from this experience was that many teachers were hesitant to use technology and would purposely tell their students that they did not know how to use the equipment. At that point, I became interested in the ways that teachers used, or did not use, computers in the classroom. Most teachers in our school in the early 1990's felt that they had to understand, totally, the software and applications before they could present technology to their classes. They also felt that they had to know more than the student does and that the class had to lock step their way through an application. Ironically students had more time to investigate software and computers than their teachers did and were usually experientially further ahead than their instructors were. I was among those educators that felt I had to know more than the students until I participated in a study with the University of Northern Iowa that emphasized student investigation and the use of technology. For the first time, I heard that it was okay for students to know more than the teacher. To let them investigate and share their investigations in technology with the class and to let the teacher become a participant observer of the advantages of technology along with the class. It was not easy for a middle-aged teacher to commit to this, but as I have studied the literature on the technology gap and the emphasis on mentoring as a way to build confidence and encourage future study in technology it seems imperative that teachers continue to view themselves as learners as well as teachers.

Study Procedures

Data in the form of observations and interviews was collected during the first months of the study. Data was first collected from the directors of the courses at the college under study during September and October of 2001. This provided foundational and background information for the study. Data was then collected from students between October 2001 and April 2002. Both the names of the directors and the participants have been changed to insure their anonymity.

The directors were head instructors in the Information Technology Program. The first, Mr. Miller, was the point of contact at the college. When I first met with him, he expressed interest in my research. We discussed a recommendation for female students to interview and he immediately was concerned because of the small numbers. The college supports a secretarial program in which the use of computer applications is a key component, but the upper level programs did not have many female students. He then introduced me to the two women in his program and we made the preliminary arrangements for interviews. Following that discussion, he introduced me to two of his colleagues. The first, Mr. Green, worked primarily with the students in the secretarial courses. After reviewing the purpose of my study and the interview questions, he agreed that these women were probably not suitable study candidates; they had not chosen computer technology courses but rather courses that required the use of computers. The second, Mr. Smetena, was in charge of the Business Information Systems course. He also discussed the female students in his course and suggested that I return the following week on Thursday when they would be available for initial meetings.

Sample Selection

The site selected was representative of technology programs offered in the area of Suffolk/Norfolk, England. Students who participated in the study enrolled voluntarily, paid their own tuition or had their expenses paid by their employers. The course of study involved technology courses that were more advanced than application software courses. The students in the technology courses were involved in coursework that would give them experience in designing and modifying programs for the unique needs of their jobs as well as learning how businesses integrate technology into the function of their work. The applications courses, on the other hand, were training the participants in the use of pre-established formats such as Microsoft Word or Excel.

The "experts" were female students enrolled in Systems Design courses and Business Information Systems courses at the college. The criteria for selection was that the experts were female, and enrolled in courses that were technology career courses not just word processing or application courses that related to other fields. Most of the respondents were returning students, that is students that were gainfully employed and were seeking advancement in their careers, or students that were changing careers. This meant that the course of study that they were pursuing was consolidated into a once a week, full day course, from 1:00pm to 9:00 p.m. A smaller number of students were in a two-year program that met four days a week from 9:00 a.m. to 5:00 p.m. To identify the students, I contacted the college and spoke to the technology careers advisor and members of his department. Upon recommendation by the advisor, I attended the college session that the student was enrolled in and presented her with the request to interview

and the interview protocol. Demographic information was exchanged and arrangements for the interview were established.

With the wide- ranging geographic locations of the students, it became evident that the most agreeable interview site would be at the college during the provided break times. Initially several women volunteered, but through the course of the study other members of the course agreed to participate based on recommendations from their colleagues. Initially arranging an area where the students felt comfortable and the atmosphere was conducive to voice recording was challenging. Repeated visits to the college revealed nooks and crannies that supported the interview situation.

Study Site

This study was conducted at a college in Suffolk England, which is about 60 miles northeast of London and 20 miles from Cambridge. The setting is rural with the two most industrial areas, Bury St. Edmunds and Ipswich relying on agriculture or shipping as their main industry. The local residents consider Cambridge the Silicon Valley of the United Kingdom. This shift from a community long considered an educational center to a technological arena has enhanced the development of technological courses of study in the adjacent communities to Cambridge. The college supports many local communities with sub-sites that offer extension course such as cosmetology, woodworking and home care as well as technological course such as computer applications. The main campus concentrates more on the advanced course of technology. Although located near Cambridge, it is not affiliated with the Cambridge University system in any way.

Study Participants

The participants in the interviews were students who were either fully employed in technology industry careers or students that were anticipating careers in the technology industry. The age range of the students was from 18 to 54. The interviewed students are employees of small firms or large department of defense organizations. Some students were looking for employment with small to medium sized corporations in the local area. Several students were interested in programming but did not see themselves in a large corporate setting like Microsoft where they were one among millions that produced programs that were universally marketed.

All participants were enrolled in what the college described as a full time program. This meant that the student was committed to a series of courses over a year or more. They do not attend classes on a daily basis, but in the case of the females that I interviewed they attend classes one or two days a week. These days were on release from their current job for a structured commitment of one to several years as the course dictates. They did not reside on campus and therefore completed most of their course requirements from their own homes or offices. Owing to the time away from the college all the students relied on their classmates for suggestions or help on assignments via the Internet or telephone.

Data Collection

Two data collection strategies were used in this study: semi-structured interviews and on-site observations. The interactions of the interviewees with other members of their classes, and particularly, the female members of the classes provided insight into the analysis. Discussions with the directors of the programs provided information about the trends in enrollment, both past and present, and the perceptions that these directors had regarding the low number of female students.

Interviews. The interviews were conducted individually on site at the college, with the exception of one student who actually worked nearer to my home location and preferred to be interviewed at her work site. Participants revealed unique situations about themselves in interviews that helped with the analysis. Some of the influential factors were age, time on the job, self-confidence, or future goals.

Face-to-face interviews were conducted between October 2001 and April 2002. The interviews were semi-structured in format and the 12 focus questions were used to establish parameters. These questions were presented to the interviewees in advance. The interviews were conducted in the participants' place of work or at the college. All interviews were audio-taped and later transcribed. The interviews with the directors and instructors were grand tour type of questions and the respondents' information was recorded in notes by the interviewer.

Observations. Students were observed in several classroom settings. Female students accounted for approximately one half the enrollment in the Business Information Technology class while in the computer programming class only two out of 27 students were female. I functioned as a non- participant observer in the first programming class and found that the female students were quite comfortable in their position in the classroom. The interviews supported their confidence.

Further observations in the Business Information Systems classes prior to interviews supported that the female interviewees were comfortable with their fellow classmates in the classroom setting but preferred to socialize with their female cohorts in an on task setting. Arriving at a session, I found all females on one side of the room and all males on the other. As the session progressed and students moved to equipment there was more interaction between genders. The male students also appeared to be younger than the female students, which could have been influential.

Discussions with Directors. Although supervisor and directors were willing to generalize, they were not willing to release specific enrollment figures for the college in technology course for the last 10 years. Relying on the directors' information had to substitute for the access to documents. The consensus of the technology department directors was that the enrollment of women in the technology courses at their institution was low despite the lack of mathematical requirements and screening. No incentive or inducement program to increase enrollment was effect.

Data Analysis

The analysis of the qualitative data is a progressive process and follows no prescribed procedure (Creswell, 1994). Therefore analyzing data as interviews progressed and looking for trends was critical to this study. Merriam supports this method (1998) reminding us that data collection and analysis need to be simultaneous. Linking the conceptual frames of perpetuation theory and networking provided lenses for the analysis and coding of the data.

Following the interviews, transcriptions were made and analyzed for main themes. Transcriptions were coded for factors that influenced the women to join the technology programs and persons who influenced their enrollment. Addition coding identified the ties and strength of ties that the women felt in their groups, work places and classes. As analysis continued, clusters of themes were developed. These themes were used as comparison to the theories of networking and perpetuation, as well as strength of ties. This procedure follows the explanatory case study research mode described by Yin (1989). He uses this method for two purposes. Firstly to compare results with patterns from theory or the literature and next as a form of "explanation building" in which the researcher looks for causal links which attempt to build an explanation about the case.

Verification

Since research is always concerned with producing valid and reliable knowledge in an ethical manner, questions that must be asked of any research examine the following

concerns (Merriam, 1998). Are the conclusions of the study based on the data? Is the analysis logical? Creswell (1994) uses three main foci to establish the confidence of a study. By verifying the following: the accuracy of the information and its match to reality (internal validity/ trustworthiness); the limits of generalizability (external validity); and the parameters of replicability the researcher can validate the study. Ethical considerations that protect the rights of the participants must be established.

Internal Validity

Internal validity is the assumption that what is observed and measured matches reality. The problem exists in a qualitative paradigm where analysis rests on a study that is changing. According to Yin (1994) the reader must be able to follow a logical set of statements. Internal validity is a logical, consistent method of making inferences. Much of the data used in the case study was derived from interviews. As the researcher makes inferences about the interviews the focus of the interview must be to understand and represent the participant's perception of reality (Merriam, 1998). To ask myself how the representation promoted inferences and set off in a clear direction I employed some of the strategies outlined by Merriam (1998) and Creswell (1994). The main strategies were triangulation of the data, member checks, peer examination and an examination of researcher bias.

Triangulation. Triangulation allows the researcher to search for converging themes from various sources of information (Creswell, 1994). This is supported by Merriam (1998) as a method of quality assurance. Data for this study data was collected through multiple sources to include, interviews, observations and discussions with the directors of the programs.

Member Checks. Following the transcriptions of the interviews the students or directors were contacted for verification of interpretation of the data. This will insure the value of my interpretation and the reality of the students' information. The necessity of this was obvious as the vocabulary of the interviews unfolded. Many acronyms of the British educational system were used in comparisons and additional terminology that was unfamiliar to the researcher upon analysis. Member checks were conducted on an informal as needs basis. In most cases students were contacted by phone or e-mail for clarification.

Peer Examination. Peer examination allows for the researcher to check findings and conclusions with colleagues. From the beginning of the study, two colleagues, fellow doctoral students at Oklahoma State University, have provided feedback on the study through weekly meetings and help sessions. These peers were familiar with the goals of my research and the process of development of the study design and review of the literature and data. In the peer review, these colleagues participated in the development of main themes and the refinement of the focus of the study. Using the transcriptions, peer reviewers helped to solidify the codes and themes.

External Validity

External validity refers to the extent to which results of the study can be applied to another setting. Qualitative design does not follow the traditional patterns that quantitative research does, but relies on the readers' thorough understanding of the study. The reader's thorough understanding supports the ability to recognize similarities in other contexts (Merriam, 1998). The use of thick rich description and the use of a detailed trail of data collection and analysis increase the external validity of a study (Creswell, 1994).

The results of this study are presented in a narrative using thick, rich description. The in-depth description of my results should guide the reader in deciding whether this study is applicable to other situations. The record of data collection and analysis was maintained to provide an accurate and detailed account of the methods that were used and the decisions made throughout the study. My university advisor has reviewed all phases of the study.

Replicability. Because of the nature of the qualitative design, where reality is constantly changing, the traditional procedure for replication needs to be re-interpreted. Consistency in observation, labeling and interpretation are ways that increase the replicability of the study (Boyatzis, 1998). These could be achieved through identifying the method of sample selection, data collection and data analysis. Documentation of observations and notes increase the replicability of the study as well as the validity of the study (Merriam, 1998).

Ethical Considerations

All researchers have the obligation to protect the rights of the participants. Merriam (1998) states that these ethical considerations must be applied at all stages of the qualitative research. From data collection to dissemination of results of the study safeguards must be employed to ensure the rights and needs of the participants. The following strategies were used in this study.

1. Participants in interviews were given a written overview of the research. This included how the research was to be used. Questions that were to be used in the research were presented at this time.
2. Written permission was obtained from the interviewees.
3. At observations a verbal announcement of the purpose of the observation was made by the instructors of the course or by myself.
4. The specifications and procedures of this study were submitted to, and approved by, the Institutional Review Board of Oklahoma State University.
5. Verbatim transcripts of interviews and all reports are available to the participants for review.
6. All audiotapes, verbatim transcripts, and field notes are secured in a locked cabinet for a minimum of two years, after which they will be destroyed.
7. Only my advisor will have access to the names of the participants.

Summary

This qualitative case study sought to identify female students' perceptions of the factors influencing their enrollments in computer course work and choice of technology-related careers. In an attempt to investigate whether the female students in technology courses identified these factors, I interviewed female students in a natural environment, a college in Suffolk England. As the researcher, I identified personal beliefs and assumptions, which may have shaped my data collection and interpretation of the data. A sample of the students revealed supporting data to the gap in females in the technology and the sample was actually all female students who were enrolled in the upper level technology courses. Data were collected through semi-structured interviews with female students at the college, informal observations of class composition and interactions, and discussions with instructors. The three theories provided the lens of coding and evaluating the data.

The study's internal validity was reinforced through the use of triangulation of the data, member checks, peer examination, and examination of the researcher's bias. External validity was supported through thick rich description and detailed notes of the observations and meetings and analysis. Reliability was maintained through the same thick rich description and data trail. Ethical standards were considered throughout the study in accordance with the guidelines of the Institutional Review Board of Oklahoma State University.

CHAPTER IV

Data Presentation

Seven female students and two directors participated in the discussions and interviews. The directors have been instructors at the college in Suffolk for the past 10 years in the Information Technology Program. The students are enrolled in either a Systems Design course or a Business Information Systems Program. The Systems Design course meets daily and runs for two years. The first term began in August, 2001. Students will continue for subsequent terms which should finish by July 2003. Students, involved in this course attended classes from 9 am to 5 pm throughout the week. However, classes did not meet at all on Tuesdays. The Business Information Systems program, on the other, hand is offered once a week, but again for a two-year period. The students who participated in Business Information Systems program are full-time employees and are often subsidized by their employers.

Selection of Respondents

The directors recommended the students selected for the interviews. It was later revealed that the students interviewed were in fact the only female students in the

Systems Design course and in the Business Information Systems Program. The Systems Design course numbered about 25 members. They were young, probably in their twenties and, of the group, only two were females. These women were full-time students and held part-time non-technology jobs when they were not in courses. The Business Information Systems Program was a slightly larger group, about 30 members and the age range was more varied. Again the number of women (5) was considerably smaller than the number of men and the men were much younger than the women. Most of the women in the group were employed in businesses that used Information Technology already.

Respondents and Setting the Stage

Following these first conversations, Mr. Miller and I adjourned to a faculty lounge where we continued to talk for a while about the history of the program over the past 10 years. He confirmed the trend that was evident in the literature. Initially the technology courses were equally attended by both genders. Then gradually the shift began to occur. More female students were enrolling in the college in general and many were enrolling in word processing and other similar applications program classes. The number of females that enrolled in the Business Information Systems Program and Systems Design course has declined. This decline mirrored the trend noted by Furger (1998) and Wright (1997).

We discussed several issues. I had been familiar with the college for the past 20 years and knew that its reputation had been more of a technical school, specializing in woodworking, beauty care, and catering. Additionally, we reviewed the issues of increasing attendance in colleges in the United Kingdom during the 1990's. Finally, we

discussed the issue of female enrollment in the Information Technology programs and compared enrollment of females in other colleges programs. I asked if I could have access to attendance profiles to generalize from the documents. He assured me that I would not be able to do that without permission from the past students for reasons of privacy for those students.

I was curious as to whether the history of the college had any impact on the current enrollment. Mr. Miller did not believe that the college's previous focus had an impact on the current attendance in the technology courses. He indicated that, if nothing else, the college had done its best to expand with the needs of the increasing interest in post-secondary education following the economic down slide in the late 1980's. When he listed the variety of programs, I was really surprised. The college had indeed expanded its listings. Not only was the college still maintaining the technical courses, but was also offering programs that were competing with traditional university courses.

The issue of expansion also led into the second topic, how college enrollment has changed in the United Kingdom over the past 10-20 years. When I first arrived in England in 1976 very few people, in the rural area of England where I lived, attended school beyond the age of 16. Students would leave formal schooling and find apprenticeships in shops or other trades. Most women did not work. Over the years the trend began to change. More people attended classes to learn trades and get certificates or qualifications. People became more mobile and these certificates allowed them to apply for work in areas other than where they could have apprenticed.

Additionally, societal changes occurred. More women were working. We discussed how this changed the focus of the college. He mentioned that it was not only

school leavers that were coming to the college. Women who had been trained in high school to work in offices but had left work to marry and have families were returning to work. When they returned, they found a new kind of office from the one they left. Typewriters had gone electric. Computers were beginning to be used in larger businesses. There was a need for re-education. Without a certificate it was hard to get a job.

We discussed enrollment in the technology courses. Mr. Miller said at first there were a lot of women enrolled in computer courses. Key punching and data entry were popular. Many of the applications had to be inputted into computers. This was long before Bill Gates. But in recent years the interest in technology courses had slowed. He was baffled because he said there were really no entry requirements, no math qualifications and no pre-requisites. Yet men chose the course and women did not. I was curious about the factors that made the women that I interviewed choose these courses.

Respondents

This section presents demographic information about the respondents. It also provides insight into the respondents' beliefs about computing and how they see themselves as members of the programs in which they are enrolled.

Ginny. Ginny was the youngest of the female students that I interviewed. I had met Ginny several weeks before and explained the purpose of my study and the types of questions that would be involved in the interview. She had a holiday planned so this delayed our first meeting. When I arrived for the interview, Ginny was involved in a

review lesson. We met in the computer lab at the end of her classes on a Wednesday afternoon in January. A tutor was reviewing information from earlier in the day and Ginny was actively participating or, as she called it, "mucking in." The remaining students were all males as the other female student was off sick that day. Heads down at the computers, they were sharing work and commenting on the projects that each had on the screen. Several of her classmates called to her asking advice and she did the same. The English winter weather meant that it was already very dark and the students were wrapped-up for the trip home. Despite the lateness of the afternoon, we settled down to discuss the questions. Finding a quiet location proved difficult and the other students were curious about the purpose of the interview. I explained that I was doing a study on women in technology fields and they left us to it.

As we began the interview she commented on how nervous she was. I told her that I was too as this was my first interview. That seemed to break the ice. I had provided her with the interview questions after my first visit and she was prepared with answers to them. It made it easier to talk to her as she was prepared and could see the direction that the interview was going. I had to stop her several times because, like so many people, she was used to referring to things with acronyms and initials.

Ginny "felt quite confident about them [computers]." She was "keen to get into programming…there seems to be a lot of money in programming and I enjoy the challenge." Her confidence has increased throughout the duration of the course, but her overall career goal is still uncertain.

> It is really hard at times but I feel so much better after I have really done it. As we are coming to a new topic in programming I dig in and start looking at someone

else's screen and see what they have done and say, "oh well, that looks quite simple" and feel quite confident from there on.

She feels that her primary influence comes from her dad and working with computers in her previous school.

Yancy. This interview was also done at the college. Most of the students lived away from the college and used public transportation to get to school, so it was easier for me to go to the college and meet with the students. This time we found a quiet break room which lent itself quite nicely to the interview. Yancy is on a student visa from Israel. She had spent time in the Israeli army where she had her first introduction to computing. She shared that her original career choice was going to be social work, but changed her mind after working with computers. "I was hungry for information. I just wanted to know how it started, and why so much is done with computers. I just wanted to know."

She is enrolled in the Business Information Systems Program. She is paying for the course even though she is working for a company. She was quite focused on her ambitions. "I want to work in an Internet company really. That's really my dream. I want to work as part of a team to design Websites and do PC support but definitely in a big company." When asked if she would like a managerial position she responded, "Yeah, definitely but not in an office of a big company, more as a team leader."

Brenda. The interview with Brenda was conducted in her work place. She is a Ministry of Defense employee and works on the American base nearby. She is one of the

few British employees in her office. Her title is Information Technology specialist. Middle-aged, she claims that her entire working career she has been involved with using the computer. She started in high school as did many of the other women in the Business Information Systems course. She selected a computer course in high school as part of her "options."

Describing her career, she states, "I always envisage a job with computers, whether I am instructing computing or whether I am actually physically working at a computer. I can't imagine having a job without a computer." When Brenda described her early decision to get into computing, she noted that "there was no one that particularly influenced me. It was me, myself, realizing what computers could do and deciding if I wanted to be part of it." She related the same opinion later when asked why she was enrolled in the current course. She noted that "because I am the IT manager in this office, I felt the need to know more than I did. Her "20-odd year career with the Ministry of Defense" has allowed her to see changes not only in the use of computers but also changes in women's points of view regarding careers.

Becky. Becky, like many of the other women in the Business Information program, was a returning student. Her family was grown and she came back to the office realizing that she needed more training and education. This interview was conducted at the college. Of the women that I interviewed, she was the most reluctant. At first she did not want to go through with the interview but changed her mind at the last minute. She expressed an uneasiness at taking the course and, since the interview, has dropped out of the program.

> I guess that I have been out of the office too long. So much has changed. I don't know if I want the hassle of all of this. But the other girls keep at me. They say that I should stick it out. They are a great help with assignments. I don't like to use the computer that much and so I tend to not do an assignment until the last minute. They help but … I am not sure.

Shirley. Shirley was interviewed on the same day as Becky. We used the classroom where they had previously had a lesson. Shirley is employed by a small repro-graphics company that produces company letterheads and advertising. She is responsible for the company accounts, transferring design art and layout to computers, as well as the usual office correspondence. Her first contact with computers was about 20 years ago. She began at school, like many of the others, but feels that most of her experience has come from her perseverance and self-motivation.

> I started out my first job about 13 years ago and we started out with an antiquated typewriter and I mean it really was antiquated. So I said we need a computer---Okay!---and then we need the software---Okay and here's the book and we need to do the training and be set up by next week. In addition, it was a case of hands-on learning, and that's what the case has been most of my career, hands-on learning.

She attributes her initial introduction to computing to her father but goes on to say "I think that the only person that influenced me is ME! Kind of kick myself up the back side."

She finds the network of women that are taking the course essential. Her strongest link is Brenda and they work on projects together over the Internet.

> It tends to be that we females tend to stick together rather than the guys. If we don't understand something that has gone on in the course then we e-mail and discuss it. What I have been trying to do is develop a working example and e-mail it on to the other [female] members of the course.

Shirley's explanation of the minority of women in the computing industry is that women "look at computing as a part of engineering and engineering is a career that is primarily a male career field. It's the women's perspective I guess. It should be a tool rather than a man's job." Her perspective on women's choice is that

> I think that women just tend to look at the more traditional jobs like receptionist or secretary. So I think that it is women that should be educating themselves rather than have the school push it. They [male and female students] are all given the equal chance with each other now.

Janie. The other female member of the Systems Design course was interviewed the end of January 2002. She had been out sick for about a month. Janie was a particularly confident student. She was young like Ginny and although she had had a prolonged absence from the classes, she was confident that she would get right back into things. Some of the class members had kept in contact with her regarding assignments via the Internet so she was sure that she would be back on track soon.

One striking feature about Janie was her confidence in her ability as a programmer. She had been an active "gamer" prior to starting the course. She plays

computer games and has a network of friends that challenge her regularly to games. She was not easily daunted by software. "I love programming and for a woman to be a programmer puts them at the top of their league." Her approach to the programming and the course in itself set her apart from any of the other interviewees. She had been using computers in a competitive way since she was at school. She liked the games' aspect of the computer and met it as a challenge. She prided herself on the ability "to get the topic first and have others come to my screen to see what I had done."

When asked if she had a stronger working relationship with Ginny, the other female class member, compared to others students in the class, Janie definitely replied no. She would consider her working relationship with any member of the class equal to or the same as the others. This was obvious in the interactions that she described and that I briefly observed as the session was ending.

Wendy. Wendy was the last female member of the Business Information System program that I interviewed. We met at the college in March, 2002. Wendy works at a small hospital and is responsible for maintaining the hospital records, training, and a large variety of tasks. She is viewed as the computer expert in her workplace, but claims that when she is at college, she realizes how little she does know. She, like many of the other women, describes her work with computers as "experimenting." She had taken a DOS (Direct Operating Systems) course around 10 years ago to learn the basic commands to construct programs. She had since experimented with different applications programs that were necessary for her job. Her first reaction to the question about how she sees herself

with computers tells quite a bit about her attitude. "I think they are fun … they are a challenge and I like that."

She explained her first work with computers started back in the key punch stages. She was working at a temporary job for a company that was designing a program. Her recent course work was the result of trying out for a promotion and not having the written qualifications for the job.

She feels that women still opt for the more traditional jobs and part time work, but feels that they should be considering more career or professional work.

Summary

Table I summarizes the respondent demographics by representation of age, course or program, reason for enrollment, current job and most significant source of influence.

Table 1
Respondent Demographics

	Age Range	Course/Program	Reason for Enrollment	Current Work Situation	Source of Influence
Ginny	18- 24	Systems Design	Computers a part of life	Student	Father
Yancy	24-29	Business Information Systems	Computers necessary for all work	Student	Military experience
Brenda	49-54	Business Information Systems	Staying on top of changes at work	Information Specialist for MOD	Self
Becky	44-49	Business Information Systems	Returning to the workforce	Secretarial	Self/
Shirley	38-44	Business Information Systems	Certification	Repro graphics	Self/ father
Janie	24-29	Systems Design	Desires programming position	Student	Self
Wendy	49-54	Business Information Systems	Job upgrade	Hospital clerk	Self/boss

Observations

Most of the observations were conducted prior to the interviews. When I initially arrived at the college the classes were in session and I could observe the make up of the classes and the interaction of the female students with each other and with the class members in general. As previously mentioned, the Systems Design course was the smaller of the two groups. Only two of the members were female. Both male and female

students appeared to be similar in age. The course had been running for about a month when I visited the first time and the students seemed to intermingle, share work, and ideas with each other while they were on the computers. The instructor was wrapping up on a lesson and the students appeared to be equally involved in the assignments.

The second observation occurred when I met with the group from the Business Information Systems course. The class was on a break and all of the women from the class were together in the snack area. This group had been together about six weeks and only met on a once-a-week basis, but already the women had segregated themselves from the men on a social basis.

The third observation that I made was of the Business Information Systems class. The class was just concluding a session. As I entered the room the students were seated in an oval for discussion. This situation was also segregated. Women sat on one edge of the room and men sat on the other three sides. The men were considerably younger than the women. I was not able to observe the discussion part of the class and the lesson did not involve the use of computers.

Why computers?

In the research on the computer gender gap, three reoccurring positive themes presented themselves. Self-efficacy, mentoring and role models, and teacher attitudes toward computer integration were the themes cited as making the greatest impact. Were these same themes from the literature be the factors that these women felt had the most impact on their choice of technology careers or courses?

"Self-efficacy has been shown to be an excellent predictor of behavior. Individuals with a low sense of self-efficacy will, more often than not, shy away from the best alternative, and instead choose alternatives that they believe they can handle" (Houle, 1996, p. 31).

Self-efficacy

Self-efficacy beliefs influence individuals through 1) choice of activities, 2) level of effort expended, 3) persistence in difficulties and 4) overall performance (Ramalingan & Weidenbeck, 1998). In academics, the two main foci have been self-efficacy and college majors or career choice and self-efficacy and academic motivation and achievement. Both of these issues tie into the technology gender gap research. It has been shown that career choice and course taking is often dependent on self-confidence.

How would self-confidence with computers and self-efficacy present itself among the interviewees? When asked about their use of computers and their confidence in using the computer, all but one of the women responded with a great deal of confidence. Becky, on the other hand, admitted

> I have been out of the office too long. There are so many things to learn about the computer as it is used in the office and this course is more about analyzing the needs for computers in the workplace not just how to use them. I should probably have started with a course on applications.

In contrast, Wendy and Janie passionately expressed their involvement with computers. Janie's interest developed while she was at school. She states how "my

parents had to limit my time on the computer" and that "ever since I learned to use them at school you couldn't keep me away from them." Wendy began her interview with the statement and a giggle. "I just think that they're fun."

The other interviewees were more serious in nature, but expressed a wide use of computer applications and experience with computers in their work and personal life in addition to what they were doing for their course work. Shirley related her transition from the typewriter office to a computerized setting by indicating that she was the primary motivator in the change. Brenda, who has worked for over 20 years with the ministry of defense, admits that she has "almost always worked with computers." Although she is quite confident in her ability to use applications and make modifications, she does not use the computer for personal enjoyment.

When addressing the issue of self-efficacy in dealing with the programs of study they were pursuing the degree of confidence became even more apparent. Janie exemplified this in her statement.

> When we study a new topic I am usually the first to get it and then everyone is over looking at my screen and trying what I did…I like the challenge of trying something new …I just try and see what happens.

Yancy and Ginny began their statements with "I think that I am very confident". Both mentioned enjoying a challenge and trying things out on their own. Yancy's statement "I rely on myself to sort things out was echoed by Shirley and Brenda. Both of these women are initiators in their jobs. Shirley was responsible for converting her office to computers and Brenda is the IT specialist in her workplace. All of the women started computing in school as long as 25 years. They persevered in their use of computers mostly through trial

and error with an odd course thrown in along the way. Yancy expressed her confidence as a "hunger for information." Wendy still related her confidence factor to her enjoyment level. She felt that when challenged she could find out things she needed to know by playing around with the computer. These women were not ones to "shy away from the alternatives" (Houle, 1996, p.31). As Bandura (1986) claimed, these women possess an internal system that allow[ed] them to control their thoughts, feelings and actions. Their self-efficacy system gave them the ability to learn from others, to plan alternative strategies, to regulate one's own behavior, and engage in self reflection.

Mentoring and Role Models

Mentoring, the use of adults or older peers as models of behavior and support, has given women the opportunity to develop a network of persons of similar career aspirations and interests. Who had influenced the women in this course? The responses were varied.

Ginny, the youngest, was very definite that her father was her greatest influence. His interest in computing led him to encourage her to come to work with him and then to enroll in the course. Shirley also attributed her father's influence to her career choice but for other reasons. Shirley first used computers when they were the big room-sized versions. "My father said that I would have quite an opportunity to start at school at the beginning. I feel that computers are going to be big so I would advise you to take this particular course."

Yancy's initial exposure to computers occurred during her time with the Israeli army and it turned out to be a life changing experience. She had originally intended on a career in social work, but her "hunger for knowledge about computers" and her aggressive interest in programming has changed her entire career focus. The other respondents had all started in computing at school. They had taken advantage of the choice or "option" during the 80's. Many had worked through the key-punch stage of computing and had had a long-term relationship with computing. Most attributed their continued use of computers to their own initiative. Although Shirley said that her father had been an initial influence, her comment really emphasizes this self-motivation.

> Have other people influenced me? Well no, not really. The only person that influenced me is ME! I kind of kick myself up the back side. I had to after my previous company went into liquidation."

Her sentiment is echoed by Brenda and Wendy, but to a lesser degree. They also attribute their bosses for the encouragement to go further. Both of these women attributed their perseverance to their initial work situation, but as they attempted to pursue advancements in their jobs, they found that they had the initiative but not the qualifications. As Brenda said it is the qualifications, "particularly on paper that would increase their status." Janie was the only respondent to mention teachers as an influence. Her statement "I guess the main influence would be me," was followed by her explanation of seeing a computer as a toy. Her reference to teacher influence was the upper-school teacher that encouraged the students to go up to the college and interview and join the course.

Teacher Attitudes

The theme of teacher's attitudes toward computer literacy was considered important by a series of researchers. Hignite and Echternacht (1992) conducted a series of attitudinal surveys to determine the anxiety and acceptance levels of teachers toward computers in the classroom. Robin and Harris (1998) found that teachers who integrated computers into classroom instruction were more likely to be teachers that preferred learner-centered teaching. Sherry, Billig, Tavilin and Gibson (2000) developed a four-stage approach to adoption of computer-based classrooms. The first is the teacher as the learner, then the teacher as the adopter, next the teacher and student as co-learners and co-explorers, and finally the affirmation of computing as part of their personal vision of learning or a rejection of computing as part of their way of teaching. Evans-Andris believes "teachers shape the meaning of computer technology in their school through their styles of computing including avoidance, integration, and technical specialization" (1995, p. 15). She describes her findings in the follow statement "there are important implications for the ongoing process of computer implementation in elementary schools…educators need to establish the relevancy of computer training and encourage computing as part of the curriculum rather than itinerant role" (1995, p.30).

The third theme did not surface directly. None of the women mentioned a specific teacher influence. The women interviewed had positive attitudes toward computing. They had confidence in their ability. Although no particular teacher was mentioned, the women all reacted positively to their introductory experiences with computing whether it was at school or in military training. The "options" courses were all mentioned in a positive

manner. The choice to enroll in those "options" courses was supported by family and friends because those people viewed computing as "a way forward." This brief phrase was repeated in many of the interviews. It not only shows the importance of education in directing the women's choice in careers, but also the shift that was occurring in England toward women's work. It further supports the change in attitude about what was considered "acceptable" women's work.

The women interviewed joined the computing world in its earlier stage. According to Sherry, Billig, Tavilin, and Gibson (2000) the development of teachers in adopting a computer-based classroom follows four stages. The instructors that were teaching these early "options" courses were at level one, the learner stage themselves. Lessons were more about how the computer worked and what a person would need to do to accomplish a task.

Shirley relates her experience in the following way.

> I was first introduced to computers at school, so you are talking about 20 years ago. I was doing a computer course, one of the first computer courses, which gave us time on the computer. I was one of the few females in the class. Then I worked on a job for thirteen years. We started out with an antiquated typewriter and I mean it really antiquated. So I said that we need a computer. When the boss agreed he said, okay here's the book; and now we need the training; and we have to be set up next week. In my case, it is usually hands-on learning, and probably about 10 years later it is actually going to proper courses and learning the things that I don't know.

Brenda sums this up by saying

> I first started into computing back in the mid 70's really. Computers weren't really that popular and boys did think they were more for computing than women. I think that it is more women have though about it now as more women are thinking about careers and such. I feel that I have made the right choice...because my knowledge of computers has always brought me to believe that there is a way forward in computers.

By the time the women had enrolled in the courses at West Suffolk College, a transition had occurred. The instructors at the college were more at the level three or four, mixing teachers as co-learners and co-explorers with those who affirmed computing as a way of life.

In support of Evans-Andris' beliefs (1995) about teachers shaping the meaning of computer technology, the early teachers must have projected a positive attitude toward computing. Although most women in the study believed their own perseverance to learning and using the computer was essential to their success in technology careers, they never mentioned past computer courses in a negative way.

Summary

In summary data presented in this chapter introduced the reader to the respondents in the study, their work situation and their reasons for pursuing a technology career. Based on the review of the literature, the three positive themes that seemed to equate with following a technology career were reviewed. Two of the themes were very much evidenced in the responses of the interviewees. These were a strong self-efficacy and

positive mentors. The third theme, teachers attitudes toward technology integration, was not directly apparent in the responses of the participants, but could be inferred from comments made about early computer education and training.

CHAPTER V

Analysis

The purpose of the study was to explore female students' perceptions of the factors influencing their enrollment in computer course work. The frameworks of perpetuation theory (Braddock & McPartland, 1987), "strength of ties" (Granovetter, 1986), and social network theory (Wells & Crain, 1994) were used to assess factors that influence these same students' choice of technology-related careers.

Perpetuation Theory

The perpetuation theory described by Braddock and McPartland (1980) posits the beliefs that exposure to interracial interactions generally produces positive changes in inter-group attitudes and interaction patterns. The conditions that were most affected included equal status, shared common goals, cooperative interaction and environmental support. In their study, Braddock and McPartland's minority group was racial but this study's minority group is gender.

Inferring from Braddock and McPartland, it was believed that if the opportunity for women to integrate into the educational stream of mathematics, science, and

technology occurred at an early age, then the cycle of perpetuation would not show itself in women's later educational life. Women would be more likely to choose and maintain careers outside of the culturally dominant mode.

One major theme that developed in the discussions with the directors of the technology department was the change in women's roles in the technology department from the late 1980's to the present day. Mr. Miller comments echoed the literature (Sanders, 1982; Chaika, 1995; Gadalla, 1995) when he stated "initially the technology courses were equally attended by both genders." Even though "more women were enrolling in college in general and many were enrolling in word processing and other similar applications program classes, fewer women were enrolled in the Business Information Systems programs and System Design courses." He discussed the change in women working in this area of England and the trend for women to pursue higher-level education. Although the enrollment in colleges for women had increased, there was still a trend in this area of the country for women to stick to more traditional work, such as part-time work that was semi-professional rather than career oriented.

This opinion was echoed by several of the women that were interviewed. Wendy, Brenda, and Shirley were the most vocal.

Wendy's comments:

> Well the trouble is that women are the ones that have the babies and then they come back into the workforce. There tend to be quite a lot of women that do part time work that doesn't tend to be skilled work. They do like work in Tesco's [a grocery chain] or domestic jobs like in the hospitals. They have part time jobs and the men because they have to support the family need to have the full time jobs. I

> think that more women should be working with computing. Now that more women are working but they are still doing a lot of the more menial jobs. I think that they could do with getting into more skilled jobs.

Brenda goes back to the early development of computing careers when she states

> When I started into computing back in the mid 70's, computers weren't really that popular and boys did think that they were more for computing than women did. I think that it is more women have thought about it now as more women are thinking about careers and such. More women are looking for work outside the home than they did before. I have worked for the Ministry of Defense for more than 20 odd years now and I have seen a big change. Women will have a career now; I mean they will have a family; a family and a career.

Shirley explains her position by connecting enrollment back to the male dominance in the computer fields and its links to science and engineering.

> I think that women just tend to look at the more traditional jobs like a receptionist or a secretary. So, I think that it is women that should be educating themselves rather than have schools push it [technology education].

Even the younger women in the Systems Design course, Janie and Ginny were quite conservative in their choice of career goals. Ginny chose technology because she wanted "an office job" and Janie describes her interest in programming as a career in relation to "good pay" and as an alternative to "working in a shop." She expresses her desire to "have a career; something I can take care of myself on…to not end up on the dole…to get a certificate that would let me get a job anywhere in Britain."

The most adventurous of the interviewees was Yancy. She had her initial exposure to computing during her conscription in the Israeli army. She became absorbed by computers and has a goal to "become a manager in an Internet company."

However, relating back to Braddock and McPartland's theory of perpetuation and the contact-hypothesis, it is interesting to note that each of the women in the Business Information Systems class had a long running career with computers and technology. Most of them started out as a minority in their high school and college programs 20 to 25 years ago. Their contact with other women in the technology fields was limited and yet each of them related a high degree of confidence in their ability to deal with the issues that each of their jobs created. Their additional pursuit of coursework to further their careers was also evident. The only one of the women that did not follow this pattern was Becky, who has subsequently dropped out of the program. This would support Braddock and McPartland's premise that early contact would increase the chances that minority groups would continue to move beyond traditional boundaries.

Strength of Ties and Social Network Development

The second study by Braddock and McPartland (1987) concentrated on the way informal social networks provide, or deny, access to minority groups in education and in the workplace. Three stages in the social network theory depend on the success that minority groups experience in entering, remaining and promoting themselves within an educational setting or work situation. This study supported Granovetter's theory on social networks. Granovetter's study focused on interpersonal networks as it applied to

diffusion, social mobility, political organization, and social cohesion. Granovetter's definition of "ties" that link persons to one another are either weak, strong or absent. The "strength of the tie is a combination of the amount of time, the emotional intensity, the intimacy (mutual confiding), and reciprocal services which characterize the tie" (1973, p 1361).

> Analysis of social networks is suggested as a tool for linking micro and macro levels of sociological theory. The procedure is illustrated by elaboration of macro implications of one aspect of small-scale interaction: the strength of dyadic ties...the degree of overlap of two individuals' friendship networks varies directly with the strength of their tie to one another. The impact of this principle of diffusion on the influence and information, mobility opportunity, and community organization is explored. (Granovetter, 1973, p.1360)

Granovetter posited that weak ties actually improved social and educational mobility because the relationships among participants extend to a larger variety of persons. It allowed information to travel and opened lines of communication. Wells and Crain (1994) compiled 21 studies on strength of ties. Their findings indicated that "strong ties" existed in segregated communities and "weak ties" in desegregated communities.

In my research, I have attempted to determine the networks established by the women enrolled in the technology courses and if these networks were either "strong ties" or "weak ties" or were indeed absent ties. I wanted to know how the networks that the women had before enrolling in the technology courses impact on their success? How did the networks that the women established during the coursework impact on their success

in the technology courses? Is the establishment of "strong ties" detrimental to success in technology? Does the nature of a woman as described by Orenstein (1994) continue to perpetuate the problem of entering a career that is now considered a male domain?

The women interviewed in this study were part of two different technology programs: Systems Design and Business Information Systems. As stated in the Chapter IV, most of the women expressed a strong self-efficacy, which I felt enabled them to pursue their careers without the necessity for strong ties that many women felt the necessity to develop. They were motivated to enroll in the courses, primarily through their interest in increasing their knowledge and ability to progress in their jobs. None of the women had previous contact with each other prior to starting the course. The two younger women enrolled in the Systems Design program cited family and friends as strong influences in starting the course, but did not indicate that any of these were enrolled at the college. Janie and Ginny stated "friends encouraged them to try for the courses, go for the interviews". These same friends emphasized the money and marketability of the course in later life. They also admitted that their families' financial support was necessary.

I would think that these women would be considered to have "weak ties" which would concur with Granovetter's theory (1973). These women were able to have the social and educational mobility needed to pursue the new courses. They also demonstrated the three stages of social network development presented by Braddock and McPartland (1987). The informal social network that they developed during the coursework enabled them to remain in, and promote each other in, their educational setting.

The organization of the programs impacted on the development of the student networks. The group of women that were involved in the Business Information Systems program only met once a week. To work on projects, share ideas and prepare for the classes, the women relied on each other as a study group. In the Systems Design course the students were assigned to work on projects together. The women in this group did not have an option regarding who they were assigned to work with and therefore tended to be even less tied to each other.

Of the group in the Business Information Systems course, Wendy indicated that her interest in computing was renewed when she and a friend decided to study a basic computer course at night school about 10 years ago. Her boss influenced her to enroll in the current program to upgrade her skills. Brenda, on the other hand, had continued experience with computing all of her working career, but as the primary Information Technology specialist in her office felt the need to pursue further education. Yancy, likewise, was personally motivated following exposure to computing while in military service. Shirley was motivated by job a change. Becky, the one who dropped out, was the only woman who really discussed her friends as an influence. She was uncertain about taking the course and had been relying on her friends for support, confidence and help in coping with the material.

I did not feel that any of the respondents had strong ties with each other before beginning the course. As stated previously, most of the women were quite independent. They are unique in their workplace experiences; most of them working in a situation where they were the only women that had expertise with computers. As Shirley indicated, she was responsible for converting her workplace "from an antiquated office, to a

computer-based workplace". Wendy works in a hospital; her clerical status relies on computer skills that need to constantly be upgraded. Brenda, a Ministry of Defense employee for more than 20 years, has worked "in a nearly [all] male environment" most of this time. All of the women in the Business Information Systems course had experience with computing at school, mostly in the 1980's when computing courses were offered as part of their "options" courses. They agree with Brenda. "There were very few women in the courses...They were nearly all male. But, I took it anyway. I enjoyed it." The women in the Systems Design classes were also very independent.

I do not feel that any of these women would fit into the "strong ties" category at the onset of the course. They did not have the mutual confiding in each other, nor the emotional intensity that Granovetter uses in describing a strong tie. As the course progressed however the women began to engage in the reciprocity of services. Yet, I do not believe that reciprocity developed to the extent to describe their relationships as strong ties even later in the course.

In observations of the classes, the women in the Business Information Systems course had definitely formed a networking system with each other. I had begun the interviews in October so the course work was really only six weeks into development. My initial meeting with the women was during a lunch break so it was not surprising to find them all eating together in the canteen. However, future observations revealed that they also sat together during classes while the male members of the class sat on the opposite side of the room.

On the other hand, the two women who were enrolled in the Systems Design course could be observed in a quite different setting. Both observations of this class in

action revealed the women as an active and integral parts of the class. Janie's first comment:

> We have only been on this course together since August so I can't see that I have any real strong relations within the group. I was not really looking for that when I started the course, but of course, you do have to think about sharing and some of the projects make us work as a team so…

When asked about her relationship with the other female student, Ginny, she stated:

> I don't have any closer relationship with Ginny than any other members of the course. We both see ourselves as part of the group not special because we are females. In fact, I would feel just as comfortable working with most of the people on this course. Partly I think that it is we are pretty much the same age. We started with computing as part of our options in upper school and most of us have used computers for fun as well as work. I don't know if men see me as an equal. Well I don't really know. I don't care. We all get stuck and try to help each other out if we can.

Ginny, her counterpart, is more reserved, yet maintains an air of independence and pride in the fact that she is able to hold her own in the class and contribute to the investigations with as much confidence as many of the male members of the course. She is just as likely to have a solution that she can share with the rest of the class as any of the men. She does enjoy the socialization with the group but looks at it in a casual, friendly way. When asked whether they had developed a support group of sorts, she replied

> Oh yes, especially if you are on a computer next to each other and some of them get really stressed when ya (sic) can't do something…It is there in phases, like you help them and they help you.

Of the women in the Business Information Systems program, the networking issue developed in a slightly different way. The course work that they are on is developed in modules. The five women had been on the first module together. Some of the members of the program had dropped out after the first module. The next module was a lot larger group but the women's population remained at the original five. Yancy, Wendy, Brenda, Becky, and Shirley formed a study group. Yancy explained the group as "a contact and support for each other" Through e-mail and telephone calls, they help each other out with assignments and concerns about the course.

Wendy expressed her connections in the following quote.

> Feeling connected is important for me to continue this course. I like interactions with other people but I don't think that my connections now would keep me from moving on. I would be sad to see them go but I wouldn't want to give up. I don't like giving up on things.

Brenda's feelings further explain connections.

> College is different for me [At work I am on my own] because we kind of hooked together with one common aim. Although we see each other just once a week, we do e-mail each other frequently with different things and different problems. I think that it is a really good thing. It does keep everyone connected. It is just a case of creating a bond really.

Yancy also liked the idea of the support group. She noted that:

> I think it is better to learn in such a small group and actually support each other. After college [classes] we e-mail each other, if we have exams we study together. We are on the phone or something if someone has a question and we contact each other and support each other. It is our first year of working together, but it is such a small group that it is no problem to get to each other. We get in touch really quick, make the connections really quick.

Becky felt the need of the group more than the rest of the women. She felt that she would not cope with the lessons without their advice.

> I am very unsure. The girls say that they will continue to help me that I should keep on trying. They seem to understand what they are doing, but I just feel like I am copying them. I need the help. As soon as I am away from college I don't feel that I know what I am doing.

Shirley remained the most disengaged with the group. She and Brenda were more comfortable to go into things on their own, but were willing to help out their friends.

> Again it tends to be that we females tend to stick together rather than the guys. What I have been trying to do is develop a working example and then email it on to the other [female] members of the course. We are currently in a class on software engineering. It is a new business so what I have done is actually talked with people that have taken the course last semester and have gotten notes from them and extra books so I have built up a relationship with them as well. I am not afraid to reach out and get what I need, but I am willing to share. (Shirley)

The relationships that were building in the group were closer to the "strong ties" described by Granovetter (1986) and Wells and Crain (1994). They were not insular

enough to make the women change the overwhelmingly independent attitudes that they brought with them from the work place. It would be interesting to observe how this relationship progressed at the end of the courses. When asked if she thought support groups were critical, Wendy summarized for the group.

> Well I suppose that I could do it on my own but it is nicer to have that feeling that you can ask others on the course and that you can give help to others. It does make us feel more close to each other and that we can help each other out.

Summary

Using the lenses of perpetuation theory, "strength of ties" and social network theory, I wanted to analyze women's choices in technology education and career fields and their success in maintaining these career goals. Perpetuation theory, particularly the side of the theory which supported the idea that diversity of social networks at an early age, encouraged women to desegregate themselves from the social norm, played itself out in the study as well. Most of the women had developed an interest in computing during their high school years. Many had been one of a few women in an all male classroom. Additionally they maintained a career and interest in computing over a sustained period of time, some longer than 25 years. I feel that this early exposure and the persistence are supportive of Braddock and McPartland's theory.

Strength of ties was an evident part of the women's successes in the educational courses that they attended. Although most of the women would probably be described as

having weak ties with other members of the courses, they did establish and rely on the ties they established during the course.

The women interviewed were uniquely individualistic. In terms of social network theory, all but one stated that they would have continued the course without the support of the other women members, but appreciated the fact that the support structure they had begun to develop at the college was beneficial to their success. The social networks, that have and had been working for them in their jobs before starting the coursework, identified them as independent and confident members of their workplaces. This strength of character and commitment enabled them to form a social network that would increase their success rate as they pursued this new career even though they did not have a strong social network among themselves at the college.

CHAPTER VI

Summary of the Study, Conclusions, Implications, and Commentary

Perpetuation theory and network analysis are based on the assumption that access to a change for minority groups will be dependent on the integration of that minority into the larger cultural domain that surrounds it. Perpetuation theory (Braddock & McPartland, 1987) holds that the minority group will remain in a stasis if they do not desegregate from the situation that is considered a cultural norm. In this study, the desegregation observed was related to gender. As the research reports, women and men started out at parity level when technology careers were first developing (AAUW, 1999).

In the mid-1980's a difference began to appear. Men began to dominate the technology courses and careers. This continued throughout the 1990's until concern among the researchers labeled this difference as a gender gap (Furger, 1998; Wright, 1997). The factors that moved women from the norm in technology fields to the fringe of technology fields developed into three central themes. One of the themes was self-efficacy. The other two themes were role modeling and mentoring as well as the impact of teacher's attitudes toward integration of computing in the classroom.

What appeared to develop in the 1990's was a shift towards the feeling that technology was linked to science and engineering which were traditionally white

heterosexual male occupations (Dupagne & Krendl, 1992). To make a change in the developing attitudes, women entering technology fields had to be prepared to face a different type of educational program and different type of work place environment than would have been considered the norm. It was the purpose of this study to discover the ways in which the women interviewed could identify factors that distinguished them from other women and created their success in technology courses and careers.

The "strength of ties" theory and social network theory (Granovetter, 1983; Wells & Crain, 1994) explain that associations people make in their educational and career situations can either eliminate or accentuate their ability to assimilate into an alternative culture. When the technological gender gap studies began, Braddock and McPartland (1987) and Wells and Crain (1994) identified two reasons for exclusion. One was the lack of a social network in schools to encourage women to enter technology courses (Braddock & Mc Partland, 1987; Furger, 1998; Gadalla, 1995). Additionally, women did not find a supportive social network in higher education or employment where the majority of the members were male (Wells & Crain, 1994; Furger, 1994). Granovetter (1983) spoke to a different issue. If social networks were developed, did they help or hinder the situations? He explained the "strength of ties" in the following way. If ties are strong then people tend to remain static. If ties are weak, they still provide a support system but people tend to move on to new areas. The purpose of this study was to observe if the strength of ties that developed among the women interviewed would support Granovetter's belief.

Study Summary

A qualitative case study was used to identify the factors that influenced women to participate in career-oriented technology courses. The women studied were enrolled in two higher-level technology courses at a local college in West Suffolk, England. The data were collected through semi-structured interviews with seven women who comprised the female portion of Business Information Systems and Systems Design courses at the college. They represented approximately 12% of the total enrollment in the course. Observations of the classes and discussions with the directors of the college's technology department also provided additional data.

In the study, the model of "strength of ties" and network analysis, as well as perpetuation theory, provided a lens for classifying and evaluating data. To insure the internal validity of the study, triangulation of the data, peer examination and an examination of the researcher bias were used. External validity was maintained through the use of thick rich description and an audit trail of data collection and analysis. To support reliability protocols, notes and an audit trail of the interviews was maintained.

The factor that did emerge from the study, that had the greatest impact on the women in the study, was their self-efficacy. The women, who persisted in their technology careers, were those who expressed the greatest amount of confidence in their ability to deal with computer issues on their own. They were often the only woman in their place of work and the expert in the use of technology as well.

The second factor that emerged was that of mentorship. Many of the women cited family members as being influential in helping the make the initial choice to pursue

technology courses. Because of the age of the women, many of them, in fact, were the mentors rather than the recipient of the expertise. Other significant factors in mentorship and role models were supervisors or bosses.

Conclusions

The study conclusions provide support for the theories used in analysis as well as the literature. At the same time, conclusions will provide support for contradictions to these same sources.

Findings that Support the Literature and Theories

The purpose of the study was to investigate factors that had emerged in literature to help explain the reasons why women were entering technology career fields. The more current factors that distinguished themselves in literature were self–efficacy (Sadker & Sadker, 1994; Houle, 1996; Pajares, 1996), mentoring and role models (Kantor, 1977; Furger, 1998), and teachers' attitudes toward the integration of technology into the curriculum (Dupange & Krendl, 1992; Evans-Andris, 1995; Sherry, Billig, Tavilin & Gibson, 2000). In this study, the women interviewed followed the model of desegregation that Braddock and Mc Partland (1987) described in the sense that they were unique among their peers from an early age. They were women who enrolled in technology courses in the 1980's. Most of the women had jobs that incorporated the use of technology from that time onward. They had not followed the mold of many of their

contemporaries in a traditional office setting. Additionally, they were still pursuing training in a technology career field that would take them to yet another level of expertise. The women interviewed did not see themselves as part of the traditional culture of women in the work place. They commented on the roles of women in work, especially as this has evolved over the past 20 years in the United Kingdom.

They also followed the model of "strength of ties" in that they were relatively independent people. They formed a support group at the college-not because they felt that they could not survive with out each other-but because they functioned as a circle of friends or colleagues working together. They all admitted that they would be likely to continue with the course work even if other female members of the courses decided to withdraw. They had independent goals for themselves. This would support the theory that "weak ties" allowed members of a group to stretch themselves and move on to, or out of, a particular mode of work or education.

The other two emerging themes, role models and mentoring and the impact of teachers' attitudes toward integration of computers, were not as evident among the women interviewed. However, in discussions with the directors, it was evident that they viewed some of these women as the role models. This finding would support the theory posited by Braddock and McPartland in that they had managed to desegregate from the traditional roles defined for women. Additionally they had been able to pass on their beliefs about the roles of women in technology fields to other women that they worked with. They also exhibited the model of "strength of ties" (Granovetter, 1983; Wells & Crain, 1994) in that they were able to associate with each other to the betterment of their educational attainments. However they did not form such strong relationships that it was

detrimental for them to move on from one course to the next without the support of the others. The role models mentioned in the interviews seemed more predominant in the discussions with the younger members of the courses. They mentioned parents and friends rather than teachers when considering those people who influenced their decision to pursue technology careers. This also would support Braddock and McPartland in that the parents were supporting change or desegregation rather than encourage these women to remain in a status quo situation. "Strength of ties" among the women in the Systems Design course was definitely the weakest, or could possible be classified as non-existent because they did perceive themselves as differing in ability or needing each other any more than other members of the same course.

The issue of teacher's attitudes toward integration of technology in the classroom was more indirect. The women in the study had a positive attitude toward their introduction to computing in their "options" courses whether they had taken them 20 or more years ago, or just a year before enrolling in their current course of study. This would support the theories that teacher attitude toward computing would have a positive effect on students. Positive teachers' attitudes toward encouraging women to enter technology careers would be consistent with Braddock and McPartland's theory on breaking down the desegregation cycle.

Findings that Contradict the Literature and Theories

The finding that I thought would be more evident was the impact of teachers on students entering technology career fields. Yet, in most interviews, the direct mention of

teachers as an influence was lacking. This was inconsistent with my perceptions from the Perpetuation Theory. I thought that the role of teachers would be to encourage all students. I also did not perceive any reference to "strength of ties" and social network analysis in regards to teachers. In evaluating the reason for this lack, I have concluded that age had a big impact in the results. As mentioned in previous discussion, the majority of the women interviewed were among those who were part of the era of early computing. Beginning computing in the 1970's and 1980's the women were a product of computer education as it changed from a mathematically based formula-type communication to English or language-based communication programming. Computing was also taught as machine code and key punching rather than the programming and software usage that we see today. The idea of teachers integrating computing into classroom instruction was not feasible in the era that these women were introduced to computing.

The younger women in the group were more at ease with the hardware and used to the idea that computers would be part of their future. This would be the case whether they pursued a technology career or not, but they did not comment on the impact that teachers had in implementing this situation. I believe that they represent another era. Their era was one where computers had always been a part of their lives. They probably found it hard to imagine working or living without the use of a computer.

The ideas expressed by the women in this study made it difficult to identify findings about the implications of teachers on career choice and education. As mentioned above, the women interviewed were part of the computing revolution. They had teachers, who taught computing as programming and keypunching. They were teaching computing as a naked science. If there were an influence at all on the interviewees, computing as a

novelty and an innovation was what attracted the women to technology career fields. I had hoped that more of the participants would have mentioned their teachers as being influential but it was the course of study that was influential not the person. The younger two participants did not even mention teachers. Both referred to parents and friends as being influential in making their decisions to pursue technology careers. Of additional interest, was the participant who had her first experience with computing while in the Israeli armed forces. Although she associated the interest of computing with her training in the Israeli Forces, she did not mention any particular persons as being influential.

Networking was not addressed in the manner that Wells and Crain (1994) described. The women had come to the college from work situations that involved small companies or offices to the Business Information Systems course. They were often the only women employed in the office, and the only women involved with the use of technology. When questioned about strength of ties, they almost felt obligated to explain the lack of ties that they had with other members of the course. Although they networked with each other in the sense of helping each other with ideas, they did not express any need for networking that might lead to a change in work conditions. Most do not intend to make a job change but felt the need to expand their knowledge base to be more proficient in the job that they already held.

The participant who expressed the most interest in radical change was the woman who had the experience in the Armed Forces. Her goal to work for a programming company in a managerial position was far different from the rest of the participants. However, this goal was not dependent upon the other members of the course, but rather her perseverance with her lessons.

The members of the Systems Designs course did express more interest in developing acquaintances with other members of the class, but did not limit that networking to only the female members of the course. Age, again, may have been a contributing factor. The women and men in the Systems Design course were much closer in age. They were full-time students and attended the same classes with each other all week. They did not have an occupation, unless it was a part-time job, other than being a student. The members of the Business Information Systems course on the other hand were full-time employees for various companies and business and only attended college courses once a week. The men were 15-20 years younger than the women. Some of the men were sponsored by their companies to take the Business Information Systems courses while the women specifically stated that they were providing their own funding for the course work. Since I did not interview the male members of the class, I do not know if they would be networking more than the women.

Usefulness of the Theories

Using the theories of Perpetuation Theory, "strength of ties" and social network theory, to understand the impact of teachers on female students' perspectives is useful to a certain extent. Understanding the philosophy of perpetuation theory, the impact of teachers could be thought to extend a student's ability to move out from a preconceived framework of reference and extend their framework to new and different careers or courses of study. By encouraging students to move to new groups and try out different things, teachers could be at a place where they modify female students' perspectives of roles and goals in the future. Understanding "strength of ties" and social network development theory, was helpful in developing social concepts of relationships. I did not

realize that strong ties would be detrimental to movement away for a cultural norm. I found that understanding this concept also explains how perpetuation theory interconnects with these other two theories.

Implications for Theory, Research and Practice

Since the purpose of this study was to investigate factors that affect women in their pursuit of technology careers, it is important to consider how the results could add to existing theories, research and educational practice. Without a contribution to any, or all, of these areas much of the information collected would be of little consequence. I feel that the information collected could add to all three areas in the following ways.
In reference to the significance of the three theories that were used as a lens, I feel that Perpetuation Theory had the most impact on my understanding of the phenomena of women's choice. The least significant was the social network theory as most of the women in the study were established in their positions. An understanding of the "strength of ties" theory has given me a better perspective on why women may have difficulty in pursuing a non-traditional career.

Theory

This study contributes to the understanding of perpetuation theory among minority groups by looking at women as the minority in certain educational and career situations. Perpetuation theory states that segregation of a minority group tends to continue the

isolation or limit the ability of the segregated group to join the dominant cultural group. In the case with women studying technology, and seeking employment in technology career fields, the women needed to be able to participate in courses and obtain work that was atypical of their gender. By taking courses that move women into a more integrated social situation or pursuing employment in an equally integrated situation, the perpetuation of the dominant (male) role in technology careers.

The study contributes to the theory of strength of ties and network analysis by looking at the ways that women integrate into a cultural domain that is considered predominantly male. The strength of ties that are traditionally associated with women are those that Granovetter (1986) defines as "strong ties," yet he identifies those ties as ones that tend to stifle transitions. Identifying these traits and making women aware of this trend within groups helps both women and men understand why certain methods of association limit integration into businesses and careers that are traditionally either male or female. This awareness of types of ties also helps identify what would make successful at integration into the same sort of businesses and careers.

Network analysis also explained why women find working in technology fields and pursuing technology careers difficult. Networking is necessary at three stages of employment: entry to training, employment seeking, and promotion. Women are missing as role models and mentors in the technology careers. Therefore, the influences and networks are not there to help women progress comfortably in the technology fields.

Research

The purpose of the study was to determine factors the influenced women in their choice of technology courses and careers. The three leading factors in recent research were self-efficacy, mentoring and role models and teachers impact through their method of integration of technology in the classroom.

The study that I conducted added to the research on self-efficacy in that the results supported the idea that the stronger the self-efficacy the more likely the participants were to be successful in their technology courses. Only one of the participants showed a weak self-efficacy and within the time of the study, did withdraw from the program. It was very evident in the results from the other participants that they viewed their success in their jobs and also in the course work that they were undertaking on the basis that they had a high degree of confidence in their past performance and expected that to continue to relate to their future challenges.

The second factor also supported the previously existing theory that mentoring and role models improved the likelihood that women would enter and succeed in technology careers if they had positive models to guide them. The results of the study actually found that the participants were the role models for others.

Further research on this topic could follow other pathways. Some of these were represented by the limitations of the study. The sample group was split into two generations of women exposed to computing. An examination of a group whose age was between the two age groups could present differing views on the factors. The women who were interviewed did not relate their successes or failures to teachers. They did not talk

about integration of technology into other classes, but rather viewed computing as distinct from other curriculums. Further research might reflect the rapid change in computer use in the past five to 10 years. The accessibility of the Internet has changed the face of computing and perhaps the way that computers are used in schools and homes. Students have been using computers in the classroom on a routine basis for the past 10 to 15 years. Consequently, that group of students might be more likely to analyze the impact that their teachers' confidence in using computers had on their decisions to enter computer careers. Additionally seeking out information on the number of women in higher education who are teaching computing might make a difference in the results of the study.

Practice

The findings of this study impact practice in that teachers may now be able to look at several different aspects of girls and women's educational patterns. First, how do women view the use of computers in education and the work place? Has this view changed over the past five or 10 years? If women still view using computers and technology as a male preoccupation then it would benefit schools to attempt to change that perspective. The use of computers to complete assignments and the introduction to research on the Internet has opened many avenues for continued use of computers as well as ease and familiarity with the equipment.

As the younger women in the interviews have stated, life without computers and technology seems rather obscure. Encouragement in the use of technology for any or all students regardless of gender should become part of the practice of our educational

systems. Role models for females in the teaching profession, integration of technology projects into regular curricular activities and exposure to career and job opportunities are all implications for future practice.

Commentary

On completion of the study, I had a feeling for the change that was occurring in women and their pursuit of technology training and careers. Having been educated in a pre-computer climate but being a teacher of mathematics at the middle school grades, I was aware of the gender gap in mathematics. I was surprised at the beginning of my study to see the evidence of the gap discovered in technology education and careers. While doing the coursework for my doctorate, I found that I had the opportunity to informally observe my own students and colleagues as they interacted with computers and other forms of technology used in mathematics education. It was revealing to see how many of the observations presented in the literature played out in the classroom. When I began to conduct my research, I wanted to know what kind of factors made women become attracted to technology careers and what factors made them stick with technology careers.

Additionally I could also observe how the technology career fields were changing. Female family members employed as computer programmers and systems analysts in the late 1980's and early 1990's were laid off from their companies. When I asked them about seeking employment in similar positions but with different companies, they responded that they were not getting the job satisfaction in what was now an almost male-dominant career.

Following all the aspects that the literature dealt with, I think that one of the most significant factors that this study supported was the importance of self-efficacy among the women. In spite of all other factors, they expressed a confidence in their ability and courage in their career choices. If nothing else, teachers and parents should be aware of this aspect of development when encouraging their students, particularly female students to make educational and career choices. The women that were interviewed cited this confidence as a factor that made them choose the careers. Confidence was also a factor that made them decide to pursue additional education in technology.

Although I did not collect direct evidence in my interviews, I also feel that the importance in education of teachers and parents encouraging their female students to get involved in the use of technology through implementation of projects, and the everyday use of technology will also lead to the narrowing of the gender gap in technology. The reality of the accessibility to technology, the change in the way information can be accessed, and the daily exposure to computing will undoubtedly affect the way in which computing is viewed in the near future.

A number of questions remain. How will females make the transition? Will they remain more involved with the lower paying, more mundane aspects of computing or will they again begin to reach parity with males in the computing and technology fields? Will teachers be able to provide the role models necessary to implement this change by integrating more technology in the classroom and promoting a positive image toward the use of computers? Although the use of computers is more a necessity than an opportunity in today's world, the reality may still be that women will remain in the shadows. If this is the case then educators will continue to perpetuate the social cycles of the past.

Intervention from educational experts and sociologists will be necessary to make a change in this cycle.

Therefore I think that I have taken away two important ideas as a result of this study. The first of these is the way social roles are perpetuated. The second is how a person's self-efficacy can greatly affect his or her success and ambitions. How educators could help influence the effect of the technology gender gap could be in these areas. Educators who understand the effects of perpetuation theory and "strength of ties" could encourage female students to diversify and break away from the effects of these theories. Additionally, by promoting self-efficacy within themselves and students, educators could create a positive effect toward the use of technology and the pursuit of technology related careers.

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Appendix A

Introductory Letter

Dear_____,

I am writing to invite you to take part in a research project that I am conducting as part of my doctoral degree in educational administration with Oklahoma State University. The purpose of this study is to examine the factors that impact on women's choices to choose technology education training or careers.

If you agree to participate, I will interview you. Interviews will take approximately one hour, but may run a bit longer. A follow-up interview may be needed to clarify information. Interview will be taped and then transcribed for analysis.

Complete anonymity will be maintained. Specific names of participants or identifying information will not be used in this study. Tapes, transcripts, and notes will be treated as confidential materials. Only my advisor, my dissertation committee and myself will have access to the data.

I would appreciate it if you would be willing to participate in this study and contribute to this field of research. This research will contribute to the knowledge base regarding the gender gap in technology education. I will begin my research in October 2001. I will ask you to sign a consent form should you agree to participate.

Please return the consent form and your basic demographic information so that we can arrange an interview time and place that is mutually agreeable. An enclosed self-addressed, stamped envelope has been provided. If you have questions, please call me at 01842-860574 or e-mail me at jacquiedostal@hotmail.com.

Respectfully submitted,

Jacqueline Dostal

Appendix B

Research Consent Form

I, _____, agree to participate in the research project conducted by Jacqueline L. Dostal. I understand that the data collected during this study will be used by Ms. Dostal to complete the requirements necessary for the completion of a doctoral program of study in the Educational Administration program at Oklahoma State University in Stillwater, Oklahoma.

By agreeing to participate in this study, I agree to do the following:

1) to participate in a personal interview;
2) to participate in a follow-up interview to clarify information and provide additional information as needed.

I further understand:

1) interviews will be tape recorded and transcribed verbatim
2) all data collected during the study will remain confidential and that access will to limited to the researcher and the dissertation advisor;
3) all source data will be destroyed two years following the satisfactory completion of the Ed. D. program by the researcher,
4) prior to the presentation in final form, all data will be encoded and pseudonyms will be used in all text and graphical representations of the data;
5) This research project is being conducted with the intent of contributing to existing research and knowledge regarding the factors that influence women to enter technology education and careers.

I understand that participation is voluntary, that there is no penalty for refusal to participate, and that I am free to withdraw my consent and participation in this project at any time without penalty after notifying Jacqueline Dostal or her dissertation advisor.

Should I wish further information about the research project, I may contact Jacqueline Dostal at 01842-860574. I may also contact the dissertation advisor, Dr. Adrienne Hyle, PhD., by mail at the School of Educational Studies, College of Education, Oklahoma State University, Stillwater, Oklahoma 74078 or by telephone at (International code-001)-405-744-7246.

I have fully read and understand the consent form. I sign it freely and voluntarily. A copy has been given to me as well.

Date_____ Time _____(a.m./p.m.)

Signed _____
(Signature of Subject)

I certify that I have personally explained all elements of this form to the subject or his/her representative before asking the subject or representative to sign it.

Date_____ Time _____(a.m./p.m.)

Signed_____

Demographic information:
Name_____ Address_____

Daytime Telephone Number/ Mobile Number _____

Workplace Telephone Number_____

Best time for interview Morning Afternoon Evening Weekends

Appendix C

Interview Protocol

Each interview will begin with an introduction of the researcher, and explanation of the study that I am conducting.

The following general questions will be used to begin the interview:

1. What do think about computers and why?
2. In what ways do you see your self in a future with computers? Why?

Additional questions will include

1. Describe the kind of computer user that you are: that is when and for what purposes do you use a computer?
2. How confident are you about using a computer?
3. Who influenced you to start computing? How? When? Why? Where?
4. Of the connections or ties that you have with members of your technology education courses or careers, describe the time, intensity, intimacy (mutual confiding) and reciprocal services that this connection has involves.
5. How important is confidence to you continued interest in computer technology education?
6. Where do you use the computer the most?
7. Why are you enrolled in a computing course at the moment?
8. Is there a particular incident or person that influenced you to enroll in computer technology courses?
9. Do you feel that women should do computing more than men or vice versa?

Appendix D

Institutional Review Board Approval

Oklahoma State University
Institutional Review Board

Protocol Expires: 7/16/02

Date: Tuesday, July 17, 2001 IRB Application No ED022

Proposal Title: NETWORKS AND THE PERPETUATION OF DOMINANT CULTURAL ROLE: THE TECHNOLOGY GENDER GAPS AND THE IMPACT OF TEACHERS

Principal Investigator(s):

Jacqueline Dostal
PSC 41 Box 741
APO AE, 09464

Adrienne Hyle
314 Willard Hall
Stillwater, OK 74078

Reviewed and Processed as: Exempt

Approval Status Recommended by Reviewer(s): Approved

Dear PI :

Your IRB application referenced above has been approved for one calendar year. Please make note of the expiration date indicated above. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval.
2. Submit a request for continuation if the study extends beyond the approval period of one calendar year. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of this research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved projects are subject to monitoring by the IRB. If you have questions about the IRB procedures or need any assistance from the Board, please contact Sharon Bacher, the Executive Secretary to the IRB, in 203 Whitehurst (phone: 405-744-5700, sbacher@okstate.edu).

Sincerely,

Carol Olson

Carol Olson, Chair
Institutional Review Board

VITA 2

Jacqueline Lois Dostal

Candidate for the Degree of
Doctor of Education

Thesis: NETWORKS AND THE PERPETUATION OF DOMINANT CULTURE ROLES: THE TECHNOLOGY GENDER GAP AND THE IMPACT OF TEACHERS

Major Field: Educational Administration

Biographical:

Personal Data: Born in Evanston, Illinois, on December 15, 1947, the eldest daughter of George and La Verne Miller.

Education: Graduated from Palatine Township High School, Palatine, Illinois in June 1965; received Bachelor of Science degree in Junior High Education from Illinois State University, Normal, Illinois in June 1969; and Master of Education in Curriculum and Development from Michigan State University, East Lansing, Michigan in 1980. Completed the requirements for the Doctor of Education degree with an option in Educational Administration at Oklahoma State University in August, 2003.

Experience: Worked as a nanny during high school and college summers. Also worked in an electronics factory during college years as well as food service. Following graduation worked as a substitute for Department of Defense Dependent School in Germany from 1969 to 1972. In the United Kingdom from the years 1974 to 1983 lectured for the University of Maryland and DoDEA Adult education program. From 1983 to the present worked as a mathematics, science and language arts teacher in Lakenheath Middle School.

Memberships: National Council of Teachers of Mathematics, ASCD