Female Information Technology and Engineering Faculty Members from the State-Wide
We Are IT! Consortium in Ohio Public Community Colleges: Strategies for Success and
Overcoming Barriers

A dissertation presented to
the faculty of
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Doctor of Philosophy

Patricia A. Ross
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This dissertation titled
Female Information Technology and Engineering Faculty Members From the State-Wide
We Are IT! Consortium in Ohio Public Community Colleges: Strategies for Success and
Overcoming Barriers

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ABSTRACT

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Female Information Technology and Engineering Faculty Members From the State-Wide We Are IT! Consortium in Ohio Public Community Colleges: Strategies for Success and Overcoming Barriers

Director of Dissertation: Valerie Martin Conley.

This qualitative study utilized focus groups that investigated career paths, life experiences, and factors that influenced academic career success for female faculty in information technology (IT) and engineering related disciplines at public community colleges. This study examined their experiences and ways that these female faculty members persisted in their disciplines, made the decision to teach in a community college and overcame barriers to their success. More studies need to be conducted on the experiences of successful women to discover their strategies for becoming and staying successful and overcoming barriers, especially in male-dominated fields like IT and engineering. The purpose of this study was to explore characteristics and behaviors of female community college IT and engineering faculty in the belief that insight into persistence, success, and strategies that these women have used to overcome barriers may in turn help us nurture younger women and facilitate their pursuit of IT and engineering careers. Female community college faculty members serve as role models to young women pursuing careers in IT and engineering. Increasing the number of women pursuing careers in these fields will increase the number of IT and engineering professionals that the United States needs to improve the economy and drive innovation
and product development which could improve the United States economy. It is important to explore how community colleges may contribute to developing IT and engineering talent so that we have the advantage of more female IT and engineering graduates in the workplace.
DEDICATION

My work is dedicated to my mother, Betty Thompson, my life-long mentor.
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I would like to acknowledge my committee members Dr. Barbara Reeves, Dr. Cynthia Anderson and Dr. Phyllis Bernt as well as my chair Dr. Valerie Conley for their support and guidance through the dissertation process.

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CHAPTER I: INTRODUCTION

Women’s under-representation in information technology (IT) and engineering disciplines is well documented. There have been many efforts since the mid-1980’s to include more women in IT and engineering careers, yet research from institutions such as the National Center for Women and Information Technology (NCWIT, 2010) and the National Association of Colleges and Employers (NACE, 2009) shows fewer women graduating with math-based, IT and engineering majors. Numerous studies have examined the barriers to women’s participation in IT/engineering (Townsend and LaPaglia, 2000; Wolf-Wendel, Ward, and Twombly, 2007; Townsend and Twombly, 2008; Trauth, Quesenberry and Yeo, 2008).

Female faculty in IT and engineering disciplines at two-year institutions can have an impact on recruitment and retention of IT and engineering students, yet this group has not received much attention in higher education research. A current comprehensive review of literature on community colleges by Townsend and Twombly (2007) devotes no attention to this group. Not enough is known about the characteristics of women who are attracted to and successful in IT/engineering careers to make decisions about how to recruit and retain women. Few studies have been based on faculty in information technology (IT) and engineering disciplines at two-year institutions.

The purpose of this study was to examine the career development, tenacity and success of female community college IT and engineering faculty. Community colleges are uniquely positioned to respond to individual needs. Community colleges tend to emphasize application over theory and incorporate project-based learning into their
curricula. At the community college level, more freshman and sophomore students are taught by their full-time faculty advisors than at four year universities (AACC).

Understanding how female community college faculty members have been able to persevere, complete IT and engineering majors, and become college faculty members, allows us to develop strategies that will help young women beginning in middle school be more successful in IT and engineering careers. These community college faculty members influence their female students and have an impact on recruitment and retention.

From the pool of We Are IT! faculty, we need to understand the pathways these women have taken to become community college faculty members. How did they get where they are? What strategies did these women employ in order to persist and become successful community college faculty members? This study focused on the characteristics that have helped female IT and engineering faculty members at community colleges succeed, the barriers they faced, and the strategies they used to overcome those barriers. These women have not only proven to be successful in IT and engineering professions, but have become college faculty members.

It is important to strengthen the representation of female faculty in IT and engineering for at least four reasons: 1) Increasing the number of women pursuing careers in these fields will increase the number of IT and engineering professionals that the United States needs to improve the economy and drive innovation and product development which could improve the United States economy. This could impact the United States economy positively; 2) Many IT and engineering jobs are highly paid and
in high demand. College graduates fill most of these higher-skilled, higher-paid jobs. Including more women in IT and engineering will create new opportunities for the advancement of women in the United States; 3) A gender-balanced workforce better understands the demands of a larger portion of the population and design products accordingly; and 4) Applying IT and engineering tools is essential to the United States’ economic future (Cohoon & Aspray, 2006).

Women are attending college and earn nearly 58% of baccalaureate degrees (Bureau of Labor Statistics, 2008). Even though 62.1% of associate's degrees and 57.5% of baccalaureate degrees were earned by women in the United States in 2008, male college freshman are more likely than their female peers to choose IT or engineering majors (Diekman, Brown, Johnston, and Clark, 2010). At graduation time, women represent less than 20% of baccalaureate degrees in nearly every IT and engineering field (NSF, 2007). What is not well understood is why women are not choosing IT and engineering majors.

A large number of these women begin their educational journey at community colleges. Many factors affect career decisions: academic expectations and support from family, teachers and peers, parents’ education level and family income, self-confidence, academic preparedness and GPA, ACT/SAT scores, patterns of persistence, perceived barriers to success, and activities outside the classroom. More emphasis needs to be put on the effect of these factors on young women. Learning how successful IT and engineering professional female faculty responded to these factors may help identify
Traditionally male dominated careers emphasize the characteristics of authority, rationality, and self-control necessary to succeed as managers. Good managers have been described as “unemotional, intelligent, fair, and able to interact well with subordinates and colleagues alike” (Demaiter and Adams, 2009, p. 34). Mental toughness, aggressiveness, rationality, power, competence, and commitment to work are rewarded (Hatmaker, 2009). The question then becomes what are the characteristics of women who are entering such professions? Do these characteristics contribute to or create barriers to their success?

In a similar vein, Martin and Knopoff (1997) challenge the fundamental assumptions of bureaucratic organizations, including their gender neutrality. They observe that the set of values underlying the structure of contemporary organizations devalues and excludes women’s experiences by imposing perspectives and practices biased in favor of men. Few, if any, of these assumptions have been tested in the community college setting.

IT and engineering have traditionally been, and continue to be, male dominated professions. According to a report by the National Science Foundation, *Women, Minorities, and Persons with Disabilities in Science and Engineering*, in all areas of IT and engineering employment, men outnumber women 73% to 27%. The gap is largest in business and industry where men outnumber women 79% to 21% (NSF, 2007, pp. 14-15). The IT/engineering “occupational culture has been described as masculine, manly,
and male-centered by both academic and industry researchers” (McIlwee & Robinson, 1992, p. 109), thus according to Hatmaker, this culture “presents a rich environment from which to learn about women's professional identity construction in a gendered occupation” (Hatmaker, 2009, p. 219).

Ours is a society in which the design, sharing, use and integration of information is a critical economic, political, and cultural activity. Many IT and engineering jobs are higher-skilled, higher-paid jobs. Including more women in IT and engineering could create new opportunities for financial stability for a larger portion of the United States population (U.S. Department of Labor report, 2007). The inclusion of more women in the IT and engineering workforce has become more important as the modern United States economy develops. It is crucial to examine the causes of women’s declining participation in IT and engineering because their influence will increase as the modern United States economy grows (Trauth, Quesenberry, Yeo, 2008). Engineering’s connection with the development of and IT workers’ role in the support and maintenance of technological devices and processes has broad implications for innovation throughout the world.

Human capital is represented by employees’ competencies, knowledge and personality attributes that produce economic value. This representation of human capital emphasizes the importance of the talents and capabilities that individuals contribute to the process of production. These attributes are gained through education and experience. The human capital requirements of our highly technical world make evident the need for women to become stronger participants as creators, designers and specialists in IT and
engineering professions. Fountain (2000) believes that “stronger representation by women in design and technical roles would not only help to address our human capital deficit, but also is probable to change and expand the range of technological applications, products, standards and practices to benefit all of society” (p. 1).

The underdevelopment of human capital represented by women is a national problem. The under-representation of women in IT and engineering is emphasized by the fact that women represent only 3% of the leadership positions in IT in the United States and only 11% of the engineering workforce (National Center for Women and Information Technology, 2010).

The industry is failing to attract and retain a diverse range of computing talent. Even though a large investment has been made since the late 1980’s to help address the decreasing number of women entering and persisting in IT and engineering undergraduate programs, very little increase in graduation rates has been achieved (NSF, 2007). The NSF (2007) reports that computing professions rank among the top ten fastest growing professions. It predicts that only half of the available IT jobs will be filled in 2016 if current trends continue. According to a study conducted in 2010 by the National Center for Women In Technology (NCWIT), only “18% of computer and information science degrees were awarded to women in 2008, down from 37% in 1985” and women held only “24% of professional IT-related occupations in the United States 2008 workforce, down from 36% in 1991” (NCWIT, By The Numbers Report, 2010, p.1).

Findings from NCWIT study show that IT “is one of the fastest growing industries” (NCWIT, 2010, p.1) in the United States. Technology professions will
become increasingly more important in world economies, yet a study conducted by the National Association of Colleges and Employers (NACE, 2009), found fewer people graduating with math-based majors, such as IT and engineering. College women’s representation varies by field: the ratio of men to women is 65/35% in chemical engineering degrees, 86/14% in electrical engineering degrees and 93/7% in mechanical engineering degrees (NSF, 2007). By middle school, girls show less interest computers and have fewer computer skills than boys (AAUW, 2000; Margolis & Fisher, 2002) and the number of females choosing degrees in IT and engineering has been on the decline since the mid-1980s (Spertus, 2004). In 2007, women represented only 11% of the engineering workforce (NSF, 2007). Even in master and doctoral level IT and engineering programs, the percentage of women continues to decline (National Science Board, 2006, 2008).

Researchers have identified many factors that may influence the under-representation and decline of women in IT and engineering, but there is still no clear understanding of why this phenomenon exists. We know we are losing women, but we do not know enough about what helps them succeed in order to design programs and policies to recruit and retain them. The findings from this study are intended to provide insight into what women in IT and engineering need in order to succeed as faculty members in public community colleges as well as the barriers they encounter. I also plan to provide clear recommendations for actions and policies needed to address the issue of their under-representation in the fields of IT and engineering.
Creating more opportunities for women in IT and engineering education may yield dividends beyond the obvious goals of attaining increased social justice and diversity in these academic fields. Minna Salminen-Karlsson viewed increased participation by women in IT and engineering as a “significant educational and public policy issue that will affect the future economic competitiveness of the United States in the global marketplace” (Salminen-Karlsson, 2002, p. 435). Her research calls for not only increasing the enrollment and retention of female IT and engineering students, but also enabling female students to have “full access to the educational experiences women must have” (Salminen-Karlsson, 2002, p. 435) in order to develop the inherent learning objectives they need to produce success in IT and engineering employment beyond the classroom.

Moore, Schuurman, & Bogue (2004) presented a paper at the Annual Conference of the American Society for Engineering Education that outlines how decisions about women persisting in an IT or engineering major are influenced. Their research focused on whether “organizational and social structures, rather than generalizations about gender group characteristics” (Moore, et. al., 2004, p. 3) influence decisions women make about persisting in a major. As a result of their research, they believe it is important to understand the uniqueness of the computer science and engineering workforce, especially the opportunities and restrictions that effect IT and engineering professionals’ decisions to continue in their careers. Their research emphasized the need to investigate “individual career anchors (or self-perceived values and career motives) and how these factors relate to career satisfaction and turnover intentions among females” (Moore, et. al., 2004, p. 5).
My study focused on the importance of understanding those self-perceived values and career motives and how decisions about an IT or engineering majors are influenced.

Community college faculty members teach and advise 40% of the incoming first-year college students in the United States. Keeping these females in IT and engineering majors and encouraging them to transfer to four-year institutions will help increase the number of IT and engineering graduates and thus increase the number of female IT and engineering majors entering the workforce.

Studies show mentoring female students has proven to be a successful retention strategy (Blake-Beard, 2001; Seymour & Hewitt, 1997; Dee, 2009; Clark, 2007; Lockwood, 2006). Faculty serving as role models have the opportunity to influence students’ choice of major. Producing fewer female IT and engineering graduates impacts the potential number of IT and engineering faculty members, which in turn impacts the number of available role models. If there were more female IT and engineering majors, we would potentially have a larger pool of women available to recruit into faculty positions and to the community college environment specifically. Increasing the number of women pursuing degrees in IT and engineering will help increase the number of graduates. This creates potential for increasing the number of female community college faculty members. Community college faculty members have the opportunity to mentor and serve as role models for female students. Attracting more female community college faculty would increase the number of mentors and role models available to IT and engineering students.
According to a report published by the National Center for Education Statistics (2008), the ratio of female to male faculty is relatively equal at community colleges, whereas the ratio of female to male faculty at public and private 4-year institutions is roughly 40/60. Female undergraduate students are much more likely to have personal contact with academics, or a female mentor, at the community college because of smaller classes and a higher percentage of female faculty members.

Statement of the Problem

The declining number of women choosing to pursue degrees in IT and engineering since the late 1980’s has impacted the number of women in IT and engineering careers at higher levels in organizations (National Science Board, 2006, 2008). Based upon data from the U.S Department of Labor, Bureau of Labor Statistics (2011) freshman college women declaring a major in computer science between 2000 and 2011 has declined by 79%.

By 2016 the United States will have 1.5 million IT jobs available and universities will only produce 53% of the computer science baccalaureate degree graduates needed to fill them (NCWIT, 2010). In order for the United States to compete, more students need to be encouraged to pursue degrees and careers in IT and engineering. Even though the demand for skilled IT and engineering professionals is increasing, the number of females graduating with IT and engineering degrees is decreasing (NSF, 2007). In 1985 women earned 37% of computer science degrees. This was a high point for women; in 2010 the percent of computer and information science degrees awarded to women had dropped to 18% (U.S Department of Labor, Bureau of Labor Statistics, 2011). Since women represent roughly 50% of our population, it is important to understand why they do not represent a larger percentage of the
IT and engineering workforce. Increasing the number of women pursuing degrees in IT and engineering will help increase the total number of graduates, thus increase the percentage of graduates United States universities will produce to fill the 1.5 million available jobs.

According to a study conducted by the American Association of University Women (AAUW), women represent a very low percentage of graduates from IT and engineering majors, thus women represent a very low percentage of IT and engineering professionals. Women are choosing to go into other fields; they find other professions, specifically law and medicine, more appealing (AAUW, 2000). Increasing the number of women in IT and engineering majors would increase the number of graduates. Researchers are interested in what influences women’s choice of college major; the more that is known about how women are making those choices, the better prepared colleges will be to attract and retain women to the IT and engineering field.

Since a large percentage of students begin at a community college, the community college may be a place where significant improvement can be made to recruit and retain women in IT and engineering disciplines. According to the American Association of Community Colleges (AACC, 2010), 43% of all faculty members in public colleges and universities are employed at public two-year institutions and 40% of all first year college students attend community colleges. Community college faculty have the opportunity to influence students’ choice of college major.

A study conducted by Stacy Blake-Beard (2001) found that female students respond positively to mentors. Female faculty play an important role recruiting, mentoring, serving as role models and retaining female students. Female faculty who
work to recruit female students are able to encourage them to value their academic talents and pursue careers in IT and engineering. These faculty members have insight into the college application process and can help students focus on college readiness, preparation and choice of major. According to Blake-Beard (2001):

Mentoring helps create better and more cooperative learning environments on campus. Mentors can help cultivate closer relationships with students, some of whom may become peers in the future, thus promoting greater representation and retention of women in academe. (p. 333)

Community college faculty members have the opportunity to mentor and serve as role models for female students. Attracting more female community college faculty would increase the number of mentors and role models available to IT and engineering students. While 57% of 2010 undergraduate degree recipients were women, only 36% of the full time faculty at community colleges were women (National Study of Postsecondary Faculty (NSOPF):04 data (Cataldi, Fahimi, & Bradburn, 2005). Increasing the number of female community college faculty in IT and engineering would increase the number of role models at community colleges available to recruit and retain female students.

Why do we not have more women studying IT and engineering? We begin losing females as early as the eighth grade. Another significant drop in interest occurs between high school and college. A third significant drop happens when declared IT/engineering majors change their majors. Tracy Camp first referred to the “pipeline” as a representation of the percentage of females participating in computer-related coursework
from secondary through their post-secondary studies in her journal publication, “The Incredible Shrinking Pipeline” in 1997. With all the leaks we have in our pipeline it is no wonder we do not have more female faculty. What strategies do women employ in order to persist and become successful community college faculty members?

It is important to understand strategies for success that successful IT and engineering faculty members have developed so that we have a better understanding of what contributed to their success. This can contribute to a better understanding of how to nurture and support more female students who in turn may choose an academic career in IT or engineering. We need to study the 1) characteristics and behaviors of female community college IT and engineering faculty that enabled them to build strategies for success, 2) strategies these female IT and engineering faculty members developed to help them overcome barriers they encountered along the way and 3) social, educational and family experiences that women in IT and engineering believe influenced their decision to become an IT/engineering faculty member.

Purpose of the Study

The purpose of this study was to explore characteristics and behaviors of female community college IT and engineering faculty in the belief that insight into persistence, success, and strategies that these women have used to overcome barriers may in turn help us nurture younger women and facilitate their pursuit of IT and engineering careers. These women serve as role models for younger women beginning to pursue careers in IT and engineering. This study helps address the problem of the United States declining competitiveness in IT and engineering. The results of this qualitative study will help to
more clearly define the characteristics of women who have successfully pursued careers as IT and engineering faculty members. Nurturing these characteristics in younger women may help to encourage them to pursue degrees in IT and engineering and therefore mentor our next generation of IT and engineering professionals.

Research Questions

The research questions, as well as follow up questions that guided this study were:

1) What are the educational, social, and familial experiences that women in IT and engineering cite as influential in their decision to pursue a faculty position in an IT and engineering field?

Statistics show that girls are less interested than boys in careers in computing and engineering. What characteristics or previous life experiences have you had that led you to become interested in your IT/engineering career? What attracted you to IT or engineering? From your own past, what drives you to do this work?

Studies show that women lose confidence from middle school through doctoral programs. How do successful IT and/or engineering women stay confident? Who was influential in helping to instill confidence in you?

Do you think it is important to have mentors? Who have been your most important mentors in your career? How have they influenced you?

2) What strategies did these female IT and Engineering faculty members develop to help them to overcome barriers they encountered along the way?

Studies show lower job satisfaction as one reason women leave IT and engineering careers. Are you satisfied with your job? What strategies do you use to overcome barriers that would inhibit your satisfaction with their job? Why do you stay in your IT/engineering career?
Studies show that isolation can also be a factor in the retention of women in IT and engineering. Do you feel isolated? If so, how do you overcome or compensate for those feelings?

Many studies show that family-related issues cause women to leave the field. How have you managed the balance? What would you say to someone who assumes that teaching in a community college will allow her to more easily balance work/family?

3) What are the characteristics and behaviors of female community college IT and engineering faculty that enabled them to build strategies for success?

As a female community college faculty member in IT or engineering, what is your role in this whole challenge of the lack of women in IT and Engineering? How do you see your role as influencer of young women? What is your role in encouraging young women? What are you going to do to replicate yourself?

Significance of the Study

Recruitment of young women into IT and engineering disciplines is important. Retention is also a challenge. The challenge of keeping women in the field is not new. Rosemary Wright published her research findings in 1997 and concluded that “women leave STEM fields at a higher rate than their male peers” (Wright, 1997, p. 19).

A Harvard Business Review Research Report, *The Athena Factor: Reversing the Brain Drain in Science, Engineering, and Technology*, (Hewlett, et. al., 2008) found that over 40% of engineers and technology professionals at the lowest levels of corporations are now female and that fifty two percent of women leave IT and engineering careers.

would cultivate better decision making. The findings from this select subset of women are intended to provide insight into how these women who have chosen and persisted in IT and engineering were able to succeed in college and persist to graduation.

When studying the under-representation of women within the IT and engineering professions, the influence of factors in the socio-cultural environment should not be overlooked. In 1975 Tinto conducted a study exploring socio/cultural aspects of peoples’ college and career decisions. According to Astin’s theory of involvement and Tinto's interactionalist model of individual student departure there are issues with persistence in college. Tinto (1975) says that, “a higher degree of interaction of students into the academic environment and social tracks are contributors in solving the institutional problem of retention” (p. 123). Socio-cultural factors such as confidence and availability of mentors were addressed in the study. Trauth, et. al. (2008) believe that, “socio-cultural factors serve as both barriers to and facilitators of women's recruitment and retention” and that there is a need for studies of “not just women themselves, but also of the societal environments within which they live and work” (p. 8).

The declining number of women pursuing degrees in IT and engineering since the late 1980’s has impacted the number of women in IT and engineering careers at higher levels in organizations (National Science Board, 2006, 2008). In order for the United States to stay competitive at higher levels, more needs to be done to encourage women to pursue degrees and careers in IT and engineering, but not enough is known about the characteristics of women who are successful in these disciplines. The intent of this study was to study those characteristics shared by the study group that led to their success.
In their book, *Talking About Leaving*, Seymour & Hewitt (1997) discuss their findings on the reasons that lead undergraduates of strong ability in science, mathematics and engineering to switch to non-science majors. Differences in classroom interaction between males and females was a focus of their work. They saw that male students more often received praise, positive attention, critical feedback and support for assertive behavior. Girls were not as assertive, less demanding and less experiential. They concluded that this contributed to girls’ lower self-confidence in female students and less faith in their abilities to perform mathematical calculations. Girls prefer cooperative learning opportunities and tend to credit achievement in mathematics to their efforts, but lack of achievement to lower mathematical capabilities; boys tend to credit achievement in mathematics to higher mathematical capabilities, but lack of achievement to their lack of effort. Data shows little difference in science and math achievement before the ninth grade. After middle school, differences in male and female students increase not only in the number of math and science courses they take, but their academic success in these subjects. Data from a study conducted by the National Science Foundation (2008) on science and engineering degrees support Seymour and Hewitt’s findings: undergraduate students leave engineering programs at a rate of 40%, physical and biological sciences 50% and mathematics 60%.

Seymour and Hewitt surveyed over 5,000 bright male and female students who were admitted to four universities. During their first two years of study women’s exit from science, math and engineering (SME) majors was forecast by low science course grades. What produces a gender disparity in science and mathematics course results
during the first two years at these four institutions? Seymour and Hewitt (1997, p. 9) found both undergraduate and graduate level women experienced “feelings of psychological alienation or depression” which, in turn, “plays a critical role in their decisions to leave technology based disciplines”. Regardless of good academic achievement, the women in this study experienced lower self-esteem, a decrease in self confidence and a lessoning of career ambition.

Among college seniors surveyed by Seymour and Hewitt, dissatisfaction with all faculty as teachers was higher among women (80.3%) than male students (66.2%). This differential is troubling. Young women respond positively to mentors and role models, yet 80.3% of those polled are dissatisfied with their faculty (Seymour & Hewitt, 1997). Since the percentage of female IT and engineering faculty is higher at community colleges, it is more likely that students at community colleges will have female IT and engineering faculty to serve as mentors and role models.

Women in faculty and leadership positions are essential to the development of IT and engineering talent. Female faculty, particularly in male-dominated occupations, act as role models for female students, which may result in an increase in enrollment in these disciplines at academic institutions (Martin, 2005).

In community colleges, successful faculty (men and women) are needed because of important functions that these institutions perform within the system of higher education. Two-year institutions contribute to the development of IT and engineering students by providing an academic foundation for those seeking baccalaureate degrees,
educating a skilled math and science workforce, and through significantly contributing to local economic development (Cohen & Brawer, 2003).

This study utilized focus groups that investigated career paths, employment outcomes, and factors that influenced academic career success for female faculty in IT and engineering related disciplines at public community colleges. A sizeable portion of faculty and instructional staff work in the two-year sector. According to the American Association of Community Colleges, 43% of all faculty members in public colleges and universities were employed at public two-year institutions and 40% of all first year college students attend community colleges.

Community colleges can help fill a need for more IT and engineering graduates if the talents of both female and male well-qualified IT and engineering students are developed to their fullest potential. More in-depth examination of IT and engineering women faculty at public two-year institutions is needed to understand their career choices and success. The broader impact of the study stems from today’s climate of economic downturn. It is important to explore how community colleges may contribute to developing IT and engineering talent so that we have the advantage of more female faculty members who in turn influence IT and engineering students to become graduates and enter the workplace.

Delimitations

This study concentrated only on female IT and engineering community college faculty members in the We Are IT! consortium in Ohio. By focusing on only female IT and engineering community college faculty members in the We Are IT! consortium in
Ohio, there may be limitations to the study. The study will not present the perspectives of male IT and engineering faculty members or non-IT and engineering faculty of either gender. It will not present the perspectives of faculty from four-year institutions or institutions outside of Ohio or the United States.

Limitations

One of the strengths of qualitative research is that issues can be examined in depth and the facilitator can guide/reframe questions. At times this approach produces data which is rich and sometimes more powerful than quantitative data. Details and nuances about the research participants and/or topics are revealed which are often overlooked by other means.

Even so, the quality of qualitative research relies heavily on the particular skills of the researcher and could be influenced by the researcher's personal biases.

When using qualitative research, concerns about anonymity and confidentiality could also present problems when presenting findings. This group of subjects has worked together since 2006 and has had much interaction together.

There were 16 participants in this study. These women are full time IT or engineering faculty members in community colleges in Ohio who have served together on the We Are IT! state-wide committee. This group may not accurately represent the larger population of female community college IT/engineering faculty.

The short amount of time focus groups spent together could be a disadvantage where trust building is concerned. Even though the researcher has worked with the We
Are IT! consortium since 2006, it takes time to build participant trust which facilitates self-disclosure and honesty.

The researcher's presence during data gathering can affect the subjects' responses. Therefore, my presence during data gathering may have affected participants' responses.

Assumptions

Several assumptions are made in this study. Women are as capable as men of participating and succeeding in an IT and engineering career. They are equally talented academically in math and science and play valuable roles in IT and engineering professions. This study also assumes the importance of women and their perspectives on the future of IT and engineering and that more female faculty will have a positive influence on female students and their career choices. Finally, the assumption is made that there are factors, other than academic, that determine whether women pursue a career in IT or engineering.

Definition of Terms

*Community college.* The American Association of Community Colleges (AACC) describes community colleges as “two-year, public colleges that provide associate's degrees and also prepare students who will transfer to four-year institutions” Retrieved from American Association of Community Colleges web site: http://www.aacc.nche.edu.

*Engineering.* The American Engineers' Council for Professional Development defines engineering as:

the creative application of scientific principles to design or develop structures, machines, apparatus, or manufacturing processes, or works utilizing them singly
or in combination; or to construct or operate the same with full cognizance of their design; or to forecast their behavior under specific operating conditions; all as respects an intended function, economics of operation and safety to life and property. Retrieved from Engineers' Council for Professional Development web site: http://www.abet.org.

Most community colleges include electronics, automation and robotics, industrial management, advanced manufacturing and mechanical design in their engineering technology programs.

*Human capital.* Human capital in this research is represented by employees’ competencies, knowledge and personality attributes that produce economic value. This representation of human capital emphasizes the importance of the talents and capabilities that individuals contribute to the process of production. These attributes are gained through education and experience.

*Information technology (IT).* The Information Technology Association of America (ITAA) defines IT as “the study, design, development, implementation, support or management of computer-based information systems, particularly software applications and computer hardware”. Retrieved from The Information Technology Association of America web site: http://www.itaa.org.

Most community colleges include courses such as programming, operating systems concepts, database management, networking, computer hardware, computer systems development, computer security and forensics in their information technology programs.
Mentor. According to the Merriam-Webster dictionary, a mentor is one who serves as a teacher or trusted counselor, an advisor for students and a wise and trusted guide to other teachers.

We Are IT!. The We Are IT! steering committee was formed in 2006 and represents 21 colleges across Ohio. This group is funded by the Ohio Department of Education. This grant funded consortium is designed to encourage young women in grades 8-10 to consider careers in IT. Members of the steering committee are female community college IT and engineering faculty members. In 2011 the grant was renamed We Are STEM! to include science, engineering and math.

Summary

The purpose of this study was to explore characteristics and behaviors of female community college IT and engineering faculty. These women serve as role models for younger women beginning to pursue IT and engineering careers. Clearly defining the characteristics of women who have successfully pursued careers in IT and engineering that have contributed to the persistence, success and strategies these women use to overcome barriers in the field may help us to nurture younger women, therefore encouraging more women to pursue careers as IT and engineering professionals and faculty members.

In Chapter II I review research that has examined the role of women in IT and engineering. In Chapter III I outline my qualitative method in depth. In Chapter IV I share the findings of the focus group sessions I conducted telling their stories, outlining common categories and defining emerging themes. Finally, in Chapter V I present a
summary of the study based on the data gathered through focus groups, put the literature
review into context, make suggestions for practice and discuss future research.
CHAPTER II: LITERATURE REVIEW

The decrease in the number of women entering the information technology (IT) and engineering fields in the United States today is perplexing. A good deal of the research on this subject has focused on what keeps women from entering the fields of IT and engineering, not what strategies IT and engineering professionals have developed that contribute to their success. Topics such as girls’ lack of interest in the fields of IT and engineering, gender differences in the classroom, self-confidence/self-esteem, job satisfaction and retention of women in IT and engineering positions, isolation and balancing family and career have been studied. Researchers have also studied the success of mentoring programs and the importance of diversity in product design.

Little research has been done to analyze the causes of success or persistence of women pursuing careers in IT and engineering in contrast to defining negative influences and effects. Studies have focused on the attitudes and experiences of women at three specific stages of their lives: secondary (middle/high school), post-secondary (college/university), and professional women in IT and engineering. Most research has been based on the causes for women’s lack of participation.

The loss of women starting as early as middle school has often been compared to a “leaky pipeline” (Camp, 1997, p. 104) for women. Tracy Camp first referred to the “pipeline” as a representation of “the ratio of women involved in computer science from high school to graduate school” in her journal publication, *The Incredible Shrinking Pipeline* (1997, p. 104). Earlier research helps us understand the societal environments
within which female faculty members in IT and engineering at community colleges have grown up, live and work.

The study group members, female community college faculty who teach IT and/or engineering, were chosen because one of the places we can have a national impact on young women is in our colleges and universities. Few studies have focused on female IT and engineering faculty members and their strategies for success. Far fewer have focused on successful community college faculty and the barriers they have overcome. Female community college faculty members’ attitudes began forming while they were young girls. How did past experiences impact their choice of major? It is important to understand the strategies these women developed in order to persist and become successful from middle school through their academic and professional careers.

Past experiences help build the framework for the decisions women make about career choices. My review of the research on women’s under-representation in the fields of IT and engineering focused on the characteristics of women in IT and engineering that may have supported them through their educational experience and allowed them to succeed and persist in their IT and/or engineering career.

McKinney, et. al. (2008) conducted a web-based survey in 2003 that assessed the viewpoints and experiences of over 800 male and female IT professionals working in numerous industries across the United States. They concluded that there are two general reasons why women are underrepresented in IT: not enough women are entering the IT field, and when women do enter they IT field, they leave at a higher rate than their male peers. Their study found surprisingly little difference between the genders when focusing
on experience in and connection to their profession. McKinney, et. al. (2008) suggest that the problem of under-representation may be caused by fewer women entering IT, not by more women leaving IT.

Findings from this 2008 study revealed only one significant gender difference between male and female IT professionals. The participants felt similarly about “experience regarding the work-family balance, feelings of burnout, perceptions of work load, questions about fair treatment in job scheduling, realities of job responsibilities and the amount of supervisor support related to family issues” (McKinney, 2008, p. 83). The difference was evident in relationship to their insight into how supervisors supported their careers. These findings suggest that women require different kinds of support in achieving professional goals, identifying career opportunities and excelling in their jobs from their superiors or mentors.

Female IT professionals in this study were not significantly different from their male counterparts in their relationship to IT. The authors suggest that even more support is necessary before girls choose their career path. Girls’ familiarity with the variety of computer career opportunities and early identification with technology are important.

Use of the Internet and technology continues to explode. The United States economy increasingly requires a labor force with computer technology based skills. Demand for professionals able to design, build and utilize these new technologies is not limited to the technology and engineering industries, but extends into service industries, medicine, engineering technologies, supply chain management, government services and education. According to the Bureau of Labor Statistics (2008) economic growth and
national competitiveness will decrease as a result of shortages in technology and engineering professionals (computer scientists, programmers and engineers) and therefore effect the development of new and innovative products and services.

Fountain (2000) believes the United States policies developed around employment and education need to be updated in order to sustain growth in our information technology society. She also believes the current United States economy offers a great “opportunity for women to assume leadership roles in research and development of information technologies and applications” (Fountain, 2000, p. 47).

Previous Studies Involving Girls and Women in IT and Engineering

Prior research findings involving girls and women in IT and engineering helped develop the research questions that guided my research. Topics included girls’ interest in math and science, gender differences in the classroom, issues with confidence, the importance of mentors, job satisfaction, isolation and family-related issues.

Girls Express Less Interest

As early as middle school, girls become less interested in math or science careers than boys (Lapan, Adams, Turner, Hinkelman, 2000; Turner, Conkel, Starkey, Landgraf, Lapan, Siewert, 2008). A 2009 poll conducted by the American Society for Quality (ASQ) queried students between the ages of 8 and 17 and discovered that just 5% of the females were interested in pursuing an engineering career compared to 24% of the males in the study (American Society for Quality, 2009). Another 2009 poll, conducted by the Education Foundation & Association for Computing Machinery, queried students ages 13–17 and 74% of the boys responded that they would choose computer science as a
college major. Only 32% of their female peers expressed a similar interest. (Education Foundation & Association for Computing Machinery, 2009).

This study builds on the research of Tillberg and Cohoon (2005) who focused on what is attractive to women about computer science (CS) field which is part of the larger IT discipline. Part of their research focused on students’ choice of major. Their study found that, “there are informal criteria for the selection of major that support entry by certain populations but filter others out” (Tillberg and Cohoon, 2005, p. 137). Women who fit the criteria are more comfortable enrolling in introductory computer coursework, but are less likely than men to meet this computing profile. Tillberg and Cohoon conclude that providing women the same pre-college activities, encouragement, skills and confidence building men have could help women have more long term CS success.

In their study, 182 United States students from 16 computer science departments provided data through 31 focus groups. From their analysis, they found students’, “initial experiences with computing - parents, teachers, work, play, peers and core curriculum” (Tillberg and Cohoon, 2005, p. 128) were the most common influences for their choice of major.

Most of the Tillberg and Cohoon (2005) focus group participants were: attracted to computing by experiences with either parents who introduced them to computing and supported their interest, teachers who encouraged them, exposure at work, or the pleasure of playing on a computer. Female students did not have much exposure to computing as their male counterparts. (p. 128)
Instead, these students were influenced by college peers who were either role models or actively encouraged them. Other females became interested in CS after enjoying an introductory computing class which was a mandatory part of their core curriculum.

The similarities suggest that the choice of major attracts primarily students from five distinct categories. Categories included those who: 1) entered college with prior computing experience at work, school, or home; 2) had support from parents or teachers to engage in computer science; 3) feel adept in math and logic; 4) excel at programming; and 5) are interested in careers that offer flexibility and opportunity. Young women who do not meet the informal criteria for the selection of major are more likely to filter themselves out of the IT and engineering fields.

Tinto’s and Astin’s studies on social/cultural aspects help explain some of the reasons that women are under-represented in IT and engineering. One factor may be that these professions are ‘geek’ professions and not attractive to women; another may be that young women respond differently than young men in various classroom environments. The third is that women are much more attracted to collaborative learning; if they are the only woman in the class, they tend to drop out. Finally, issues with confidence may contribute to young women’s persistence in their career choices.

‘Geek’ Professions Are Not Attractive to Women

IT and engineering careers may bring about images of the “lone scientist” or “geeks” and their technology and gadgets. Because women tend to support “communal goals” (working with others) (Diekman, et. al, 2010, p. 1052), more than men, this perception may particularly influence women’s IT and engineering career decisions. A
study done at Miami University (Diekman, et. al., 2010) proposes that career choice may be the result of people’s preconceptions of what those careers have to offer. Their hypothesis was that people perceive IT and engineering careers as not being compatible with their goal of working with others or an emphasis on caring for other people. The authors posit that because women tend to support communal goals, they may choose careers other than IT and engineering in favor of careers that seem to favor those goals.

Diekman, et. al., (2010) points out that girls who perceive careers to be altruistic tend to show more interest in them. Possibly when girls believe that IT and engineering careers, “do not involve helping or working with others the result may be that even scientifically talented women frequently choose careers they believe will allow them to fulfill their goals” of working with and helping others (Diekman, et. al., 2010, p. 1055). Examples from faculty members could show students how IT and engineering disciplines involve working with and caring for others, which could help provide the link to mathematics and science and help females to succeed.

Girls in the Classroom

A persistent theme for both IT and engineering, including computer science, is that women are attracted to programs that emphasize application of the technology (Randall, Price, Reichgelt, 2003). Research shows that girls respond positively to a different learning environment than boys (Moore et. al., 2004). Moore’s study found that when learning becomes co-constructed, collaborative, interdisciplinary, creative and personal, girls, more than boys, become more active. The aim of a curriculum developed to enhance girls’ learning is to provide students with individualized academic support, a
group of peers, mentors, examples of successful women in technology, contact with a
diverse range of technology and individual successes along the way.

Helping “women adapt to a traditionally masculine field” (Salminen-Karlsson, 2002, p. 430) is just part of what needs to be done in IT and engineering programs. Salminen-Karlsson (2002) believes that it is important to first identify gender patterns in development and learning. Her research indicates that, “males and females may need different challenges and support systems to ensure their future skill levels” (Salminen-Karlsson, 2002, p. 433). She suggests that faculty should emphasize teaching applied skills to aid female students in problem solving and design. The use of active learning pedagogies in class “encourage(s) female students to develop their group skills” (Salminen-Karlsson, 2002, p. 433).

Gender differences in perceptions about and attraction to technology begin as early as middle school (AAUW 1992; NSF 2007). Even though girls and boys enroll in the same number of high school science courses and do as well (AAUW, 2004), many girls who enroll in math and science courses in high school do not choose to study technology in college. Girls do, however, respond more positively than boys to female mentors (Seymour & Hewitt, 1997). Thus, this study focuses on female community college IT and engineering faculty members who have persisted through college and on to a community college faculty position and who serve as mentors to their female students. Research indicates that access to effective mentoring is vital to advancement in academic careers (Blake-Beard, 2001).
Despite the national and local initiatives to bring technology into schools in the twenty-first century, few computer science learning opportunities actually exist at the high school level. Cohoon and Aspray (2006) found that three things had significant impact on students’ interest in computer science: an understanding of what computer science is, negative experiences in the classroom and lack of focus on critical thinking skills in the curriculum. They concluded that limited and narrow presentation of what computer science is as well as what computer scientists actually do impacts students’ views on how computer science could further their academic and career endeavors. Also, for the female students who do take computer science, there is evidence showing negative experiences in the classroom, and despite the critical-thinking and problem-solving skills that are the foundation of computer science, curricula of most computer science classes at the secondary level are missing a higher-order thinking focus. Community colleges can work with their secondary partners (high schools) to start to make necessary changes to help girls become more successful. Some of these changes may include curriculum designed around research that shows that a network of peers, mentors, successful female role models in technology and exposure to a wide range of technology are positive influences for girls (Fox, Sonnert, Nikiforova, 2011).

Moore’s study presented at the Annual Conference of the American Society for Engineering Education examined whether “the shift to the soft or less technical skills in engineering encouraged by new accreditation standards could potentially have differential effects for women in engineering than their male counterparts” (Moore et. al., 2004, p. 17). In particular, Moore’s study explored the proposal that “program practices
and policies, faculty members' activities and the experiences of engineering students in college, affect the learning of female students differently than that of male students” (Moore et. al., 2004, p. 19). They found that when learning becomes co-constructed, collaborative, interdisciplinary, creative and personal, girls, more than boys, become more active.

Women Are Much More Attracted to Collaborative Environments

Seymour and Hewitt (1997) found that girls show a preference for collaborative learning and respond positively to female mentors. They conclude that one way to reduce female students’ feelings of isolation and to make them feel more welcome is to ensure that they have female role models and mentors. Thus, this study focuses on female community college IT and engineering faculty members who have persisted and who serve as mentors to their female students.

Findings from a 2010 study conducted by the American Association of University Women (AAUW) show that although good professional and personal interactions with colleagues are important for both female and male IT and engineering faculty, such interactions may be critically important for women. Many IT and engineering departments may have only one or two women, so that a female faculty member may be the only woman in the department. Feelings of isolation, few female peers and lack of mentoring are particularly serious problems for women in STEM disciplines (AAUW, 2010).

According to a 2010 AAUW study, “Isolation is a critical problem that can be a major source of dissatisfaction among female faculty and can influence their decision to
leave the field. Women report being excluded from informal social gatherings and formal events, as well as from collaborating on research or teaching” (AAUW, 2010, p. 59).

Women may have a tougher time advancing in their careers since it is less likely that female faculty have role models or mentors than their male counterparts. A recent study by the National Academy of Sciences found that male faculty were significantly more likely than female faculty to report having discussions with colleagues about research, salaries and benefits. The study results also emphasized the importance of fit, highlighting that the most problematic kind of attrition involves faculty who leave because they feel unwelcome. (National Academy of Sciences, 2006).

A study of successful four-year programs for female science and engineering undergraduates examined ways programs “express issues, problems and solutions for improving the participation of women in science and engineering as “individual,” as opposed to “structural/institutional,” concerns” (Fox, et. al., 2011, p. 590). They looked at the on-going and divisive dispute over whether it is “the women or the social systems of education and work that need to be ’fixed’” (Fox, et. al., 2011, p. 513) in order to increase the performance and investment of women in science and engineering. They conclude that women are not the problem, the system is. They emphasize the importance of working toward systemic transformation. The institution needs to create communities for female students, strengthen their involvement in careers in science and engineering, and help female students develop positive attitudes and self-talk, showing that the institution has put policies in place that will help recruit and retain female students in science and engineering.
Issues with Confidence

Literature concerned with the experiences of women in IT and engineering frequently addresses issues such as confidence and self-esteem. A pattern of decline in confidence emerges beginning in middle school. Why So Few, a 2010 study by the AAUW, found that women entering engineering majors describe themselves as self-confident with positive self-esteem. Their self-confidence begins to decline as early as their first year of college and even though it tends to increase, it never reaches pre-college levels. Women judge themselves harshly when comparing themselves to male classmates during college, much more so than those male classmates judge themselves. Even though female engineering students perform as well as or better than male students, women cite one of the major challenges to completing their engineering degree is lack of self-confidence. Women attribute the lack of confidence in their abilities to their decisions to leave engineering. Women are more likely to leave their engineering degree programs altogether when they earn failing grades. Their male classmates are more likely to continue in their programs and repeat the failed course. Supporting activities that will help to develop girls’ confidence in math and science courses will help to increase interest in these technical disciplines. The AAUW (2010) study also found that:

When teachers and parents tell girls that their intelligence can expand with experience and learning, girls do better on math tests and are more likely to say they want to continue to study math in the future. Believing in the potential for intellectual growth improves outcomes. (p. xiv)
The AAUW research also found that, “girls assess their mathematical abilities lower than do boys with similar mathematical achievements”, while also “believing that they have to be exceptional to succeed” (AAUW, 2010, p. xv) in what they consider male disciplines.

As part of Seymour and Hewitt’s three-year, multi-campus research study, male peers of senior women students were interviewed. These men described their female peers’ aptitude and interest in science or mathematics as unnatural and were likely to describe women who chose IT and engineering majors as: essentially ugly; being too busy with college assignments to learn to make herself attractive; become less attractive after becoming math or science majors; or subtly inferred they might be lesbian (Seymour & Hewitt, 1997). How do IT and engineering faculty deal with this kind of cultural bias?

Seymour and Hewitt also discovered that a change from their past educational and social experience is a common theme among women and men in IT and engineering majors. Most women surveyed in the study entered college with high self-confidence, high quality secondary achievements, good Scholastic Aptitude Test (SAT) scores and a lot of support and encouragement from high school teachers, family and friends. However, by the end of their freshman year, these same high achieving, very confident young women began to experience feelings of insecurity, intimidation and isolation. They questioned whether they should even be enrolled in the sciences and if they should continue in their coursework (Seymour & Hewitt, 1997).
According to a study by Brainard and Carlin (2001), female undergraduates begin their IT and engineering studies highly qualified and capable, but experience low self-confidence by the end of their freshman year.

As the Seymour and Hewitt study found, young women react positively to mentors. The female community college IT and engineering faculty members in this study serve as mentors and support the development of these girls’ confidence. The faculty members’ experiences relating to their success in the field and the barriers they faced along the way can help them help others. Their experiences and ways that these female faculty members persisted in their disciplines, made the decision to teach in a community college and overcame barriers they faced along the way can be shared with their students in order to help them become successful.

Cohoon’s (2007) analysis of gendered experiences in computer science and computer engineering doctoral programs analyzed data from 41 departments. The data showed that women computer science and computer engineering students were less confident that they would earn their doctoral degree than men computer science and computer engineering students. The data also showed that women are not as comfortable speaking up during class, which is exacerbated by the studies that show men are called upon to answer questions in class more than their female peers.

According to a study on gender, achievement and persistence in undergraduate computer science programs (Katz, 2006), male college students earning a grade of C or lower in introductory freshman-level computer course were more likely to enroll in the next level course than were females who earned a grade of C or lower. Students'
decisions not to continue in a technology-related program are often based on a perceived lack of achievement.

In their research on why women are attracted to the study of computer science, Tillberg and Cohoon (2005) concluded that there are two reasons individualized encouragement from teachers or others may be more of an advantage to women than men. This encouragement can help offset a wide-spread belief that computer science is the province of males. Personal encouragement may also help females improve their self-confidence in the skills associated with computing. The perception that computing is male oriented may fuel an underestimation by others which may result in girls’ low self-confidence toward their own success in computer science (Tillberg and Cohoon, 2005).

Pajares (2005) found differences in levels of self-confidence in science, technology, engineering and math (STEM) abilities between genders as early as middle school and continue to decrease throughout high school and college. The study concluded that students will give up sooner when faced with difficulty if they have little confidence in their STEM abilities and are less likely to participate in activities that involve those abilities. Since girls and women may have less confidence in their math or science skills, they may be more likely to lose interest in STEM careers. Dweck concluded that when a girl thinks she is able to “become smarter and learn what she needs to know in STEM subjects” instead of thinking that she was born with a fixed amount of aptitude in science and math, “she is more likely to succeed in a STEM field” (Dweck, 2006, p. 5).

Margolis and Fisher (2002, p. 72) explained, “There is a dominant culture of ‘this is how you do computer science,’ and if you do not fit that image, that shakes confidence
and interest in continuing.” They believe that it is highly important to provide “multiple ways to ‘be in’ computer science”. Feeling like a misfit can lower confidence, especially among women. Margolis and Fisher also found that the group of female computer science majors who were brimming with confidence and excitement about their major in the earliest interviews were no longer buzzing by the second and third semester. Margolis and Fisher (2002, p. 92) argue, “The decline in women’s confidence must be acknowledged as an institutional problem.”

Dweck’s (2006, p. 2) study offers evidence that a “growth mindset (viewing intelligence as a changeable, malleable attribute that can be developed through effort) as opposed to a fixed mindset (viewing intelligence as an inborn, uncontrollable trait)” is apt to lead to greater perseverance when faced with difficulty and ultimately success in any field. If students have to persist at a task, they may begin to question their skills and lose confidence. As their confidence wanes, they are more likely to give up because they believe they are not smart enough and they will never excel academically because their intelligence is fixed. Dweck offers that “Individuals with a growth mindset show a far greater belief in the power of effort”, so when they are faced with academic challenges, “their confidence actually grows because they believe they are learning and getting smarter as a result of challenging themselves” (Dweck, 2006, p. 8). The 2010 AAUW study, Why So Few? also found parents and teachers can have a strong influence on girls when they study and apply themselves, they can develop their intelligence and improve their test scores.
Research on gender differences in leadership style has addressed barriers such as stereotyping, low self-esteem, lack of self-efficacy and self- and other-perception in an effort to understand why women have not made more progress in emerging as leaders. Younger (2002) studied the relationships among the constructs of self-esteem, self-efficacy, psychological androgyny and leadership style among career and professional women. Self-efficacy, androgyny and self-esteem were found to be positive and direct predictors of transformational leadership style. Psychological androgyny and self-esteem were found to be positive and indirect predictors of leadership style through self-efficacy. The level of educational attainment was found to have a positive direct relationship to self-efficacy and be a positive and indirect predictor of transformational leadership behavior through the leader's degree of self-efficacy. Both men and women are perceived in traditionally stereotypical ways and as a result, men continue to emerge more often as leaders.

The Importance of Mentors

Female faculty members serve as mentors and advisors to students; mentoring female IT and engineering students has proven to be a successful retention strategy (Blake-Beard, 2001; Seymour & Hewitt, 1997; Margolis & Fisher, 2002; Cohoon & Aspray, 2006; Tillberg & Cohoon, 2005). A study conducted by Stacy Blake-Beard (2001) found that female students respond positively to mentors. Mentors can help encourage greater participation and retention of women in academia by developing stronger mentoring relationships with their students; some may choose to become
educators in the future (Blake-Beard, 2001). Blake-Beard’s research indicates that access to effective mentoring is vital to advancement in academic careers.

Seymour and Hewitt (1997) found that girls show a preference for collaborative learning and respond positively to female mentors. They conclude that one way to reduce female students’ feelings of isolation and to make them feel more welcome is to ensure that they have female role models and mentors. Although males and females both respond positively to mentors, girls do, however, respond more positively than boys to female mentors (Seymour & Hewitt, 1997). Other findings show that while female role models can be very positive for women starting out in a field such as computing, there is evidence to suggest that the gender of the role model is not crucial, and that women are often happy to consider men as role models (Dee, et. al., 2009; Clark, et. al., 2007; Lockwood, 2006). The women in this study also believe role models and mentors were critical to their success and take their roles as role models/mentors seriously.

Various researchers have tried to investigate the influence of female role models and mentors on the performance and experience of women in male dominated professions such as engineering and computing. Female professionals obtain less counseling on professional development and career advancement because it is less likely that they have role models or mentors than their male peers (Macfarlane & Luzzadder-Beach, 1998; Rosser, 2004).

Mentors play a strong role in potentially influencing women’s interest in the IT and engineering fields, sharing knowledge about how these careers can help make a difference in people’s lives, helping to build confidence and creating a sense of
belonging. To effectively influence students to pursue a degree in IT or engineering it is important to build their understanding of the profession and how that career decision can help make a difference.

Margolis and Fisher (2002) conducted a research study designed specifically to investigate Carnegie Mellon's undergraduate computer science program to discover reasons for the gender gap. Their study found that mentoring plays a role in recruitment and retention of female students. Margolis and Fisher found that some young women discount majors in IT or engineering without even knowing what those fields have to offer. Mentors provide information about these career choices and encourage young women not to discount a major simply based on their gender.

Cohoon and Aspray (2006) found that three things had significant impact on students’ interest in computer science: an understanding of what computer science is, negative experiences in the classroom and lack of critical thinking focus in the curriculum. Their research found that a network of peers, mentors, successful female role models in technology and exposure to a wide range of technology are positive influences for girls. By increasing women’s interest, confidence and sense of belonging along with a knowledge about how these careers can help make a difference in people’s lives, mentors can influence the number of female students choosing IT and engineering majors.

Research from Tillberg and Cohoon (2005) focused on what attracts women to the computer science field. Part of their research focused on students’ choice of major. Tillberg and Cohoon (2005) found that individualized encouragement from mentors may
be an advantage to females even more than males. My study builds on the research of Tillberg and Cohoon (2005) who focused on what attracts women to the computer science field. From their analysis, they found in students’ first experiences with computers, teachers, parents and peers were the most common influences for their choice of major.

Higher Percentage of Women Leave IT and Engineering Careers

A higher percentage of women leave IT and engineering careers (Society of Women Engineers, 2006; Hewlett et al., 2008; Frehill et al., 2009). Hewlett et al. (2008) found that challenges at mid-career - workplace bias, long work hours and demands of family - all influence women’s decisions to leave their STEM careers. Cited were feelings of “isolation, an unsupportive work environment, extreme work schedules and unclear rules about advancement and success as major factors in their decision to leave” (Hewlett et. al., 2008, p. 11).

“Isolation is a critical problem since it can be a major source of dissatisfaction among female faculty and can influence their decision to leave. Women report being excluded from informal social gatherings and more formal events, as well as from collaborating on research or teaching” (Massachusetts Institute of Technology, 1999, p. 64). Female professionals obtain less counseling on professional development and career advancement because it is less likely that they have role models or mentors than their male peers (Macfarlane & Luzzadder-Beach, 1998; Rosser, 2004).

Cathy Trower and Richard Chait founded Collaborative on Academic Careers in Higher Education (COACHE) in 2002 to help improve the academic environment for
junior faculty and assist colleges and universities in recruiting, retaining and increasing
the satisfaction of early career faculty. Trower and her colleagues in COACHE at
Harvard University found that female science, technology, engineering and math (STEM)
faculty are not as satisfied with their jobs as their male counterparts. Less satisfaction
with employment leads to greater turnover and a loss of females in IT and engineering.
Trower’s research supports changes to retain female STEM faculty and suggests that
implementing effective mentoring programs and establishing more favorable life-balance
policies can help improve the work environment (Trower and Chait, 2002). Community
colleges have not been included in their studies. Membership is open to four-year
colleges and universities with tenure-stream faculty. This reinforces the need for more
research on community college faculty.

Balancing Family and Career

Weinberger (2003) found that 30-40% of college women felt that careers in
computer science and engineering professions would be incompatible with raising
children. The report cited the expectation of long work hours, including overtime hours,
and the difficulty of balancing work and private life. Other recent studies (Townsend and
LaPaglia, 2000; Wolf-Wendel, Ward, and Twombly, 2007; Townsend and Twombly,
2008) describe advantages of a faculty position for women in a two-year institutional
setting. One important benefit is the perception that balancing career and family is easier
than in a four-year institution where expectations for research are high.

Several researchers have noted a public perception that women who leave STEM
academic careers do so because they are unable to achieve a balance between the
demands of family and work (Mason et al., 2009; Xie & Shauman, 2003). Xu (2008), however, found a more in-depth relationship between these intertwined factors. Though both genders feel that family responsibilities negatively impact work results, females more often report delaying having children or even postponing marriage until later in life. Recent studies by the Society of Women Engineers (2006) and Frehill et al. (2008) both found that most workers who left engineering did so because of other career interests. Even though this was true for both men and women, females more often expressed time constraints and family considerations as determining factors.

McKinney’s 2008 survey explored the attitudes and experiences of 815 male and female IT professionals working in numerous industries in the United States. Included in their findings was that when female professionals enter the field, they arrive with less positive work experiences. These female IT professionals may leave IT for different careers because they find it more difficult to find a professional/personal life balance (McKinney, 2008).

Studies on Successful Women and Barriers They Have Overcome

Dee, et. al. (2009) studied the attitudes and experiences of women at three different stages of their lives: from undergraduate to graduate student to employment. They examined various characteristics of the students’ experiences from the perspective of those who have begun to study the subject at degree level and seen some level of success. The authors explored what makes women stay in the field by focusing on the perceptions and experiences of women who have persisted in careers in technology fields.
Their core investigative technique was a questionnaire, distributed at two women-in-computing events, one aimed at postgraduate students and one aimed at undergraduate students. Both events included a significant proportion of women who were no longer students, but university staff or industry contacts. The data from the questionnaire study was augmented by semi-structured follow-up interviews, conducted online.

An investigation of the qualitative answers provided by the respondents highlights a few themes, areas for improvement and areas for concern. Notably, the importance of certain individuals (role models) upon the initial decision to take up computing, the pervasive geek culture and a desire on the part of the women participating to go on and become role models themselves.

Various studies have tried to investigate the influence of female role models on the performance and experience of women in male-dominated professions such as engineering and computing. Their study found that while female role models can be very positive for women starting out in a field such as computing, there is evidence to suggest that the gender of the role model is not crucial, and that women are often happy to consider men as role models (Dee, et. al., 2009), (Clarke, Marshall & Thorpe, 2007) (Lockwood, 2006).

Trauth et. al. (2008) studied the socio-cultural environmental impact on gender in the IT workforce to try to gain a better understanding of the increasing under-representation of women within the IT profession. This research drew on data collected over several years from female IT professionals in Massachusetts, North Carolina and Pennsylvania. The results of their study show a number of influences on these women
various responses to these factors. This research is useful to help us understand socio-cultural environmental influences on this study group in two ways. Results show that social and cultural influences can become both barriers to and support for recruitment of women and their retention in the IT profession. This calls for study of these women and their pre-collegiate environments within which they mature and work. The authors did not find a single set of factors that explained why women are under-represented. Instead, the authors found individual reactions to cultural influences. With a highly mobile population, future research may indicate a narrowing of regional influences when explaining women's under-representation in IT.

The Trauth et. al (2008) study employed an interpretive epistemology and qualitative methodology. Researcher conducted interviews were approximately 90 minutes in length. The women who were interviewed talked about their careers as IT professionals and offered their thoughts on the influences of women in IT. Interviews explored three main areas: 1) personal data including age, ethnicity, race, education, employment history, interests and personality types, 2) the significance of socio/cultural, institutional and interpersonal relationships on participants’ careers and personal development and 3) how their work culture impacted their lives. Also included in the study was additional regional specific data about gender, IT sectors and economies in the three subject states. (Trauth et. al, 2008).

Trauth et. al (2008, p. 40) conclude that results from their research have, “clear implications for the theoretical underpinnings of gender and IT research”. Varying responses by women to common IT experiences may provide an indication of regional
differences on women in the IT profession. The authors call for “deeper examination of factors affecting women’s recruitment into and retention in the IT field, as well as examination of the underlying causes of different responses to them” (Trauth, 2008, p. 40).

Demaiter and Adams (2009) were interested in assessing women who have had successful careers in information technology. They examined the professional experiences of 11 women to learn more about the barriers and opportunities these women had dealt with during their careers. Even though evidence showed that gender had an effect on their careers, these women downplayed the significance of gender. Demaiter and Adams (2009) believe that gender and the technical nature of the field serve as barriers for some women, but the resistance to see how gender affects their careers, along with their aptitude for technical work, may have contributed to these women’s success.

Demaiter and Adams (2009) explain that in order to promote a diverse workforce that includes women, we should create an awareness of the stories of women who are now successful in fields traditionally dominated by men. Studies have been conducted of women in leadership positions in technical fields like IT and engineering; many of those studies were centered around the effect of gender in organizations and on the challenges these women faced and the sacrifices they made. Demaiter and Adams (2009) believe more research must be conducted about the experiences of successful women to find out what strategies facilitate their success and what barriers they have overcome, operating in these male-dominated fields.
Their research was conducted through semi-structured interviews with eleven women working in eight different IT organizations across Canada. They asked questions about these subject's impressions about the opportunities and barriers IT work has offered them. Demaiter and Adams (2009) summarized that the literature reports many examples of IT exhibiting an image and culture of male dominance. These factors could inhibit participation of women. Their study concluded that even though men outnumber women in IT fields, there are many women with long, successful IT careers. They suspect that women who succeed in fields where men outnumber women, women “turn a blind eye to the gendered culture they inhabit, and perhaps work as conceptual men” (Demaiter and Adams, 2009, p. 41). Women interviewed in this study were encouraged by the opportunities available to females in IT, and while de-emphasizing gender-oriented problems they have encountered. Even when participants described gender-related issues of concern, they dismissed these problems as involving “isolated individuals or barriers women created for themselves” (Demaiter and Adams, 2009, p. 42).

A frequent finding in the literature is that women are often faced with the quandary of appearing to become more masculine in order to fit into a male-dominated workplace otherwise they are seen as challenging the work culture and attempting to force the workforce to become more feminine (Adam, et. al. 1994; Cockburn, 1991; von Hellens & Nielsen, 2001; Wajcman, 1991). Cotter et. al. and Drolet (2001) cite that in many areas, policies have been written to help recruit women into higher paying, more advanced positions. They believe these policies may not have achieved their intended level of success. They posit that in professions where men outnumber women, women are
perceived as not as well prepared for the requirements of a technology profession and not as likely to succeed. Even though women are becoming leaders in IT and engineering, many women are relegated to female-dominated jobs that are lower paid, lower level jobs with much less opportunity for advancement.

Muscarella’s (2004) qualitative and quantitative dissertation research investigated the barriers for women attaining leadership positions. She believes that the study was warranted due to scarce research on this targeted population. Results of the study showed common themes emerging from interviews of female leaders that did support previous research on gender stereotyping effects. These findings support evidence of prior research that points toward the conflicts of leadership roles, gender roles, culturally accepted norms and underlying perceptions about women taking charge in top posts of organizations.

Community College Faculty

According to a study conducted by the AAUW in 2010, *Why So Few? Women in Science, Technology, Engineering and Math*, women’s representation varies by discipline as well as tenure status. AAUW (2010) statistics show that:

40% of the full-time faculty in degree-granting colleges and universities in the United States were women; however, women’s representation in STEM disciplines was significantly lower. Women made up less than 22% of the faculty in computer and information sciences, 19% math, the physical sciences 18 %, and engineering 12 %. (p. 32)
Fountain’s (2000) study on women, information technology, and design stressed that now, more than ever, women can play an important role in the increase in technology in our society. Information Technology and engineering are part of virtually every aspect of our world and create great opportunities for women. The lack of women in these roles (especially in IT and engineering) may keep them from taking advantage of these opportunities. The proliferation of the Internet has created an increase in the numbers of women using Information Technology. More attention has to be paid to the potential role women play as innovators, engineers and computer scientists in our technology-based society.

Fountain is a member of the project leadership team for Commonwealth Alliance for Information Technology Education (CAITE). The National Science Foundation (NSF) awarded funds to CAITE in 2007 and again in 2008 with the charge that the Alliance, “significantly increase the number of citizens receiving postsecondary degrees in the computing disciplines, with an emphasis on students from communities with longstanding under-representation in computing: women, persons with disabilities and minorities” (NSF, 2007, p. 245). Because of the important role they play in serving non-traditional students and acting as an entry way to careers and advancement into higher education, community colleges are the focus of the CAITE initiative.

Community Colleges are often the entry way to careers and additional higher education opportunities for students. Most community colleges are open enrollment, therefore providing an entryway to college that may not otherwise exist. Community colleges provide opportunities to a variety of stakeholders, but their primary purpose is to
provide higher education to students. Community colleges serve the needs and potential
of a diverse student body.

The mission of a community college is teaching and learning and is therefore very
student-centered. Community colleges focus on developmental education, vocational-
occupational education, and university transfer. Roughly 33% of students entering
community college do so with the goal of transfer to a 4-year university and the
attainment of a bachelor’s degree or higher (AACC, 2010). Community colleges work to
collaborate with their four-year partner institutions to ensure a smooth transition.

Community colleges play an important role in recruiting, retaining, graduating
and preparing students for transfer to 4-year institutions. The community college
environment may be a place where significant improvement can be made in the access to
and achievement in higher education.

Female faculty in information technology (IT) and engineering disciplines at two-
year institutions have not received much attention in higher education research. A current
comprehensive review of literature on community colleges by Townsend and Twombly
(2007) devotes no attention to this group. Not enough is known about the characteristics
of women who are attracted to and successful in IT/engineering careers to make decisions
about how to recruit and retain women.

According to Wolf-Wendel, Ward and Twombly (2007), there is scant literature
about community college faculty. They state that, “academic life for community college
faculty has in general been understudied” (p. 257). Much of the research that has been
done focuses on finding a work life balance and making a conscious decision to commit to a teaching career in the community college setting.

Based on Wolf-Wendel, Ward and Twombly’s 2007 research, women may have more of an opportunity to balance responsibilities as faculty members with the demands of family at the community college. They found that the missions and the environments of community colleges make them potentially more accepting of female faculty with families. They suggest that community college faculty make a conscious decision to teach at a 2-year college because they believe the environment at a community college would be more receptive to young families.

Other recent studies (Townsend and Twombly, 2008; Townsend and LaPaglia, 2000) describe benefits for female faculty in a community college such as the perceived advantage of the ability to balance family obligations with career responsibilities more easily than in a four-year institution where expectations for research are high.

The mission of the community college includes a focus on teaching which has an influence on women’s decision to seek employment at a 2-year institution. Wolf-Wendel, Ward and Twombly (2007) found a love and commitment to teaching was important in making the commitment to teach in a community college setting.

Townsend (1998) conducted a study of full-time community college female faculty members to determine their satisfaction with being employed by a community college. Participants in this study shared that the ideal teaching position for them was in the community college. Townsend also found that “female faculty feel satisfied and are able to find professional fulfillment as community college faculty” (Townsend, 1998, p.
Employment at the community college enabled them to “find professional fulfillment without the pressure to publish and with sufficient time for family responsibilities” (Townsend, 1998, p. 685). The mission of the Community College is focused more on teaching than on research. According to Townsend, university faculty whose priority is research marginalize community college faculty for their emphasis on teaching. This negative image diminishes the achievement of the community college faculty who find teaching in the community college an ideal career for them.

Because of the strong emphasis on teaching at a community college, community college faculty have a stronger connection to students than research faculty have at a 4-year institution. Their availability to serve as role models and mentors to students helps to support recruiting and retention efforts not only at the community college, but for the 4-year institutions as well. Nearly 30% of community college students transfer to a 4-year institution (AACC, 2010)

Summary

Women’s under-representation in IT and engineering disciplines is well documented. What is not well documented are the characteristics of successful females in IT and engineering disciplines, their strategies for success and ways they have overcome barriers. The purpose of this study was to explore characteristics and behaviors of female community college IT and engineering faculty that enabled them to persist and succeed. These women serve as role models for younger women beginning to pursue IT and engineering careers. This study helps address the problem of the United States’ declining competitiveness in IT and engineering. The results of this qualitative
study will help to more clearly define the characteristics that have contributed to the persistence, success and strategies these women use to overcome barriers in the field.

A recommendation stemming from a report from the AAUW, (ACM 2010, p. 16), *Why So Few? Women in Science, Technology, Engineering and Math*, was that, “college and university administrators can recruit and retain more women by implementing mentoring programs and effective work-life policies for all faculty members”.

McKinney, et. al. (2008) also found that women with less education and/or access to role models in technical fields may be less likely to persevere, which could provide an explanation for their under-representation.

Technology experts design so much of what we use on a daily basis - elevators, baby strollers, robots, automobiles, prosthetics and microwave ovens. We need women’s viewpoints. When women are under-represented in the innovative process of designing these consumer products, women’s unique perspectives may be missed. Margolis and Fisher (2002) write that:

some early voice-recognition systems were calibrated to typical male voices. As a result, women’s voices were literally unheard. Similar cases are found in many other industries. For instance, a predominantly male group of engineers tailored the first generation of automotive airbags to adult male bodies, resulting in avoidable deaths for women and children. (pp. 2–3)

As Fountain (2000) clearly indicates, women are poorly represented in IT and engineering, an area of potential growth for the United States economy and that provides
the primary scientific and technological development of a society dependent on technology. Society has demonstrated the demand for the human capital required to develop new technologies. Increasing the participation of women will strengthen the number of innovators and designers of those technologies in our society.

Studies about why women leave are more abundant than why they achieve. Topics such as girls’ lack of interest in the fields of IT and engineering, self-confidence/self-esteem, gender differences in the classroom, isolation, retention of women in IT and engineering positions and balancing family and career have been studied.

Statistics show that there is less interest in careers in computing and engineering among girls than boys (WGBH Education Foundation & Association for Computing Machinery, 2009). What characteristics or previous life experiences do successful women have that led them to become interested in careers in IT and/or engineering? Studies show that women lose confidence from middle school (Pajares, 2005) through doctoral programs (Cohoon, 2007). How do successful IT and/or engineering women stay confident? Dweck’s (2006, 2008) work on growth versus fixed mindsets show that those with a growth mindset are less likely to give up. How did the successful women in this study develop a growth mindset? Studies show lower job satisfaction as one reason women leave IT and engineering careers (Trower & Chait, 2002). Are the women in this study satisfied with their jobs? What strategies do they use to overcome barriers that would inhibit their satisfaction with their jobs? Why do they stay in their IT/engineering careers? Studies (Massachusetts Institute of Technology, 1999; Macfarlane &
Luzzadder-Beach, 1998; Rosser, 2004) show that isolation can also influence the retention of women in IT and engineering. Do the women in this group feel isolated? If so, how do they overcome or compensate for those feelings? Many studies show (Mason et al., 2009; Xie & Shauman, 2003; Xu, 2008; Society of Women Engineers, 2006; Frehill et al., 2008; McKinney, et al., 2008) that family-related issues cause women to leave the field. How have these women managed the family/career balance? I asked focus group participants questions such as, “How do you see your role as an influencer of young women? What is your role in encouraging young women?” The focus group participants had a lot to say about this series of questions. They saw their primary role as providing encouragement and serving as a role model and mentor.

This study focuses on community college female faculty because of their ability to influence the next generation of IT and engineering professionals. In order to increase the number of female community college faculty members, who in turn influence the next generation of IT and engineering professionals, more in-depth study needs to be conducted to determine how the experiences of successful women helped them build strategies for success and avoid barriers that facilitate or hinder their professional lives.
CHAPTER III: METHODOLOGY

Merriam (2002, p. 35) describes qualitative research as the “search for meaning and understanding, an inductive investigative strategy with a richly descriptive end product”. She describes the researcher as the “primary instrument of data collection and analysis”. Quantitative research strives to establish relationships between a set of variables, Glesne (1999, p. 47) explains that findings from qualitative research helps to increase knowledge of “perceptions, attitudes, and processes.” Similarly, Gay, Mills and Airasian (2006, p. 63) explain that the use of qualitative research is “suitable when trying to understand a social setting or activity as viewed from the participant’s perspective”. Qualitative studies concentrate on the “experiences of individuals and seek to understand their past, present and future experiences” (Creswell, 2002, p. 17). This study was based on the experiences of focus groups comprised of IT and engineering faculty members from the statewide We Are IT! steering committee, a consortium of community colleges in Ohio. There has been very little research on the experiences of female IT and engineering faculty members from community colleges.

Focus groups were chosen because they are a type of group interview that benefits from interaction between research participants to obtain data. Group interaction is intentionally used as part of the focus group method. Participants in this study were encouraged to ask questions, interact with one another, share stories and discuss each other’s experiences. Group interaction is often used to explore participant’s perceptions and backgrounds to determine not only what people believe but why they believe what they do. This method helps people explore and explain their points of view in ways that
would be more difficult to attain using an interview format. Participants work alongside the researcher, taking the research in sometimes unforeseen directions. How participants’ attitudes, perceptions and ideas are formed and how that affects their daily performance can often times be investigated in more depth using focus group experiences. Focus groups are a good tool for exploring exactly how opinions and perceptions are constructed. This study benefited from lively interaction among participants talking to each other, asking questions, exchanging experiences and commenting on other’s stories.

Basic interpretive qualitative research is one of the most common forms of qualitative studies research in education. Merriam (2002, p.38) believes these types of studies seek to understand: “(a) how people interpret their experiences, (b) how people create their worlds, and (c) what meaning they put on their experiences.” Merriam’s study tells us that “the purpose of basic interpretive study is to understand how people make sense of their lives and their experience” (2002, p. 38). According to Merriam (2002, p. 6), “basic interpretive qualitative study tries to discover and understand a phenomenon, a process, the perspectives and worldview of the people involved or a combination of these.” The women in this study shared their experiences, explored how each interpreted her world and tried to make sense of these experiences. Like other qualitative methods, interviews, observation or analysis of documents provide the data for basic interpretive study. The data are analyzed to detect themes or patterns that occur frequently. The goal is to produce rich findings that describe participants’ experiences.
Narrative Research Design

Creswell (2002) explains that narrative research design has seven main characteristics:

(a) focusing on individual experiences, (b) providing a chronology of the experiences, (c) collecting individual stories, (d) restorying the shared stories, (e) coding the texts for themes, (f) describing the setting or contexts of the stories, and (g) collaborating throughout the process with participants whose stories are being told. (p. 526)

In narrative research design, collaboration between the researcher and the focus group participants is both a strength and weakness. While conducting interviews and capturing stories, the researcher is bound to develop a relationship with participants. The participant is able to share stories and feel that his or her experiences are relevant to the study (Creswell, 2002). I have worked with the We Are IT! steering committee since early 2006 and have established a positive relationship with this group and the group members with each other. This established open and supportive focus group experiences.

For the purpose of this study, the researcher worked from the faculty members’ stories, collected through focus groups, which supplied content for the narratives. Common themes were derived from analysis and interpretation of this content. These themes were analyzed to form the narrative description of experiences influencing the success of female community college IT and engineering faculty members.
The Role of the Co-collaborator

Collaboration with the focus group participants is essential. As the researcher, one of my roles was that of co-collaborator with those researched, the faculty. Creswell (2002, p. 531) believes there are co-collaborators have three main tasks: "(a) negotiate entry to the site and the participants, (b) work closely with participants to obtain field texts to capture individual experiences, and (c) write and tell stories in the researcher’s words."

Narrative researchers have to face the important issue of their relationship with participants. Creswell describes an ideal relationship as one that allows for equality of voice. Participants need to feel safe enough to tell their stories. Gay et al. (2006) believe it is important to establish “a high level of trust and respect like that in a close friendship” (Gay, et. al., 2006, p. 54). They describe the narrative research process as very “personal and that a high degree of caring and sensitivity” is needed (Gay, et. al., 2006, p. 54). The female IT and engineering faculty members in the We Are IT! consortium have worked with the researcher since early 2006 on a statewide initiative to encourage young women to consider IT and engineering careers. The relationships developed through this collaboration strengthened the researcher’s role as co-collaborator.

Identifying and Selecting Research Participants

Patton (2002, p. 244) tells us that, “purposeful sampling permits the in-depth study and understanding of a phenomenon.” Patton emphasizes the importance of working with a small group of people to obtain rich, in-depth data.
We Are IT! is a consortium of 21 colleges and universities in Ohio who work together to hold a conference for young women each fall. In 2010 the event was held at 21 locations across Ohio with over 3,000 young women in attendance. The steering committee for this consortium, and the faculty who present at the conference, were the target audience for focus groups.

When the steering committee met for our annual meeting in the spring of 2011, I presented materials from my dissertation proposal to the members in order to share information about the study and invite members to participate in focus group sessions that would be held over the spring and summer of 2011. The researcher fielded questions from the committee members about the study and let committee members know that they would soon be contacted with details about participation.

Faculty members were contacted by telephone or e-mail by the researcher to obtain their level of interest in the study and to ensure eligibility criteria for the study had been met (female community college faculty teaching in IT and engineering disciplines). Selected faculty members were given a consent form (see Appendix A) outlining the purpose and objectives of the study, informed of researcher expectations, and assured that safeguards were created to insure confidentiality. Approved Institutional Review Board (IRB) procedures were used for the interview process and to ensure confidentiality. Participants were given a consent form. The focus group sessions were audio taped and transcribed. All interviewees were clearly informed of their right to refuse to answer any question.
Focus Group Interviews

Qualitative interviewing establishes a structure for members of the focus group to tell their own stories in their own words. Patton (2002, p. 341) believes the, “purpose of the interview process in qualitative research is to allow us to enter into the other person’s perspective.” The researcher in a qualitative study becomes an important and integral part of the process of collecting data.

Focus groups are used as a way of interviewing in which carefully designed questions serve to glean personal experiences and insights from the participants. There is not only interaction between the facilitator and the participants, but interaction between participants as well. The exchange between and among the group members may result in a dynamic and more in depth look at a particular topic. Focus groups use the interaction between and among participants as part of the method. The researcher asks predetermined questions, but participants are encouraged to exchange ideas, ask questions, share stories and remark on each other’s experiences and perceptions. Focus group interviews are especially useful for discovering people's circumstances and experiences that have led to their perceptions. Participants in this study were interested in and eager to share their stories and discover what lead co-participants to think the way they do.

Direct observation, interviews and questionnaires are also used in qualitative research, but focus groups are used because they are designed to study experiences and participants’ perceptions formed from those experiences. They are more suitable for
investigating how ideas and perceptions develop and function within a given framework. Focus groups are useful for discovering how opinions are developed.

Morgan & Krueger (1993) describe how focus groups can be a benefit. They make four main observations: “1) When information about behaviors and motivations is more complex than a questionnaire is likely to reveal, focus groups often obtain more honest and in depth information” (p. 228). 2) When consensus is important, focus groups have the opportunity to discuss differences among participants’ responses to questions when that opportunity is not available through a questionnaire. 3) There is the risk that questionnaire respondents answer dishonestly or not take them seriously. Morgan and Krueger (1993, p. 228) suggest that “effective focus group facilitators will communicate the need to record meaningful, honest information”. Dishonest or patronizing responses can be discussed and re-worded appropriately. 4) In situations where focus group participants feel unsafe sharing their stories in their institutions, members of focus groups may feel safe and 'listened to' in the focus group. This may allow for a more open and honest sharing of information.

In a focus group, the interviewer directs the inquiry and the interaction among respondents. The interviewer must be flexible, objective, empathetic, persuasive, and a good listener. But the focus group interview does present some problems. The facilitator must keep one person from dominating the group, persuade noncompliant members to participate, and encourage the entire group to respond. The facilitator must also manage the dynamics of the group being interviewed. The focus group interviewer must direct the predetermined script of questions and be aware of group dynamics.
Researchers are not invisible neutral individuals; rather, they are part of the interaction they seek to study, and they influence that interaction. Facilitators are seen as active participants in their interaction with focus group members, and results are seen as an accomplishment of both facilitators and participants that are shaped by the context and situation in which they take place.

Patton (2002) recommends when beginning interviews the following issues be addressed: (a) the reason for gathering the information, (b) who will have access to the information and how they will use it, (c) the nature of the questions, (d) confidentiality and how answers will be treated, and (e) the risks and/or benefits for the person being interviewed.

**Qualitative Analysis**

Gay et al. (2006) believe the aim when conducting narrative research is to acquire information from the general to the specific. They also maintain that analysis involves summarizing data and the interpreting that data including forming conclusions about what it means. There is a need to determine the implications of the findings.

According to Glesne (1999), the challenge of data collection is to describe and interpret feedback participants share. Patton (2002, p.38) describes qualitative analysis as “inductive in the early stages: discovering patterns, themes, and categories in one’s data”. Several approaches to data analysis were implemented in order to limit the sizeable set of topics into manageable and significant groups. Data was scanned, coded and categorized to generate themes. A construct-oriented approach was used to generate a theory. Data analysis was based on transcripts of semi-structured, in-depth focus groups.
The focus of the qualitative data gathering was to investigate characteristics of female faculty in IT and engineering at public community colleges that participants felt helped them to persist and succeed in an IT and/or engineering career. Previous research on women in IT and engineering has found qualitative data to be crucial in understanding factors that facilitate and impede women’s academic career advancement in academic settings (Rosser, 2004; Vetter, 1996). Key dimensions examined included decisions leading to employment in two-year institutions, perceived advantages and disadvantages of such work, job satisfaction, challenges to balancing career and family, as well as other in-depth follow-up on other factors that emerged from the focus group discussions.

The researcher interviewed women in IT and engineering disciplines from community colleges all over Ohio. In terms of outcomes for women in IT and engineering, Ohio’s economically vulnerable economy makes an excellent case for the importance of two-year technical and community colleges in terms of providing access and opportunity to an under-represented population of individuals and a local labor market increasingly reliant on skills related to IT and engineering. Ohio’s statewide targeted industries for this area are characterized by skilled science and technology jobs (e.g., advanced energy and environmental technologies, bioscience and bioproducts, polymers and advanced materials, and healthcare). Thus, the experiences of women IT and engineering faculty at two-year institutions in the region are important to understanding career success in those areas where community colleges need to have a prominent role in educating local IT and engineering talent.
Faculty were interviewed through focus groups conducted during the spring of 2011. Focus groups were chosen so the researcher could enter into the participants’ perspectives. Participants were able to express their stories in their own words. The exchange of experiences among the group members produced an in-depth picture of these faculty members’ stories.

The researcher conducted five focus groups, each with three to four participants. Each focus group session lasted no longer than two hours. Each session was digitally recorded and transcribed.

Before focus groups met, participants were sent an e-mail thanking them in advance for their participation. There were two attachments in the e-mail, a consent form and a questionnaire (See Appendix A and Appendix B). The questionnaire requested information about their current employment, employment history, educational background and age. This information could then be gathered and compiled in advance of the focus groups meetings.

Focus groups began with a discussion about their background, families and education. Questions about the study were answered. Conversations also included questions about the faculty members’ experiences as they progressed through their studies, graduated and became faculty members.

The researcher obtained a list of all female faculty members in IT and engineering-related disciplines in these community colleges from our We Are IT! steering committee members. The women on this list were contacted and invited to participate. From the list of those interested, the researcher interviewed 16 women,
spread across these institutions, using a semi-structured interviewing technique. Semi-structured interviewing allowed for branching off in order to spend more or less time on parts that were important to the participants.

Our We Are IT! consortium institutions reflect different student and faculty demographics as well as geographic regions. Participating faculty represented 16 of the 23 community colleges in Ohio. This variety of geographic regions and demographics added to the richness of the focus group interactions.

Approved Institutional Review Board (IRB) procedures were used for the interview process and to ensure confidentiality. Participants were given a consent form. The focus group sessions were audio taped and transcribed. Each focus group lasted no more than two hours. All interviewees were clearly informed of their right not to answer a question if they felt uncomfortable.

I chose not to use a professional transcriptionist and transcribed the narratives myself. This gave me a richer understanding of the participants’ stories. The data was coded using common themes so that they reflected increasingly broader perspectives.

In order to understand the career choices and success of female IT and engineering faculty members at community colleges I knew I wanted to learn or understand more about the educational, social, and familial influences on women in IT and engineering at community colleges; understand the paths that women take toward employment in IT and engineering at community colleges; identify factors that facilitate and hinder women in IT and engineering at community colleges, especially strategies for overcoming barriers; and determination of attributes that contribute to success in the
This was the basis for the development of my three guiding research questions:

1) What are the educational, social, and familial experiences that women in IT and engineering cite as influential in their decision to pursue a faculty position in an IT and engineering field?

2) What strategies did these female IT and engineering faculty members develop to help them overcome barriers they encountered along the way?

3) What are the characteristics and behaviors of female community college IT and engineering faculty that enabled them to build strategies for success?

The research questions that guided this study applied specifically to the experiences of female community college information technology (IT) and engineering faculty members. The focus group questions concentrated on these faculty members’ experiences relating to their success in the field and the barriers they faced along the way. This study examined their experiences and ways that these female faculty members persisted in their disciplines, made the decision to teach in a community college and overcame barriers to their success. In order to elicit specific details about participants’ experiences, I asked the following questions in focus group sessions as they related to my guiding research questions.

Guiding Research Question: What are the educational, social, and familial experiences that women in IT and Engineering cite as influential in their decision to pursue a faculty position in an IT and Engineering field?
Focus Group Questions:

1. Statistics show that girls are less interested than boys in careers in computing and engineering. What characteristics or previous life experiences have you had that led you to become interested in your IT/engineering career? What attracted you to IT or engineering? From your own past, what drives you to do this work?

2. Studies show that women lose confidence from middle school through doctoral programs. How do successful IT and/or engineering women stay confident? Who was influential in helping to instill confidence in you?

3. Do you think it is important to have mentors? Who have been your most important mentors in your career? How have they influenced you?

Guiding Research Question: What strategies did these female IT and Engineering faculty members develop to help them to overcome barriers they encountered along the way?

Focus Group Questions:

4. Studies show lower job satisfaction as one reason women leave IT and engineering careers. Are you satisfied with your job? What strategies do you use to overcome barriers that would inhibit your satisfaction with their job? Why do you stay in your IT/engineering career?

5. Studies show that isolation can also be a factor in the retention of women in IT and engineering. Do you feel isolated? If so, how do you overcome or compensate for those feelings?

6. Many studies show that family-related issues cause women to leave the field. How have you managed the balance? What would you say to someone who assumes that teaching in a community college will allow her to more easily balance work/family?

Guiding Research Question: What are the characteristics and behaviors of female community college IT and Engineering faculty that enabled them to build strategies for success?
Focus Group Questions:

7. As a female community college faculty member in IT or engineering, what is your role in this whole challenge of the lack of women in IT and Engineering?
   - How do you see your role as influencer of young women?
   - What is your role in encouraging young women?
   - What are you going to do to replicate yourself?

Analysis began as soon as the data was collected, guided by the pre-defined key research questions. Scanning, coding, categorizing, and developing themes to learn from and interpret the texts from the interviews was continuous. The issue-focused analysis included coding (linking what the respondent says with concepts and categories), sorting by major themes, and organizing and integrating observations. A construct-oriented approach was used to generate a theory. Data analysis was based on transcripts of semi-structured, in-depth focus groups. Analysis included participating in and listening to recordings of the session. Notes were reviewed and observations documented. Special attention was taken to record and capture all of the interactions in an impartial manner, put participants’ feedback from focus groups into the proper context, and capture nonverbal behavior of group participants. Open coding was used to form initial categories of information. This process reduced the database to a set of categories. Axial coding followed and identified relationships among those categories. Finally, selective coding developed the story that integrated the categories in the axial model.

I adopted Charmaz’s belief that memo-writing is a crucial step in qualitative analysis. I wrote successive memos throughout my research process. These memos were helpful in developing my analysis and recognizing gaps that needed to be filled.
Charmaz believes that by writing memos on focused codes, the writer can build and clarify categories by examining all the data they cover and by identifying variations within them and between other categories (Charmaz, 2006).

Success can be measured using a number of social/cultural characteristics. This qualitative inquiry focused on career choices and patterns of academic career advancement, including an examination of barriers to success. More specifically, the study examined the extent to which gender and academic field are related to topics such as job satisfaction and challenges, understanding career paths, barriers that community college IT and engineering faculty face, as well as factors that facilitate or hinder their advancement. This study also investigated effect - how stereotypes function to promote or discourage persistence and performance in IT and engineering. So many factors can affect career decisions: support systems, parental academic expectations, parents’ education level, family income, self-confidence, academic preparedness, curriculum choices, highest level of math completed, patterns of persistence, perceived barriers to success, extracurricular participation and college activities outside the classroom.

For the purpose of this study, success is defined as women who have persisted in IT and engineering related majors to become IT and engineering faculty members. This study was based on the research conducted through focus groups with female IT and engineering faculty members from community colleges to discover how they persisted and what barriers they encountered along the way.

Even though the demand for IT and engineering majors has increased, the number of women in IT and engineering professions has decreased consistently since the 1980’s.
In their report from the Bureau of Labor Statistics Occupational Projections and Training Data, Lacey and Wright (2009) report the demand for computer science professions in the next five years will increase by at least 25%. The percentage of engineering graduates has fallen from 8% in the 1990’s to 4% in 2008. Only 11% of those engineering graduates were women. Half of those engineering graduates were not United States citizens. These figures give rise to the fear that the economic health of our nation is at risk.

As a state, Ohio encapsulates demographic and economic diversity. Previous research clearly demonstrates Ohio's diversity of economic structures by industrial sector (Brown et. al., 1996). Ohio's 88 counties are characterized by declining manufacturing industry, booming technology and service economies, rural farming and regions of poverty and distress (Tickamyer, et.al., 2007).

Bringing more women into the IT and engineering workforce would mean that more women would be included in the innovation and creation of new technologies in Ohio’s technology and service economies. Women would be part of the development and design of new products and services. Women may bring a new perspective to that development and design. They could incorporate their IT and engineering related skills into problem solving throughout organizations. If there is high demand for women employees, it is reasonable to assume that they would be paid higher wages, thus increasing both tax revenues and the quality of life for those women and their families.

This qualitative study 1) discovered the characteristics of female IT and engineering community college faculty members that helped them to persist and 2)
defined the barriers they encountered along the way and strategies they used to overcome them. Interview questions included topics such as job satisfaction and challenges, understanding career paths, barriers that community college IT and engineering faculty face, as well as factors that facilitate or hinder their advancement. (Data Collection Instrument in the appendix). The We Are IT! consortium members have worked together since 2006 and provide a supportive infrastructure for such a study.

Data Analysis

Creswell (2002, pg. 347) advocates that as analysis continues the researcher continuously gathers more data; he describes this stage of data analysis as iterative. The data are reviewed numerous times and, “analyzed each time by the researcher. The researcher continues scanning, coding, categorizing, and generating themes to determine what can be discovered and interpreted from that data”. Data analysis was based on transcripts of semi-structured, in-depth focus groups.

Analysis began with review of session recordings followed by the study of written notes taken during the session as well as thorough analysis of all transcripts from the session. Careful notes were taken during the session that included nonverbal cues not captured on a recorder.

The analysis included summarizing data: discovering patterns, themes, and categories. A number of data analysis approaches were used to limit the sizeable set of topics and data into manageable and significant groups of data. Open coding was used to form initial categories of information as transcripts of the focus group interviews were read. This process reduced the database to a set of categories. Axial coding followed and
identified relationships among those categories. Finally selective coding developed the story that integrated the categories in the axial model.

**Interpretation**

Patton (2002) thinks researchers need to understand what the data tells them and that qualitative interpretation starts with discovery of meaning. The meaning-making came from comparing faculty members’ stories and perceptions. The data in the study were interpreted based on themes (categories were established), axial coding helped determine relationships and selective coding helped to tell the story.

To study the faculty members’ perceived characteristics, the researcher conducted focus groups to discuss those perceived characteristics as well as to discover perceived barriers to reaching their goals as IT and engineering faculty members. Strategies they use to overcome those barriers to success were also explored. I used data collected from female community college IT and engineering faculty members from community colleges around the state of Ohio. This research provided a descriptive summary of characteristics of female community college IT and engineering faculty. The study included topics such as job satisfaction and challenges, how stereotypes function to promote or discourage persistence and performance in IT and engineering disciplines, understanding career paths, support systems, barriers that community college IT and engineering faculty face, and factors that facilitate and hinder their advancement.

The narratives were transcribed and coded. Responses were sorted and analyzed by major themes. Categories were established; my job was to conceptualize these categories and the relationships between them and to explain and interpret those
descriptive data. As I performed cross-case analysis, I began to compare my findings to the literature. Part of the work of interpreting the data is to make sense of what the data means. The meaning-making came from comparing faculty members’ stories and interpreting causes, significance, and relationships.

During the open coding stage, I studied the transcripts and listened to the audio of the focus groups. I looked and listened for common topics and began to assign initial codes. I created an excel spreadsheet to store my data and used it compile, organize and sort my data. My goal was to put the data into manageable categories. After initial coding, I began the axial coding stage. My focus was now to determine patterns in the data and begin to develop themes. During selective coding I began looking for evidence to support themes that were developing. This gave me a summary of shared or unique themes and categories. As I combined these themes and categories I developed my findings.

As a preliminary study to my dissertation, I have hosted a ‘We Are IT!’ conference since 2006 for young women targeted to girls in grades eight through ten. In 2010 our consortium had 21 Ohio colleges/universities participate with over 3,000 girls in attendance statewide. We have collected pre- and post-event surveys each year and have conducted continual longitudinal studies of these young women. Some of the data that has been surprising to me is the prevalence of the use of he/him when girls are describing Information Technology (IT) professionals and the belief of these girls that they are not ‘smart enough’ to become IT professionals. Findings from our 3,000 young women surveyed in November 2010 include:
94% plan to attend college
37% believe they have the ability to be successful in a computer-related job
21% would consider having a computer-related job
18% of the girls’ parents would consider a computer-related job a good career choice for their daughter
13.5% of the girls’ friends would consider a computer-related job a good career choice for their friend

Even today our young women are not being encouraged by their parents or peers to pursue technology-based careers. I believe now, more than ever, that female community college IT and engineering faculty can make an impact on the future of IT and engineering in the United States.

It was interesting to study female faculty members and find similarities between the feedback we have gotten from girls in grades eight through ten and female IT and engineering faculty. Female community college faculty members can help develop a stronger link between secondary and post-secondary students to help them persist to graduation whether it be from community college or transfer to a four year institution.

Follow up from this dissertation research could be consideration of those characteristics that set successful female IT and engineering faculty apart to design curriculum for young women (starting at middle school age) that would nurture those characteristics and therefore increase our ‘pipeline’ of young women entering science, technology, engineering and math professions.
CHAPTER IV: FINDINGS

Telling Their Stories

Each participant shared her personal story about how she evolved into a community college faculty member. Most did not attend college with the goal of teaching in a community college. They began with a variety of careers, mostly in industry.

I wrote and interpreted their stories based on our interactions. Over time, they responded to a survey, we met in focus group sessions and we corresponded by telephone and e-mail. I provide a summary of shared or unique themes and categories. In order to protect participant’s privacy, I did not use their real names. I’m humbled that these amazing women would share such intimate details of their lives with me. This group is passionate about teaching and describe themselves as women who are strong, tenacious, persistent, stubborn, courageous, fighters.

The shared or unique themes that developed included the participants’ initial attraction to IT and/or engineering, attraction to teaching, issues with confidence, the need to overcome barriers, problems with feelings of isolation, creating a work/life balance, and the participants’ roles in engaging young women. These roles included role model and mentor, dispelling myths and misperceptions, the need to help women to persist and succeed, and the need to build strategies for success and find resources.

Participants willingly shared their stories. Surprisingly to me, most did not attend college with college teaching as their goal. They began with a variety of careers, mostly in industry. Following is a summary of shared or unique themes and categories.
Summary of Shared or Unique Themes and Categories

Initial Attraction to IT/Engineering

Studies show that there is less interest in computing and engineering careers among girls than boys (WGBH Education Foundation & Association for Computing Machinery, 2009; Turner, et. al., 2008; Lapan, et. al., 2000). I asked each focus group these questions. What characteristics or previous life experiences have you had that led you to become interested in your IT/engineering career? What attracted you to IT or engineering? From your own past, what drives you to do this work?

When they were in secondary school, nine of the women remembered that they loved math, four loved science, one loved economics, and three loved accounting. Most (14) of the study participants had careers in industry before changing careers and joining the faculty at community colleges. Those women cited salary and a great job as their reason for seeking an IT or engineering career in industry. Six of the women (37.5% of the group) were financially responsible for their own educations.

This group of women was encouraged by parents, grandparents, high school teachers, guidance counselors and their partners. Sadly, From the We Are IT! consortium’s 3,000 respondents in 2010, only 12.06% of peers and 16.60% of parents would consider a computer-related job a good career choice for them.

A common theme in this conversation was that they took charge of their own learning. One woman stated that when she gets knocked down because of lack of knowledge, she gets training and picks herself back up. Many agreed with her. Six of
the women told stories about how someone told her she was not capable of an IT or engineering career and that just made them more determined to succeed.

Rhonda began work in the IT department and worked as their secretary. She loved the energy in the IT department at a large company in her home town. The IT guys’ work inspired her and she started work on her associate’s degree. Over the years she received an A.A.S, bachelor’s and master’s degrees in education, and finally her Ph.D.

Jennifer’s motivation to enter IT stemmed from not wanting to spend her life waiting tables. She earned a degree in programming and took a job as a programmer because that is where she could make the most money. Jennifer began at a community college, transferred to a four-year university and earned her bachelor’s degree, then continued on to graduate school to earn a master’s degree in Information Systems Management.

As a senior in high school Pam had every intention of going into accounting. She loved math and she loved accounting. Knowing these interests, her guidance counselor asked her if she had considered computer science and told her she would like it and be good at it. The counselor told her there were great jobs and high salaries. Because she was responsible for paying for her own education, the high salary was very appealing to Pam. She went on to earn a bachelor’s degree with a major in both math and computer science in only three years and a master’s degree in management science after that.

Alisa has always been interested in science and math and she attended a competitive academic high school specializing in both. She wanted to make use of her logical and practical thinking. Because she had worked with mainframe computers in
college years before, the IT field seemed like a reasonable choice.

Martha always enjoyed math and did well in math courses. Her high school physics teacher encouraged her. When he ordered a kit that allowed her to build a computer when she was a junior (in 1973), she felt as though he believed in her. Martha graduated with a bachelor’s degree in math education and taught secondary math for three years before returning to school to earn a master’s degree in business and computer science. She worked as a computer programmer for eight years before becoming a programming adjunct at her community college. She was raising young children at that time and appreciated the flexible scheduling.

Cindy did not attend community college. She earned a bachelor’s degree in geology immediately after high school and became an environmental consultant. She liked the IT side of the job and because her environmental company only had an IT professional every Friday, Cindy became the default backup IT person. She felt more confident when she worked on computers and that prompted her to go back for a masters’ degree in computer information science and then a Ph.D. in Education Studies.

Statistics reveal that girls show less interest in science and math than boys and, therefore, less interest in careers in computing and engineering (WGBH Education Foundation & Association for Computing Machinery, 2009). Shirley, however, was fascinated by ancillary subjects like puzzles, games, mysteries, cards, planning and scheduling. In elementary school she was jealous of students who were complimented for their abilities in arithmetic. In fourth grade Shirley became aware that many of her classmates dreaded math and some were actually afraid of it. She believes that much of
their reactions stemmed from teachers and parents who talked negatively about the subject. She wanted kids and adults to like math and lose their fear.

In junior high she was told that she was not good enough to take algebra. Her parents disagreed and told her to take it anyway. She became so proficient that she eventually became a tutor in algebra for kids older than she. She also was a top student in geometry and was the only student who scored 100% on the final. Those accomplishments made her see herself in a different light and she was finally guided into math as a major. For her, the thrill of figuring out a math or computer problem is her reward.

Initially Rebecca’s soft spoken presence does not reveal the strong-willed, courageous fighter that she is. She went to college to earn a degree in fine arts, but never finished. Rebecca started working in the 60’s as a clerk typist. She wired boards as a data processor and learned Assembler language. There was one department manager who was a woman; all others in the department were men. She wanted to go to college and had to pay her own way. Although she wanted to major in fine arts, she went into IT for the money and paid for three years of college by consulting. Because companies sought her out for her programming talents she did not finish college. She worked as a programmer/analyst for most of her career.

Attraction to Teaching

Because she had no interest in math or science Lynda never considered STEM or teaching as careers. In high school she did not want to be smart, she wanted to be attractive to boys. Teaching was not a respected career choice at her private boarding
school. Computer science students were considered geeks. She intended to major in
photography in college, but Daddy said no. She majored in accounting instead and hated it. She dropped out of college and went to work for an information technology (IT) company selling computer equipment. Lynda began designing and delivering training for her IT company. She really liked working with people. She believes IT feels very cold on the surface and believes her students feel that way too. She is concerned about people’s perceptions of what IT is and what that career path entails. Lynda was attracted to a community college faculty position because of her love of teaching, the sense of empowerment and validation she feels in the position, the convenient location of the college and what she perceived as a great work atmosphere.

Of all the things she did as an analyst/consultant, Sheila liked computer training/teaching the best and decided to look for a position where she could do that full-time. She started teaching as an adjunct faculty member and applied for a full-time position when it became available.

Alisa applied for her community college faculty position because she felt it would be interesting, challenging and more prestigious than her IT staff position. She finds satisfaction teaching at a community college because it is very evident to her that she has helped many of her students change their lives and improve the lives of their families.

During high school Esther wanted to be a chemistry teacher. Her high school guidance counselor told her there were no jobs in teaching. Her mother did not think chemistry would be a good career and, in 1980, told Esther to go into computers. Esther had been setting up training programs all along while working as Director of Information
Systems and really liked that part of the job. She started teaching as an adjunct and then took a full time faculty position at her current community college. Working 72-79 hours a week took a lot out of her physically and emotionally. Esther was attracted to teaching in a community college because of the flexibility and small class sizes she thought it would offer. She felt small classes would allow her to actually get to know the people with whom she worked, as well as the students she taught. She loves programming, and prefers the smaller and more personal venue of the community college.

While working on her master’s degree Ann worked as a teaching assistant and fell in love with teaching and her computer science classes. After college she taught as an adjunct at her community college for a year before taking a full time faculty position there. During that same time she was also offered a full time faculty position at a four-year university. She chose her community college because she felt it was a better fit for her and thought she would have more of an impact there. She has never regretted her decision.

Cindy was attracted to a community college faculty position not only because she grew up in the area and had family ties to the school, but also because of her experience teaching part-time for her community college while she was employed in industry.

Jennifer began her educational journey with an associate’s degree in data processing then transferred to a four-year university and earned her bachelor’s degree in business administration. She then began work on her master’s degree in Information Systems Management. While working as a programmer/analyst, information center specialist, Jennifer delivered training and enjoyed that aspect of her job. That enjoyment
of training lead her to her community college faculty position. She currently holds the rank of professor and teaches networking and applications software.

Pam also taught one class at her local community college and fell in love with teaching. What attracted her was her ability to make a difference in people’s lives.

Patty was attracted to a community college faculty position because she loves teaching and believes that engineering is a good option for her students. She is proud of her career and tries her best to convey that attitude in the classroom.

Confidence

Studies show that women lose confidence from middle school (Pajares, 2005) through doctoral programs (Cohoon, 2007). I asked how successful IT and/or engineering women stay confident. Who was influential in helping to instill confidence in you? Surprisingly, most of the women would not label themselves as confident, even though they hold higher-level degrees and serve as college professors. They shared their insecurities and agreed that as faculty members and mentors they must ‘fake’ their confidence every day. These women describe themselves as stubborn and passionate, but not necessarily confident.

Half of the participants cited family support as the biggest factor in their ability to pursue a non-traditional career. For the majority of the women, college was not an option – it was a requirement, either out of financial necessity or from parents’ expectations. Martha’s mother expected her daughters to graduate from college and work – not go to college to get an MRS. Cindy’s dad told her college was not an option and her parents never let her quit. Linda’s father was a mechanic and said she could do anything if she
could think and not let others dissuade her. Rhonda’s mother was an alcoholic and, as a result, books became Rhonda’s best friends. Her father told her college was not an option, it was a requirement.

Sue believes in destiny, a higher cause. She does not remember anyone who was influential in helping to instill confidence in her. She believes sheer survival made her stronger and that she can do whatever she sets her mind to. She came from a very abusive home and does not remember having a mentor. She believes fear may have been a motivator for her. She was afraid of the alternative to not going to college because there was no safety net, nowhere to go back to.

Many in the group said their own successes gave them a sense of validation. Rebecca shares that a sense of accomplishment helps to make her feel more confident. She says she knew she was capable and never let herself down.

Several described themselves as stubborn and they seemed to have an ‘I will show you’ attitude. They shared examples of how they felt challenged. Pam’s father told her women did not go to college. Leslie says that if someone tells her she cannot do it, she will prove them wrong. She once got mad at her realtor and went out and got a real estate license. If she wants something, she goes out and gets it. When Jennifer finished her master’s degree and started a new job in industry people told her she got her job because she was a woman. That made her even more determined. When Pam got her position as a programmer she was one of two women in a division of 100 programmers, rumors flew that she was sleeping with the boss. This just made her more focused on proving she was worthy of the position. She eventually became systems analyst and project manager.
Most agreed that they felt competent, but not confident. They feel validated by working on computers. Rhonda was always recognized for scholastics and people would complement her for her work. She got positive feedback for being knowledgeable.

Esther says she feels competent, but not confident. For her, confidence is an act. Her parents who weathered the depression have been a huge influence on her.

Studies show that women lose confidence from middle school through doctoral programs (Pajares, 2005). Unfortunately Ann’s confidence is lowest now. Others on the faculty make her feel small and she sees very intelligent faculty members who seem to take pride in making other people look stupid so she frequently feels intimidated. She believes girls can lose confidence quickly if professors belittle them. The technology field is constantly changing; it is hard to stay current. She seeks out professional development opportunities and is constantly learning so she will not feel inadequate around her peers.

Even though she does not feel confident, Ann has strong support from her parents and husband. One of her MBA professors was wonderful - she was full of confidence and intelligence. She believes faculty members need to portray confidence and be approachable because they serve as role models and mentors for students.

Early in her career Rebecca felt a sense of accomplishment when she completed a project; this helped build her confidence. She knew she was capable of more than what people expected of her. During the early years she was always proving herself. She knew she was capable and she never let herself down.
Rebecca studies root cause. She believes we need to change our cultural messages. Too many times women are told by society that they are not capable of complex thinking, critical thinking, and math so girls are not building those skills. It then becomes a self-fulfilling prophecy. Her pre-calculus teacher in high school told her girls just are not good at math. She was asked when she received promotions in industry who she had slept with to get the job. She believes we need to listen to our own language and that attitudes need to be changed in order to build these skills and self-confidence in young women.

Sheila found validation by working on computers. Because so few people knew how to interact with computers when she finished college, people respected her for knowledge about computers. She felt in control, and as a result, special. Her knowledge helped her build self-confidence.

As a female teacher, Patty believes she is able to encourage and develop confidence in the female students in her classes. Her students sometimes tell her that seeing her teaching gives them the motivation to continue with their career choice. They also tell her that seeing a woman instructor reinforces their hope that they can also pursue a good career using their engineering degree. Women instructors in colleges help to recruit more women students to engineering majors. Patty knows that is one way we can face the challenge of increasing the number of women in engineering majors.

When asked about how she has been able to stay confident, Pam replies that she would not label herself confident. She says she is “Stubborn, hugely stubborn”. She is a perfectionist. If people say she cannot do it, she is determined to prove them wrong.
Even though she does not feel confident, she is very competitive and is not afraid to face a challenge.

Overcoming Barriers

Our next theme was about strategies for overcoming barriers encountered along the way. Studies show lower job satisfaction as one reason women leave IT and engineering careers (Trower & Chait, 2002). I asked questions such as are you satisfied with your job? What strategies do you use to overcome barriers that would inhibit your satisfaction with your job? Why do you stay in your IT/engineering career?

Barriers discussed by the focus group participants included demands of family, lack of support from supervisors, bullying by peers, fear of not having enough knowledge to keep current in the field, emotionally draining jobs, high stress/high demand jobs and male perceptions of them.

Ann, who is the mother of four, said the demands of family can be a challenge and that the strong support system her family provides is critical for her. There was much agreement about the importance of a support group to help balance work and family life.

Several have encountered what they described as bullying from their peers. A barrier to their job satisfaction has been not only the bullying, but also the lack of support from supervisors and that crushes morale. Leslie feels frustrated when the Human Resources Department will not take action.

Even though several spoke of the fear of not having enough knowledge to keep current in their fields, most were proactive about their own learning. From Leslie,
“When I have an academic barrier, I go back to school” and from Pam, “You barrel through it, ask for help, don’t quit.”

Most described their industry experiences as “emotionally draining” and “high stress/high demand” and believe those experiences contribute to their decisions to become community college faculty members.

Many spoke of how male perceptions of female coworkers can be a barrier. Esther feels strongly that we need to change male perceptions because she believes compassion from male counterparts is important. She gives the example of cartoon or video game characters – the males rescue the females and solve all their problems. She says men are surprised when she walks into her classroom. They do not expect their programming instructor to be a woman. Quite often her male students tell her that girls do not go into computer science/engineering. In industry a male supervisor told her that women do not come back to work after they have babies.

Patty believes that one way we can face the challenge of increasing women in engineering majors is to have more women faculty members in that discipline. As a female faculty member, she is able to encourage and support the female students in her classes. Her students sometimes tell her that seeing her teaching gives them the motivation to continue with their career choice.

Rebecca’s experience is that women are told by society that they are not capable of complex thinking, critical thinking, and math and it becomes a self-fulfilling prophecy. Her calculus teacher told her girls just are not good at math. She believes attitudes need to be changed and that we need to listen to our own language and change our cultural
messages. One of her strategies to overcome barriers now is to tell people her goals and advises her students to do the same. She finds that listing her goals at the end of each day makes her more likely to achieve.

The barriers Esther has experienced include emotionally draining jobs, high stress/high demand jobs and the demands of family. She believes the work/family balance is very important. She thinks her daughters saw her under high stress and her daughters now seek jobs that are not that all-consuming.

Leslie believes there are two types of barriers: lack of knowledge and personnel issues. When the barrier deals with information she does not have, she goes back to school to gain the knowledge she needs. She believes “Knowing more makes you a better person.” When the barrier deals with personnel issues, she gets upset when those in positions within the college that have the authority to deal with it do not take action to stop it. She is a problem solver and when she can’t fix the problem and cannot depend on those who could, she finds it frustrating. She sees coworkers who feel stuck or trapped in a position because they don’t have the option to quit, they see no support from supervisors and they are frustrated too.

Ann relies on a strong support system at home and a strong peer support at work to overcome barriers that could inhibit satisfaction with her job. She believes everyone needs to develop a safety net. Ann is afraid her students, especially young women, might not take risks if they do not have one. She encourages her students to join clubs and/or groups to help create a support network for themselves.
Women show lower job satisfaction when they encounter barriers they cannot overcome (Trower and Chait, 2002). Pam has several strategies she uses to overcome those barriers. If the barrier is academic, she barrels through it, asks for help, does not quit. Dealing with personnel is a different barrier. For example, there is a person in her department who is so hateful, so determined to destroy people personally, that it has begun to crush morale. Social issues are hard. Bullying and attacks crush morale. It has been frustrating to her that the human resources department does not step in and take action.

One of the biggest barriers Shirley has encountered is people’s “same old thing” attitude but the constantly changing nature of her job prevents her from thinking that way. She has always been allowed to develop new programs that benefit the college and are exciting to her.

Studies show job dissatisfaction is one reason women leave IT and engineering careers (Trower & Chait, 2002). One of the strategies Esther has used to overcome barriers that inhibit her satisfaction with her job has been to over-compensate in order to be “one of the guys”. This phenomenon of women making themselves more masculine so they can succeed in a male-dominated workforce challenging the cultural system is supported by the literature. (Adam, et. al. 1994; Cockburn, 1991; von Hellens & Nielsen, 2001; Wajcman, 1991).

Even though many participants had supporting parents, Shirley’s father, a psychiatrist, said that math was not a major for a girl and that she might be having identity problems, so she started college as a French major. Eventually Shirley earned a
bachelor’s degree in math and a master’s degree in Mental Health Counseling. Following college, she worked for the telephone company in the engineering department, supervising women operators who assigned telephone numbers. She never turned down a chance to learn a new skill.

Having grown up in India, Patty has a unique perspective on being a woman in engineering. She sees both cultural and financial barriers. She saw a lot more women in engineering courses in India than she sees in the United States. Comparing the education environment in both countries she sees that the cost of higher education is more affordable in India than in the United States. A lot of students in her classes in the United States are doing some kind of part time work to support themselves. It appears to her that financial support from the family is a very important factor.

Patty observes that in the United States female students and their parents are still more interested in pursuing more female-oriented careers like teaching or health care related jobs than IT or engineering jobs. The fear of finding a job in a male dominated field might discourage some female students. In India, IT and engineering professionals are always in high demand so the number of female students pursuing these careers is on a steady increase.

When her boss told her she was not capable of completing a project, Rebecca’s response was always, “I’ll show you, I can do that.” She wanted to prove she could do anything she could conceive of. She did not work with another woman until the 80’s. There were not a lot of people in IT in the ‘60’s. The mystique of computers made her feel special.
Sue’s story is one of an incredibly strong, stubborn, courageous fighter. Born deaf, her childhood was filled with surgeries to address her deafness, and complicated by a physically abusive environment. The one place she felt safe was with her grandfather. He was a designer for IBM and since Sue had always been mechanically inclined, as a young girl, she spent time “just following him around.” Sue has amazing resolve. She believes in destiny, in a higher cause and in the strength of the human spirit. She feels that a difficult childhood has made her believe she can do whatever she sets her mind to. She thinks fear might be a motivator. She was afraid of the alternative to not going to college. She had no safety net, nowhere to go back to. Sue earned a bachelor’s degree in deaf education. She does not describe herself as confident, but determined. After college, she was not sure what she wanted to do and taught herself about computers. She liked computers and went to an Internet Service Provider and offered to work for free for two weeks. The first day on the job she did not even know what a server was. She eventually became a systems administrator and then a Tier II support person.

Isolation

Studies show that isolation can have an impact on the retention of women in IT and engineering positions in industry (Massachusetts Institute of Technology, 1999; Macfarlane & Luzzadder-Beach, 1998; Rosser, 2004). These studies show that isolation can have a negative influence on their retention. These studies show that isolation can be a factor in retention of women in IT and engineering majors in college too. I asked participants if they feel isolated. If so, how do they overcome or compensate for those feelings? Participants answered this question from their current position as a community
college faculty member, not from their experiences from industry. Maybe not
surprisingly, since these women have persisted in their IT and engineering careers, and
chose teaching as an alternative to working in industry, none of the focus group
participants reported feeling isolated.

Employers should still be aware of the negative effects of isolation and make
policy decisions with those effects in mind. Isolation can have a strong effect on the
satisfaction of female faculty and can influence their decision to leave the field.
Institutions should take special care to ensure that women are not excluded from formal
and informal campus events and be assigned mentors. Female faculty should be
encouraged to participate in professional development and the promotion process as well
as collaborate on teaching techniques.

Studies show that isolation can also have an effect on the retention of women in
classrooms where the majority of students are men (AAUW, 2010). Leslie grew up with
boys and attributes that to not feeling isolated when she finds herself the only woman in
the room. Her mother told her that when Leslie was growing up, she treated every boy
like brother. She did not find boys as foreign bodies, she is comfortable around them yet
when she plays golf with men she feels very intimidated. She feels much more confident
in the work place than on the golf course.

Pam was one of few women in her programs but was not intimidated. She grew
up with a brother and sister. She was very close to her brother and played with boys
every day. She did not feel uncomfortable or isolated being around boys. After college
Pam spent 13 years in IT serving as programmer, systems analyst, project manager, and
At the time there were 100 developers; she was one of two women. She had one boss who mentored her and that relationship meant a lot to her. They still stay in contact; she visits with him monthly. When she first got the job, there were rumors about them having an affair. At first she was bothered by the insinuation that she could not get the job on her own merit. She laughs about it now.

Life Balance

Many studies show that family-related issues cause women to leave the field (Society of Women Engineers, 2006; Frehill et al., 2008). I asked focus group participants how they have managed the balance between home life and work. The overwhelming response was that the flexibility that community college teaching offers provided the greatest advantage to balancing the two.

Patti says that teaching in a community college has allowed her the flexibility to simultaneously work and raise a family. Pam says she probably left industry to take her faculty position for the wrong reason – she had a baby and a four-year-old at the time.

Patty, mother of two young boys, says she is able to balance her work and family life with the support of her family. She is able to do a lot of class preparation and grading from home and communicate electronically with her students.

Alisa knows that teaching full-time at a community college can be very demanding. While community college faculty may not be expected to conduct research regularly, they are still expected to answer to accreditation agencies, provide assessment plans and do all the other “business” of teaching. In addition, community college faculty spend a good deal of time recruiting students and providing outreach in the community.
While Alisa is not a mother, she has faced the challenge to help take care of aging parents who still live in New York City while continuing to meet her obligations at the college. She believes faculty can achieve balance in all aspects of life, but it takes effort.

Teaching in a community college has allowed Martha the flexibility to work in a position that she loves and simultaneously raise a family. Teaching in a community college has helped her to manage a healthy work/life balance.

As a young mother, Shirley did substitute teaching in the schools and tutored high school students in math. She wanted to work with students who wanted to learn and thought students in the community college would be motivated. She believes having a somewhat flexible schedule and summers off does help balance the demands of family with teaching.

Sheila began her educational journey at a community college earning an associate’s degree and transferred to a four-year institution and earned a bachelor’s degree. After college, she began working as a sales manager at a computer store. She eventually was employed as a senior analyst/computer consultant for an accounting and consulting firm for several years before joining her community college. She remembers her 50-to-60 hour work weeks at the accounting firm as “grueling” and part of her decision to choose a career at the community college.

Esther did a summer internship as a keypunch operator and it led to a full time job as programmer. She moved from corporate programming to Director of Information Systems at an adolescent treatment center for abused, neglected and dependent children.
She was there for six years, but it became emotionally too hard for her. Her decision to teach at a community college has helped her to create a better life balance.

*Role in Engaging Young Women*

My final question was about their role in this whole challenge of the lack of women in IT and Engineering. I asked them questions such as, How do you see your role as an influencer of young women? What is your role in encouraging young women? What are you going to do to replicate yourself?

The focus group participants had a lot to say about this series of questions. They saw their primary role as providing encouragement and serving as a role model and mentor. Another role is to help dispel myths, change male perceptions, and emphasize the importance of women in the workforce. They also agreed that faculty need to let students know they have high expectations, that faculty should not coddle them, should let them experience failure, but not let them quit, and encourage them to finish their degree. Another strategy to address the challenge of the lack of women in IT and engineering is to help students build strategies for success and find resources. All agreed that while helping students build their skills in the classroom, faculty must be aware of different learning styles, and emphasize problem solving and critical thinking.

*Role Model and Mentor*

I asked each focus group about the importance of mentors. Do you think it is important to have mentors? Who have been the most important mentors in your career? How have they influenced you? All agreed that mentors are critical and most cited several mentors that they had encountered throughout their lives. Mentors were not
necessarily women; in fact 50% of those mentors described in focus group sessions were men. Mentors included high school teachers and college professors, academic and industry supervisors, partners, parents and grandparents.

Focus group members described their mentors in many ways, “She took an interest in me.”, “We all need to have someone who believes in us.”, “She was approachable.”, “We get validation from people, not job duties.”, “Mentors validate, empower and encourage.”, “Mentors show respect.”, “Mentors make time to help.”, “Mentors provide encouragement, patience and guidance.”, “My college professor encouraged problem solving and critical thinking.”, “Mentors recognize potential.”

All of these faculty members see mentorship as an integral part of their job in a community college. They know firsthand the importance of being approachable and available to students and showing interest in and validating their work. Encouraging students empowers them to recognize their own potential.

The focus group participants believe that their primary role in the challenge to influence their female students is as one who provides encouragement and serves as a role model and mentor. Leslie emphasizes the need to make sure women stay focused and finish their technical degrees. Esther adds that we need to acknowledge successes as students progress through their degree programs. Sheila thinks we should get excited for them, celebrate small successes and not let them give up. Rhonda agrees. She believes as mentors, one way faculty can provide encouragement is to celebrate little successes. Shirley’s strategy as a role model is to stop any negative self-talk that she hears. She mentors her students by advising them how to say positive things about themselves. She
tries to show her female students that she has faith in them and their ability to succeed. Patty’s students tell her that seeing her (a female instructor) reinforces their hope that they can also pursue a good career using their engineering degrees. Alisa thinks it is very important for young women to see excellent role models. She encourages her students to have their daughters come to the college and job shadow her whenever possible.

Lynda believes mentors are vitally important. She gets validation from people, not her job duties. She thought her high school literature/photography instructor was brilliant and considered her to be her first mentor. This instructor told Lynda she could do anything she wanted to do. Lynda’s mentors validated, empowered, and encouraged her without leading. She believes mentors must show respect and allow those they mentor to be who they want to be.

Alisa credits her partner for providing support for her educational efforts along with two female faculty members who were excellent mentors and provided great support so she believes mentors are very important. Hers have always made time to help her and provide encouragement, patience and guidance.

Esther’s advice to younger women entering the field is to connect with people who can support them and to seek out mentors. Student support services in college are critical. Compassion from male counterparts is also important. We need to acknowledge successes. Martha believes that mentors, whether men or women, are critical. We all need someone to believe in us. Her mother and high school physics teacher were her strongest mentors. Sheila’s parents have been her strongest mentors. Since both were professionals, it was expected that she would finish college. Ann believes part of her job
as a faculty member is to be accessible to students, to build trusting relationships.
Jennifer’s parents and grandfather valued education and it was their expectation that not only would she attend college and graduate, but pay her own way as well.

Cindy believes girls need mentors. When she went back to school, she worked in the IT department. Her female boss took her under her wing and considered her an “adopted little sister” and became Cindy’s mentor. She encouraged problem solving and critical thinking.

Linda was fortunate to have strong support from her family and her teachers, as well as two mentors who were instrumental in her academic success. She believes that the millennial generation requires lots of nurturing and encouragement and will benefit, as she did, from establishing strong relationships with mentors.

Rhonda believes strongly in the power of mentors and thinks that to be successful; they must encourage students and celebrate even the smallest successes. While she was studying for her Ph.D., she was fortunate to have two members of her committee be extraordinarily supportive, even inviting her to present at conferences with them. Now, as a community college faculty member, she is “returning the favor” and enjoys the opportunity to mentor students.

As a female college faculty member in IT Shirley believes she needs to be a role model, stop any negative talk and encourage young girls to continue to take math courses. She keeps her eyes open for girls who have potential in math and talks to them about going into the field. She believes mentors are important; having someone believe in her was critical. She mentors her students by advising them on what courses to take, how to
take tests, and how to say positive things about themselves. Her hope is that she can help girls think about math in a positive way. She was never afraid of math and does not remember having a teacher who modeled distaste for math, but as a young girl never had a mentor who had faith in her either. She would like to show girls and women that she has faith in them and their ability.

Leslie sees her role in this whole challenge of the lack of women in IT in several ways. She believes community college faculty need to make sure women are focused and finish their technical degrees and she encourages young women by talking to them about the importance of women in the workforce. She tells her students that women can be strong at math and patterns, that women have stronger emotional intelligence and a greater ability to analyze data too. She advises women to keep going to school and constantly keep their skills up to date. She wonders if there should even be extra sessions of technical courses just for women taught by female role models.

Martha’s mother has been the biggest influence in her life. The family faced adversity growing up and her mother never allowed her daughters to be anything but successful. She expected all of her children to graduate from college and go to work. Because her father left the family when Martha was young, she and her siblings knew they needed to be able to support themselves; her mother made sure her daughters were not headed to college to get their MRS.

*Dispelling Myths and Misperceptions*

Another important role of female community college faculty members is to help dispel myths, change male perceptions, and emphasize the importance of women in the
workforce. Pam wants to make her students aware of successful professional women. She wants her students to see that IT and engineering professionals “are not weird. We’re fun, we paint our nails, we drink wine.” Lynda tries to show her female students that IT jobs are people-oriented, that those in IT jobs are not isolated. She tries to help young women understand that they can be fun and feminine and still be in IT. While advising her students, Cindy tries to let girls know that she did not always have the confidence and the knowledge she does now. She tells the story about how, at one point, she did not know what a hard drive was. She encourages other faculty members to tell their stories and talk about how they learned from their failures. Rebecca believes that too often women are told by society that they are not capable of complex thinking, critical thinking, and math. She believes we need to be more aware of our own language and change our cultural messages. Jennifer believes in the power of words, we should never tell girls they cannot do math. We need to help girls turn off the negative voice.

Lynda once worked with a young male coworker who must have had the wrong perception of her potential. She asked him details about the function of a network card that he was working with and he told her she did not need to know. His response made her so angry that she read Networking for Dummies and went to a community college to take networking classes. She eventually became a network consultant and manager of the Technology Solutions Center at that company and became that young man’s boss.

When Alisa worked as a cabinetmaker she learned not to let the preconceptions of men, and their notions that women may not be as good at certain historically “male dominated” jobs, influence her behavior.
As a female community college faculty member in IT, Esther sees her role in this whole challenge of the lack of women in IT as someone who strives to change male perceptions. She is a programmer and teaches students how to develop video games. She is concerned about how the female characters in the games are portrayed. She too often sees female characters depicted as weak and helpless; the males rescue them and solve their problems. When she enters a classroom, the men in the class do not expect their instructor to be a woman. A big barrier for Esther in corporate positions was male perception – men did not think women should be in computer science/engineering jobs. Her bosses told her women did not come back to work after having babies.

As she progressed in her career, Rhonda became an education analyst and traveled all over the country teaching UNIX. She believes men still do not see women on the same plane. “Just like any other stereotype, men keep you in that framework by making you feel like you can’t do it.” Working in the computer field makes her feel her relationships are more peer-to-peer. She believes women need a strong sense of who they are. When she gets knocked down, she gets training and picks herself back up.

Jennifer was told she got her job because they needed a woman. That made her very angry and led to her wish that the girls she teaches today would get angry and say “I can do this!” When she first entered the field, Jennifer did not realize how much personal fortitude IT would require from women in the profession. She really did not understand the women’s rights movement and what it was like to be considered the token female. Her persistence and stubbornness, however, have helped her navigate in what has been traditionally a man’s world.
Ann would not have chosen CS because she did not know what jobs were available and it did not seem like a fun job when she was growing up and in college. Society’s perception of the job is not very positive. She would have been hesitant to choose a career when she was not sure what her job would be. She believes part of her role as a faculty member is to expose students to different professions within IT and opportunities they have to offer.

Pam grew up in a lower middle class family. Her father told her women did not go to college. Her brother was the “golden child”; all of their extra money went to pay for her brother’s education. In exploring her father’s attitude further, he grew up in the depression, went to school through the eighth grade, did not have enough money to pay for all of his children to go to college, and probably believed that men are to be the head of household and women are to stay at home and raise the children. Her parents had high expectations, Pam got in trouble for getting a B, but her father did not see the value of further education for women. She believes this contributed to her being stubborn; she was determined not to go to college to get her “MRS”. Pam’s response was to say to herself, “I will show him (father), I will show the world.” She notes that many women are attracted to “helping” careers and that participation by women in those sectors is growing. She believes we need to change the perception that IT and engineering are not “helping” careers.

Persistence
Participants agreed that faculty need to let students know they have high expectations of them. They believe students should not be coddled. Students should
experience failure, so they learn that failure is just another learning experience. Faculty need to stress the importance of persistence in order for students to reach their goals.

Pam told the story of her high school teacher from her honors English class. Although Pam was an excellent student, she received a “D” on her first paper. Her teacher told the class her intent was to teach them to write. With a lot of hard work, Pam completed the course, and earned an “A”. She had learned to persevere, even though she thought she might be facing failure. Sue’s approach is to give students hands-on assignments where they are forced to use their problem-solving and critical-thinking skills. No matter how discouraged students get, she will not let them quit until they present her with a solution. Participants agreed that while helping students build their skills in the classroom, faculty must be aware of different learning styles, and emphasize problem solving and critical thinking.

Cindy always had supportive parents. College was not an option, it was a requirement. One lesson her parents instilled in her was to never quit. She always liked math. Her mother was a teacher and her father was an engineer. They always supported her pursuit of a math-based career. Cindy believes faculty’s role is to encourage young women and tell their stories. She lets girls know that she did not always have the confidence or knowledge she does now. She talks about how she learns from her failures. She admits to students that early in her studies she did not know what a floppy disc was.

Leslie has not ever felt very confident and attributes her success to the fact that she is very driven even though she worries a lot and feels insecure. Growing up, failure
was not an option and she thinks her stubbornness and drive might be innate. For instance, when she got mad at her realtor, she went out and got her real estate license. If she wants something, she goes out and gets it. Even though she believes we need to allow girls to fail so they know they can survive failure, she tries to focus on the successes of her students, not the failures.

Alisa truly believes the saying “where there is a will, there is a way.” She has never let anyone keep her from what she feels is the best path for her life. She encourages her students to stay true to their goals and focus on the best path for their lives.

Sheila comes across as a person who is tenacious and persistent. As a female professor at a community college she has strategies for encouraging her female students to complete their degrees. She encourages other faculty members to get excited for their students and celebrate small successes. Above all, she says, “don’t let them give up.”

Linda is an example of someone who did not give up. She began her career by working for five years as a secretary in industry. During that time she started her post-secondary journey and over time earned a degree in data processing. Her technology skills were mostly self-taught. As a female community college faculty member in IT she advises many female students and serves as an example of her own personal persistence.

*Build Strategies for Success and Find Resources*

Many female students in community colleges face barriers that have nothing to do with academics. Some of those barriers include single parenthood, homelessness, financial struggles, childcare issues, and physical and emotional abuse. Many female
community college faculty members find themselves in academic advising sessions trying to help their students build strategies for success and find resources. Patti believes one of the ways to help young women build strategies for overcoming barriers is to help them understand where resources and support systems are. Esther shared that her female students are seeking support systems, a safety net. She feels that part of her job is to connect women with people who can support them. She believes student support services are critical. Ann sees that some of her female students might not take a risk if they do not have a safety net. She encourages her students to join clubs or groups to create a support network for themselves. She sees first-hand that students need support systems such as childcare so they have time to attend and study for classes.

Martha sees herself as a coach and mentor to young women and knows she serves as a role model. She tries to help young women build strategies for overcoming barriers and she works constantly trying to help them understand where their resources and support systems are.

Sue believes as a female community college faculty member in IT she is able to influence young women by helping them build strategies for success. She believes problem-solving and critical-thinking skills are important and advises students to ask for help, tap all resources, and make their own goals a priority. She believes finding a support system is critical.

Patty’s family supported and encouraged her to follow a career-oriented education. She believes the support of family is the number one factor that helps women choose and stay in engineering careers. Her parents always encouraged her to get a good
education and have a successful career and that helped her stay confident and determined
enough to face and overcome all tough situations. Without her family’s help and support
she would have never reached the position she holds now. She also believes she can help
do for her students what her parents did for her.

Rhonda describes her early home life as “dysfunctional.” Her father went to
school through eighth grade, her mother through the seventh. Her mother was an
alcoholic. She describes growing up with her mother as “horrifying.” She was afraid of
her mother. Books became her best friends. Reading allowed her to disconnect from
family. She was always recognized for scholastics, not because she was exceedingly
smart, but because she worked hard. She sought and received positive feedback when
people would recognize and comment on her knowledge of a particular subject. She
found support from her father who told her college was not an option, it was a
requirement. She tries to instill in her students some of the same strategies she adopted in
order to overcome barriers to her success.

Summary

Participants willingly shared their stories. Surprisingly to me, most did not attend
college with college teaching as their goal. They began with a variety of careers, mostly
in industry. Ann’s story is not uncommon. She was good at computer science (CS) and
math classes, but she did not choose CS as a major because she did not know what jobs
were available. CS did not seem like a fun job when she was growing up and in college.
She earned a bachelor’s degree in accounting and became a certified public accountant
(CPA). She went directly to graduate school and earned a master’s degree in business
administration (MBA) concentrating in management information systems thinking she would go to human resources.

The synergy grew in the focus group sessions as the participants told their stories. Common themes developed and the participants were very willing to share their experiences and intimate perceptions about their history. The themes and unique stories along with their shared experiences created the findings of this research. Chapter V considers these findings in the context of preceding work and offers suggestions for future research.
CHAPTER V: ANALYSIS

I studied several authors’ work on qualitative research and chose to use the principles of qualitative analysis using focus groups for my study. Creswell writes that patterns will become apparent in focus groups and can be developed into categories. He believes specific methods must be used in order to analyze patterns in language. He explains that researchers use systemic procedures such as open coding and axial coding for analyzing categories and developing them into themes in order to represent the relationship among categories (Creswell, 2002). Glaser and Strauss advocate that analysis of focus group data include constant comparison analysis. (Glaser & Strauss, 1967). Strauss and Corbin tell us that the researcher develops the story, or narrative statement, toward the end of the study (Strauss & Corbin, 1990). Charmaz believes we cannot separate ourselves from the environment and the data we collect from that environment. We structure our findings through our experiences and relationships with people. (Charmaz, 2006).

My goal in conducting this research was to contribute to the work done previously on the reasons for females’ decrease in interest in pursuing careers in information technology (IT) and engineering. I based my findings on these 16 participant’s collective experiences. My own history and experiences are part of my perspective and therefore part of the development of my findings. My work may serve to inform others interested in facing the challenge of increasing the number of IT and engineering professionals in the United States.
This chapter offers results of the findings from the study, discusses these findings in the context of earlier research and offers suggestions for future research.

Summary of the Study

As the Dean for IT and Engineering at Edison Community College, I see firsthand the under-representation of women in our programs. We piloted the We Are IT! initiative in 2006 to try to pique the interest of young women in our area. Our initiative has grown to the point of having up to 21 partners across the state of Ohio with over 3,000 young women participating each year. The women who participated in this study are part of the We Are IT! consortium.

Tracy Camp compared the journey from elementary school to a STEM career to a “pipeline”. Her pipeline theory suggests that the number of women coming out of the STEM pipeline and joining technology fields will increase “as the number of girls who study STEM subjects from elementary to secondary school increases (more girls go into the pipeline)” (Camp, 1997, p. 104). This has not happened, especially with tenured faculty level in engineering. According to National Science Foundation research, 12% of engineering doctorates were earned by women in 1996. Ten years later, in 2006, only 7% of tenured engineering faculty were women. (National Science Foundation, 2008). I believe we need to increase the number of female faculty members teaching in the IT and engineering fields because of their ability to influence their female students.

The purpose of this study was to explore characteristics and behaviors of female community college IT and engineering faculty in the belief that insight into persistence,
success, and strategies that these women have used to overcome barriers may in turn help us nurture younger women and facilitate their pursuit of IT and engineering careers.

Since the percentage of female IT and engineering faculty members is greater at the community college, the community college may be a place where significant improvement can be made to recruit and retain women in IT and engineering disciplines. In other words, repair the “leaky pipeline”.

The results of this qualitative study will help to more clearly define the characteristics of women who have successfully pursued careers as IT and engineering faculty members. These women can help us develop those attributes in female students.

Demographics

I interviewed 16 women for this study. Some of the demographics included: one (6.25%) woman of Indian decent, two (12.5%) African Americans and 13 (81.25%) Caucasians with an age range of 29 to 67. Degree attainment ranged from no degree to Ph.D. One interviewee has no degree (6.25%), one has a bachelor’s degree (6.25%), ten have master’s degrees (62.5%) and four have Ph.D.’s (25%). Degrees range from anthropology, economics, computer science, accounting, business, mathematics, fine arts, electronics engineering, bioengineering, deaf education to mental health counseling. Ten (62.5%) were students at community colleges. The average number of years taught at community college is 12.75, the range of time taught at a community college is three to 24 years. Faculty rank ranged from instructor to professor: four instructors (25%), six associate professors (37.5%) and six professors (37.5%).
Research Findings

The research found five common characteristics shared by our 16 female community college faculty in Ohio. As young women, participants enjoyed working with numbers and were interested in different aspects of mathematics. A common theme in focus group conversations was that we need to encourage young women throughout their studies in mathematics and dispel the myths about girls not having the same aptitude for math as boys. These women are competitive and tenacious, both academically and athletically. They learned as young girls that competition often times meant they did not always win and they learned how to survive failure. A theme in several conversations was that we do not allow girls to fail; therefore, they do not learn how to survive failure, thus give up when they experience a perceived failure. Even though these women have learned to survive failure, every focus group session included the phrase “failure is not an option”. They have learned to persevere. These women have developed the ability to secure needed resources and build support systems. Most surprising to me was the fact that the majority of these women started their careers in industry with no intent to teach or work in academia. They discovered their love for teaching before changing careers to become community college faculty members. An important factor in their decision to move from industry to careers in education was the flexibility it offered. The value placed on a family/career balance was often a deciding factor too.

**Excelled in Mathematics, Started Their Careers in Industry**

The women in this study share a love of numbers whether through mathematics or accounting, along with problem-solving, and critical-thinking skills. Pam loved math and
accounting in high school. Martha and Leslie were math majors in college. Ann loved math and majored in accounting in college. Esther says she loves numbers, not business, which is why she went into computer programming. Patty loved math and science and chose to major in engineering. Lisa loves science and math and chose a school specializing in them. Shirley liked puzzles, games, mysteries, and cards as a child and a teen. Even though our group included three math majors and two accounting majors, most started their careers in industry and did not go to college with the intent to teach. Their positions ranged from systems analyst, programmer, engineer, geologist, cabinetmaker, senior analyst for an accounting firm, to director of technology.

Many did not go directly into IT/engineering jobs. They agree that the reason was probably because in high school most did not know what a job in IT or engineering would really be like. They were drawn to what were considered high demand, high paying jobs. Money was a motivator right out of college. Many of these women were responsible for funding their own education.

*Learned to Survive Failure*

Surprisingly, these women would not label themselves as confident, but have a strong sense of who they are. They described themselves as strong, tenacious, stubborn, driven, competent, and competitive, but not confident. They are competitive and like being challenged and find that when they meet those challenges, the achievement makes them feel more confident and competent. They find teaching challenging and rewarding. They take charge of their own learning. Many of them have an “I’ll show you” attitude when told they are not capable of achieving a goal. Leslie grew up in a family that did
not coddle her simply because she was a girl. Her family held her to high standards. Pam’s family also had high expectations; she would get into trouble for bringing home a B. She believes strongly that we need to allow girls to experience failures along the way so they build the confidence to survive when they get older and the stakes are higher.

Even though they all agreed that we need to let girls experience failures along the way, whether athletically or academically, a common theme was, “failure is not an option”. Further discussion revealed that what they really meant was giving up when you experience failure is not an option. All were held to high expectations either by themselves or others and as a result, were faced with and learned to deal with failures as they progressed through school and into their careers. Through trying and not always succeeding, they learned to build strategies for themselves to survive failures. Most experienced challenges along the way, whether from an alcoholic mother, competing on an athletic team, teachers who told them girls just could not do math or fathers who said there was no need to send a daughter to college.

They built strategies for overcoming those challenges through achievement. They are tenacious and encourage their students not to give up when faced with adversity. Shirley stresses the importance of celebrating small successes along the way and says the thrill of figuring out a math or computer problem is her reward. One of Pam’s strategies when faced with a tough challenge is to just barrel through it, ask for help, and not quit. Most describe themselves as problem solvers and stress the importance of critical thinking skills. Patty makes a mental note of lessons learned from difficult situations and
then moves on vowing to learn from the experience and not allow it to be a barrier to her success.

These women have learned to be comfortable in a male dominated field and as a result, strive to dispel myths and change male perceptions. Esther feels strongly about the need to change those perceptions. She teaches games programming and points out that in most video games males rescue the female characters and solve their problems. Many participants shared that male students are surprised on the first day of class to have a female faculty teaching their class.

A common strategy for this group is to learn to tune out their own negative voice and say positive things to themselves. Over the years these women have been told, “Girls aren’t capable of complex thinking, critical thinking and math”, “Women shouldn’t be hired because they won’t come back to work after having children”, “IT and engineering are not majors for young women.” Many of these women talked about how they coach their students to use strategies that would help them give themselves more positive feedback. One woman spoke of how she ends each day with journal entries that list the positive achievements for each day. She encourages her students to do the same.

**Developed the Ability to Secure Needed Resources and Build Support Systems**

These female faculty members believe in and value mentors. Many believe mentors are critical and that we all need someone who believes in us. Mentors validated, empowered and encouraged this study’s participants. Patty says her mentors helped her to stay confident and determined when facing tough situations. Alisa thinks her mentors always made time to help her, provide encouragement, patience and guidance. Sheila
feels part of her role as a mentor is to get excited for her students and celebrate small successes. It is important not to let them give up. Linda lets girls know that she did not always know what she was talking about. She believes we should tell our stories and talk about our own failures. Linda did not know what a floppy drive was when she started her first job after college. She assures her students that no one has ever been born knowing what a floppy drive is. Everyone, male and female has to learn. Sue did not know what a server was when she started her first IT job. She emphasizes skill building and encourages young women to tap all resources and ask for help. She believes goal setting is important and encourages her students to make their goals a priority.

Our focus group members believe young women need to seek out strong role models and develop their own support systems. Many cite strong support from parents, grandparents, partners and teachers. Gender of the role model does not seem to make a difference. Others, who did not have those traditional support systems, would seek out their own. Rhonda who was afraid of her alcoholic mother says she found herself three surrogate mothers along the way. For many, going to college was not an option; it was their family’s expectation that they would graduate from college. Many of these women are the first in their family to earn a degree, even though they might have gotten encouragement from parents who may have only finished the eighth grade.

These women believe part of their job as a community college faculty member is that of role model and mentor for their students. They see their female students seeking out support systems many times through mentors who will help them develop their own safety net. Student support services are critical and compassion from male counterparts
is important as well. Ann believes that students may not take risks if they do not have a safety net. She encourages students to join clubs/groups in order to create a support network. These women got positive feedback for being knowledgeable and believe part of their role is to give that same positive feedback to their students.

Love Teaching

Most of the focus group participants discovered their love of teaching before coming to the community college as full time faculty members. Most participants want to help people make a difference in their lives; they feel community college teaching gives them that opportunity. Sheila worked as a senior analyst in an accounting firm 50 to 60 hours per week; the schedule became too grueling for her to continue at that pace. Of all the things she did as an analyst, she liked computer training/teaching the best. She started teaching as an adjunct and soon looked for a position where she could teach full time. Lynda worked as a programmer/analyst when she began designing and delivering training for her company. She enjoyed training and helping people learn new skills. Jennifer was a network consultant when she started working in her company’s training center and eventually became adjunct faculty at her community college. That is where she discovered her love of teaching. Pam says, “I taught one class as an adjunct and fell in love with teaching!”

Many did not know in college what a career in IT/engineering would be like. They were attracted to high paying jobs that in the end were also highly stressful and demanding. They were attracted to the community college because they could still practice in their chosen fields and have the advantage of the community college
atmosphere and the flexibility it offered. Having the ability to help people is personally enriching and gives them a sense of empowerment. Pam says what attracted her to the community college was the ability to make a difference in people’s lives. Esther says she was attracted to community college because of, “small class sizes so I’m able to actually get to know the people with whom I work, as well as the students I teach. I love programming, I prefer the smaller and more personal venue of the community college.” Shirley worked as an adjunct before becoming a full-time faculty member. She wanted to work with students who wanted to learn and she thought students in the community college would be motivated.

*Value a Family/Career Balance*

Right out of college, participants wanted high-demand, high-paying jobs. Money was a motivator. As they have grown older however, the high demands of their industry jobs have made them take a second look at their priorities. Demands of family, emotionally draining jobs, and high stress were common themes in our discussions. Quality of life became a factor for each of them. They found they could continue to pursue their IT/engineering careers with passion and still achieve balance if they became a community college faculty member.

They share a need for a family/career balance and see the flexibility college teaching provides as a real advantage. They were willing to trade their high-demand, high-paying jobs for a better work environment and a healthy family/career balance.

Community college teaching became attractive to Pam when she worked as a database manager for NCR. She was very attracted to the flexibility college teaching
could offer when her second child came along. Patty finds that she can do a lot of class preparation and grading from home allowing her to spend more time with family. Lisa also cares for her aging parents. She believes we can achieve balance in all aspects of our lives, but that it takes effort. All agreed that the need for flexible hours does not diminish an employee’s work ethic or value to the organization.

By addressing these five common characteristics in girls and women throughout the IT/engineering pipeline, these findings can be disseminated to educators, counselors and mentors who can use them to better understand success strategies. This research also suggests a number of ways educators, counselors and mentors can encourage and support young women as they pursue their careers.

**Literature Review in Context**

The literature supports the importance of encouraging young women to excel in mathematics, and to develop their own support systems that would include role models and mentors. There is also support for the belief that women are attracted to “helping” careers and desire a family/career balance. There is very little written about strategies for overcoming failure and the positive aspects of allowing students to experience and learn from their failures.

*Excelled in Mathematics, Started Their Careers in Industry*

The majority of the women in this study enjoyed and excelled in mathematics. They chose careers that allowed them to use their love of numbers and earn a high salary which, for most, meant starting their careers in industry. They were rewarded for their strong critical-thinking and problem-solving skills.
Even though studies show that approximately 60 percent of undergraduates leave mathematics, these women persevered. From our focus group sessions and subsequent interviews, most shared that their successes in the classroom were what made them more confident in their abilities. They received positive feedback for excelling in math. Data show that boys receive more consistent attention, praise, feedback and support for assertive behavior and yet, these women found ways to be just as competitive in the classroom (Seymour & Hewitt, 1997).

In 1975 Tinto conducted a study exploring socio/cultural aspects of peoples’ college and career decisions. Both Astin’s theory of involvement, published in 1984, and Tinto's interactionalist model of individual student departure, published in 1993, study the issue of persistence in college. Both studies show the development of academic integration is influenced by the interaction of student behaviors and perceptions. Persistence can be predicted by students’ level of academic integration (including academic self-esteem). These women were able to constantly build their academic self-esteem by being successful in the classroom.

Even though most started their careers in industry, they all eventually left to become community college faculty members. A study by the Society of Women Engineers, shows the rate women leave IT and engineering careers is higher than men (Society of Women Engineers, 2006; Hewlett et al., 2008; Frehill et al., 2009). They show that culture of the workplace, responsibilities to family and bias all play a role. Hewlett et al. (2008) found that women who leave STEM careers midway through their professional career, expressed concerns about feelings of isolation, extreme work
schedules, unsupportive supervisors and uncertainty about opportunities for advancement as major decision factors. Our study showed very similar findings.

**Developed the Ability to Secure Needed Resources and Build Support Systems**

Tinto's (1975, p. 119) research on factors influencing the socio-cultural environment tells us that, “a higher degree of interaction of students into the academic environment and social tracks are contributors in solving the institutional problem of retention”. Socio-cultural factors such as confidence and availability of mentors were addressed in the study. Thus, socio-cultural factors can be seen as both barriers to and influencers of women's recruitment and retention in IT and engineering. This supports the need for studies of not just women’s level of confidence and availability of mentors, but of the environments within which they conduct their personal and professional lives.

Various researchers have tried to investigate the influence of female role models and mentors on the performance and experience of women in male dominated professions such as engineering and computing. Seymour & Hewitt (1997) found that girls respond positively to female mentors. Blake-Beard (2001) research indicates that access to effective mentoring is vital to advancement in academic careers. Other findings show that while female role models can be very positive for women starting out in a field such as computing, there is evidence to suggest that the gender of the role model is not crucial, and that women are often happy to consider men as role models (Dee, et. al., 2009; Clark, et. al., 2007; Lockwood, 2006). The women in this study also believe role models and mentors were critical to their success and take their roles as role models/mentors seriously.
Unfortunately, many female students have little experience on computers before attending college. Most of the focus group participants found computers appealing before entering college. Parents helped them discover computers and encouraged them, teachers supported their interest, they had work experience on computers, or simply enjoyed playing games on a computer. Often, it isn’t until young women enter college that they are attracted to computer-based majors. It may be a required computer class, peers or faculty advisors who actively recruit them into computer-based majors. The literature supports the notion that limited and narrow presentation at the high school level of what computer science is as well as what computer scientists actually do has an effect on decisions about college majors (Cohoon and Aspray, 2006; McKinney, 2008; Tillberg and Cohoon, 2005).

The result suggests that the currently designed major appeals to new college students with prior computer interests developed at school, work or home; were inspired by parents or teachers to pursue a computer-based major; are talented in math and/or logic; excel in programming classes; are interested in fulfilling careers that offer flexibility and opportunity. Young women who do not meet the informal criteria for the selection of major are more likely to filter themselves out of the IT and engineering fields. Many of the women in this study were encouraged by parents or teachers to use their math and logic skills and pursue rewarding careers in technology fields.

Love Teaching

Most of the women in this group discovered their love for teaching while working in industry. They found that helping others learn was very rewarding. The literature
supports a tendency of women to be attracted to careers that endorse communal goals (working with others), more than men. A study done at Miami University (Diekman, et. al., 2010) proposes that the choice of one career over another results when people’s goals and their preconceptions of opportunities offered by those careers intersect. Their hypothesis was that people perceive careers in IT and engineering as being especially incompatible with their goal of working with others or their desire to help other people. The authors posit that because women are more inclined to embrace communal goals, they may be more likely than men to decide against careers in IT and engineering in favor of careers that seem to encompass those goals.

Diekman, et. al., (2010) points out that girls who perceive professions to be altruistic tend to be attracted to those professions. Possibly when women believe that IT and engineering careers could involve helping other people, the result may be that technically talented women will choose technical careers that would fulfill their goal of working with and helping others. Interventions by faculty members could provide opportunities for female students to succeed in math and computer science and demonstrate how IT and engineering disciplines can be collaborative and helpful to other people.

Our data from the We Are IT! consortium’s 3,000 respondents in 2010, shows that 51.37% of the girls believe helping people is very important when choosing their careers. The women in this study have found teaching and helping others learn a rewarding career decision.
Value a Family/Career Balance

All but two of the focus group participants started their careers in industry and left those careers to become community college faculty members. The literature shows that the trend to leave industry is universal in the IT and engineering fields. Many studies show (Mason et al., 2009; Xie & Shauman, 2003; Xu, 2008; Society of Women Engineers, 2006; Frehill et al., 2008; McKinney, et. al., 2008) that family-related issues cause women to leave the field.

Weinberger (2003) found that 30% to 40% of female college students thought that careers in computer science and engineering professions would be incompatible with raising children. The report listed reasons such as the expectation of long work hours, required overtime, and the challenges of balancing career and family responsibilities.

Other recent studies (Townsend and Twombly, 2008; Wolf-Wendel, Ward, and Twombly, 2007; Townsend and LaPaglia, 2000) describe advantages for female faculty in a two-year institutional setting. One important perception is that there is more flexibility in balancing work and life responsibilities than in a four-year institution where expectations for research are high.

McKinney’s web-based survey in 2003 that studied the attitudes and experiences of men and women working as IT professionals. Included in their findings was that female IT professionals encountered difficulty balancing work and family. This may have been a factor in their decision to leave IT and pursue other careers.

A 2008 ACM study found that women leave technology fields at a rate of 56% mid-career, more than double the rate for men. This study discovered that women
choosing to teach IT and engineering tend to leave IT and engineering careers for the same reasons women in business and industry do. Some of these reasons include: work-family conflict, long work hours, over-time, job responsibilities, difficulty with flexible work hours, issues around fair pay, and lack of supervisor support for dealing with family issues (McKinney, et. al., 2008).

A Harvard Business Review Research Report, *The Athena Factor: Reversing the Brain Drain in Science, Engineering, and Technology* (Hewlett, Luce, Servon, Sherbin, Shiller, Sosnovich, & Sumberg, 2008) cited problems for women in current science, engineering, and technology (SET) cultures. This research report identifies a time when female attrition spikes from ages 35-40. Career challenges increase and family responsibilities intensify at the same time; 52% of women leave the field.

From the We Are IT! consortium’s 3,000 respondents in 2010, 58.18% of the girls said the ability to balance work and life responsibilities is very important and 40.25% believe flexible hours are very important when choosing their careers.

The literature reflects decisions made by those focus group participants who started their careers in industry and left those careers to become community college faculty members.

Implications for Practice

Follow up from this dissertation research could be consideration of those characteristics that set successful female IT and engineering faculty apart in order to design curriculum for young women (starting at middle school age) that would nurture those characteristics and therefore increase our ‘pipeline’ of young women entering
science, technology, engineering and math professions. We need to recruit and develop more female community college faculty in IT and engineering so that we not only repair the “leaky pipeline”, but build a bigger pipeline.

The women in this study described themselves as strong, tenacious, stubborn, driven, competent, and competitive. How can we instill those traits in our young women?

All agreed that while helping students build their skills in the classroom, faculty must be aware of different learning styles, and emphasize problem solving and critical thinking. More needs to be done to ensure girls’ success in the classroom, especially in mathematics. Focus group participants also agreed that faculty need to let students know they have high expectations, that faculty should not coddle them, let them experience failure, but do not let them quit, and should encourage them to finish their degrees.

Another strategy to address the challenge of the lack of women in IT and engineering is to help students build strategies for success and find resources. The focus group participants see themselves as resources in their role of one who provides encouragement and serves as a role model and mentor. In that role they help dispel myths, change male perceptions, and emphasize the importance of women in the workforce. Since women are more attracted to “helping” careers, we need to nurture girls’ love of teaching and help them understand how careers in IT and engineering can help people. The literature supports the view that women are searching for balance between family and career. The women in this study have found that balance in their community college faculty positions. This information could prove valuable when we are considering policies around our community college faculty members.
Classroom Experiences

Despite the national and local initiatives to bring technology into schools in the twenty-first century, few computer science learning opportunities actually exist at the high school level. Cohoon and Aspray (2006) found that three things had significant impact on students’ interest in computer science: an understanding of what computer science is, negative experiences in the classroom and lack of critical thinking focus in the curriculum. They concluded that limited and narrow presentation of what computer science is as well as what computer scientists actually do impacts students’ views on how computer science could further their academic and career endeavors. Also, for the female students who do take computer science, there is evidence showing negative experiences in the classroom, and despite the critical-thinking and problem-solving skills that are the foundation of computer science, curriculum of most computer science classes at the secondary level are missing a higher-order thinking focus. Community colleges can work with their secondary partners (high schools) to start to make necessary changes to help girls become more successful. Some of these changes may include 1) teachers and counselors who help students develop a better understanding of what careers in IT (including computer science) and engineering entail, 2) curriculum designed around research that shows that a examples of successful women in technology, a peer network, mentors, and exposure to a wide range of technology are positive influences for girls, and 3) a stronger emphasis on critical-thinking and problem-solving skills.

McKinney’s web-based survey in 2003 that studied the attitudes and experiences of men and women working as IT professionals in several organizations across the
United States supports the work of Cahoon and Aspray. The authors suggest that greater attention is needed when women are in middle and secondary school. Students should be exposed to examples of successful women in technology and more attention should be paid to learning styles in computer education (McKinney, 2008).

My study builds on the research of Tillberg and Cohoon (2005) who focused on what attracts women to the computer science field which is part of the larger IT discipline. Part of their research focused on students’ choice of major. Their study found that positive early experiences with computing was a big influence on students’ choice of major, but those with little exposure to computing tend to filter themselves out. Female students in general are less likely than their male peers to have had that exposure. From their analysis, they found students’ first experiences with computers - peers, teachers, parents, core curriculum, recreation and work were the most common influences for their choice of major.

From the data we collected from our We Are IT! consortium’s 3,000 respondents in 2010, only 18.25% said they have a good idea about what people do in computer-related jobs and just 10.02% said they would definitely consider having a computer-related job. Only 32.97% took a computer class because it was required by her high school. Many of this study’s participants did not go directly into IT/engineering jobs. They agree that the reason was probably because when they were in high school most did not know what a job in IT or engineering would really be like. We need more counselors and teachers talking to students about the IT and engineering career fields. We also need
to encourage the pursuit of mathematics which is a critical component in any IT or engineering major.

Supporting the development of girls’ math and science abilities, will boost confidence and help motivate interest in these disciplines. Research by the AAUW found that, when girls believe they can grow intellectually test scores improve. That is, when parents and teachers help young women understand that with study and practice they can increase math scores and can succeed in math courses in the future. The AAUW research also found girls believe they have to outperform boys in math and science courses to be successful (AAUW, 2010). Girls rank their ability to excel in math lower than boys with similar achievements in math do.

_Talking About Leaving_ (Seymour & Hewitt, 1997), a book based on the explanation for why high performing undergraduates change from their science, engineering or math majors to non-science majors. Data shows that almost 60% leave mathematics. Much of this work was based on differences observed on interactions in the classroom. More feedback, attention, praise and support for assertive behavior is received by boys, thus lowering girls’ confidence in their ability to succeed in math. The result of these differences in classroom interaction is apparent by the end of middle school, even though before this, girls’ and boys’ achievement in math and science are virtually the same. K-12 teachers as well as community college faculty need to be aware of this and develop ways to help develop more equity in the classroom and build awareness of the messages being sent to our young women.
Girls need to learn how to recover after a perceived failure. Bright young women may have graduated at the top of their high school class, but may become more challenged when they face the rigors of college coursework. They may also feel defeated when they encounter cultural bias on their college campuses. According to a study on gender, achievement and persistence in undergraduate computer science programs, (Katz, ACM 2006) girls were less likely to take the next course in the curriculum after earning less than a B in a computer related course than boys. Women may lose confidence and therefore lose interest in their computer related programs if they consider their grades sub-standard.

Male peers of senior women students were interviewed as part of Seymour and Hewitt’s three-year, multi-campus research study. These male peers viewed their female peers’ interest and success in science or mathematics as unnatural and portrayed their classmates who chose IT and engineering majors as: unattractive; focusing too much on academic work and not on being more physically attractive; having lost their physical appeal after they entered a math or science major; or subtly inferred they might be lesbian (Seymour & Hewitt, 1997).

Community college faculty members can help young women build strategies for overcoming what they perceive as failure whether it is academic or cultural.
Developing Needed Resources and Building Support Systems

This study pointed out the importance of supporting women as they work to develop resources and support systems. Educational institutions need to support these women’s efforts as a retention strategy.

Seymour and Hewitt (1997) found that girls respond positively to female mentors. They conclude that one way to reduce female students’ feelings of isolation and to make them feel more welcome is to ensure that they have female role models and mentors. Thus, this study focuses on female community college IT and engineering faculty members who have persisted and who serve as mentors to their female students.

Most women surveyed in the study had entered college self-confident, with good high school grades, acceptable Scholastic Aptitude Test (S.A.T.) scores and plenty of praise and encouragement from teachers, friends and family. By the completion of their first year of college, female students who were bright and confident in their ability to succeed in college, began to feel, “isolated, insecure, intimidated and questioned whether they ‘belonged’ in the sciences” (including computer science) at all (Seymour & Hewitt, 1997, pg. 149).

According to a study by Brainard and Carlin (2001), female students begin their college careers competent and confident, but lack confidence by the end of the first year of their IT and engineering programs. The issue of loss of confidence needs to be addressed. One way to address this issue is through positive coaching from community college faculty members who serve as advisors, role models and mentors.
Results from our We Are IT! survey in 2010 show disturbingly low numbers for girls who have talked to people who encouraged them to seek a computer-related job. Just 15.11% responded positively. If young women are entering college without the necessary resources and support systems, the role of the community college faculty member is even greater.

*Career Counseling*

Many girls do not know what a career in IT/engineering would be like. There are many misperceptions about what they would be doing in those jobs. More career counseling and job shadowing needs to be done at the high school level so that young women can make informed decisions about their careers. The combination of their passion for IT/engineering paired with love of teaching is a successful combination for developing more community college faculty members. Wolf-Wendel, Ward and Twombly (2007) found a love and commitment to teaching was important in making the decision to teach in a community college setting.

Diekman, et. al., (2010) point out that girls who perceive professions as altruistic tend to be interested in those professions. We need to address women’s communal goal orientation in order to encourage them to enter the IT and engineering fields. We must work to show how professionals in these careers help people, and support them to fulfill their goals of working with and helping others. Interventions by faculty members could provide opportunities for female students to succeed in math and science and also show how IT and engineering disciplines can be collaborative and help other people.
Work-Life Policies

The literature supports the view that women are searching for balance between family and career. The women in this study have found that balance in their community college faculty positions. A recommendation stemming from a report from the American Association of University Women (AAUW), *Why So Few? Women in Science, Technology, Engineering and Math* (ACM 2010), suggests that by supporting mentoring programs and more family-friendly policies for all faculty members, colleges and universities can recruit and retain more women. This information could prove valuable when we are considering policies around our community college faculty members.

Cathy Trower and Richard Chait founded Collaborative on Academic Careers in Higher Education (COACHE) in 2002 to help improve the academic environment for junior faculty and assist colleges and universities in recruiting, retaining, and increasing the satisfaction of early career faculty. Trower’s research on the retention of female STEM faculty finds that satisfaction improves with positive work environment in IT and engineering departments and that developing more family-friendly policies and providing mentoring can also help improve job satisfaction of female faculty.

All but two of the focus group participants started their careers in industry and left those careers to become community college faculty members. The literature shows that the trend to leave industry is universal in the IT and engineering fields (Society of Women Engineers, 2006; Hewlett et al., 2008; Frehill et al., 2009). Community colleges need to look at their work-life policies closely to ensure that when women are ready to leave industry community college teaching is a viable career option for them.
Future Research

There were many discussions about future research during our focus group sessions. Most agreed that more needs to be done about cultural messages we send, including what seems to be male bias. Issues with lack of confidence affect classroom performance. We need to know more about what causes the drop in confidence because it affects young women’s ability to complete IT and engineering majors and ultimately to become IT and engineering professionals. The issue of failure and how to survive it was always a focus group topic. There is scant research on this topic. There was some discussion in each focus group about innate tendencies - the belief that we may be born with certain attributes that may predict our behavior. And finally, one of our participants who was born and raised in India noted strong cultural differences and wonders if the United States culture has a different influence over young women than other cultures do. She also wonders if the way we teach teachers to teach math in our United States schools of education may have an effect.

Cultural Messages

Tillberg and Cohoon (2005) contend there is a persistent belief in our society that working with computers is a male activity. Their research on what attracts women to the computer science field concluded that encouragement and support from teachers, parents and peers might be an advantage to females even more than males. The belief that computing is a male activity may lead to an underestimation of girls’ talents and therefore, lead to girls’ declining confidence in their ability to succeed in the field. Encouragement, support and success stories from other women can help build confidence in young women’s computing abilities.
The 2010 AAUW study, “Why So Few?” looked at negative stereotypes surrounding girls’ abilities to understand and succeed in math. They found measurable differences in girls’ test performance as a result. Stereotypes like these can also lower girls’ interest in science and engineering careers. They concluded that when girls are encouraged by teachers and parents who tell them that they can increase their knowledge with practice and study, girls improve test scores and are more likely to continue to study math in the future. This research could be expanded and actions could be applied to enhance girls’ math test scores.

More research needs to be done on ways to educate society about the cultural messages we send, their effect on our society and how we can make changes in the future.

**Confidence**

The women in this study described themselves as strong, tenacious, stubborn, driven, competent, and competitive. Pajares tells us that, “gender differences in self-confidence in STEM subjects begin in middle school and increase in high school and college, with girls reporting less confidence in their math and science ability than boys do” (Pajares, 2005, p. 327). The study concluded that when students begin to lose confidence in their math or science abilities, they become less likely to participate in activities that use those skills and will be less persistent when faced with difficulty. As a result, female students may be at risk of losing confidence in STEM subjects because when girls believe that they learn what they need to know in STEM subjects and become
more intelligent - as opposed to “viewing intelligence as an inborn, uncontrollable trait” (Dweck, 2006, p. 51) - they are more likely to succeed in a STEM field.

Margolis and Fisher (2002, p. 72) explained, “There is a dominant culture of ‘this is how you do computer science,’ and if you do not fit that image, that shakes confidence and interest in continuing.” According to Margolis and Fisher, a vital element of recruiting more females to computer science is to provide numerous ways to ‘be in’ computer science. Feeling like a misfit can lower confidence, especially among women. Margolis and Fisher also found that the group of female computer science majors who were brimming with confidence and excitement about their major in the earliest interviews were no longer buzzing by the second and third semester. Margolis and Fisher (2002, p. 92) argue, “The decline in women’s confidence must be acknowledged as an institutional problem.” I believe the issue of confidence needs to be acknowledged, researched and acted upon. Measuring to what extent characteristics such as confidence and self-efficacy contribute to success may prove beneficial.

Dweck’s (2006, p. 51) research posits evidence that a growth mindset, “viewing intelligence as a changeable, malleable attribute that can be developed through effort” as opposed to a fixed mindset, “viewing intelligence as an inborn, uncontrollable trait” encourages students to persist when faced with academic difficulty and eventually succeed. If students understand the difference between a growth mindset and a fixed mindset they will understand that the hard work and effort they put into something will help them succeed and build confidence. Since those with a growth mindset believe strongly in the power of effort more research needs to be conducted to discover how to
help more students develop a growth mindset. The results of this study suggest that students become more confident because they believe they are becoming more intelligent as a result of challenging themselves.

*Failure*

Many of the women in this study purposefully built strategies for learning to survive failure as they progressed from secondary to postsecondary school to their professional lives. Little research has been done on the benefits of failure. Our focus group members felt strongly that girls do not experience small failures along the way, and therefore do not develop strategies for overcoming failure. There is little in the literature referring to girls and their ability to survive failure. Much is written about how girls leave majors if they do not feel they can excel. They give up or change majors when they perceive failure. However, little has been written about strategies to overcome the perceptions. Their perception of failure may be that they receive grades below a B. There may be positive aspects of allowing students to experience and learn from their failures.

*Innate Tendencies*

Pam believes that we all have our own innate tendencies. She points to the Myers/Briggs concepts of personality type and cognitive style. A study published by the Center for Applications of Psychological Type (Martin & McCaulley, 1996) finds that science and mathematics attract relatively more thinking types (T) and that female engineers are more T. It could prove insightful to conduct a study of how the 16 personality types of Myers/Briggs apply to women in IT and engineering compared to those who choose other careers.
A recent report, *Let Every Child Shine*, asks the question, “Do internalized feminine norms depress girls’ STEM attitudes and participation?” (p. 1). The report is based on recent research funded by an Innovation Generation grant from the Motorola Solutions Foundation. This ongoing project is based on the belief that understanding how girls see themselves related to STEM and the affect these perceptions have on their academic interests is crucial. Research about girls’ perceptions and relationships to STEM professions is critical in understanding the decline of females entering STEM fields. The results of this research may help shed some light onto why many women are attracted to “helping” careers and why participation by women in those sectors is growing. If we are able to change the perception that IT and engineering are not “helping” careers, we may be able to attract more females.

*Other Cultures*

One of our participants was born and raised in India. She sees strong cultural differences and wonders if the United States culture has a different influence over young women than other cultures do. The number of women in her engineering classes in India was often equal to the number of men. Studying the percentage of female graduates in IT and engineering in other countries may show differences that would be worth investigating.

Margolis and Fisher have studied other cultures through their research at Carnegie Mellon. Their research participants were predominantly white, but included students from Asia, India and Eastern Europe. They noted that the underrepresentation of African American and Hispanic students in their sample reflected the small numbers majoring in computer science. They also concluded that the shortage of people of color in the
computing profession is even more dire than the shortage of women. These topics also merit future research. (Margolis & Fisher, 2002).

**Pedagogy**

The way we teach mathematics has an effect on our young women. Young women respond more positively to more collaborative, applications based projects and positive feedback. We need to conduct more research on our United States schools of education on the pedagogy used to teach mathematics. Moore, et. al. found that when learning becomes co-constructed, collaborative, interdisciplinary, creative and personal, girls, more than boys, become more active (Moore, et. al., 2004). Fox, et. al., 2011, suggest some of the changes should include curriculum designed around their research that shows that a network of peers, mentors, successful female role models in technology and exposure to a wide range of technology are positive influences for girls.

**Conclusion**

Statistics reveal that girls show less interest in careers in computing and engineering than boys (WGBH Education Foundation & Association for Computing Machinery, 2009). The common denominator among the participants in this study is their love of mathematics. More needs to be done to nurture that love in girls and young women and to encourage them to excel. There is also work to be done to dispel myths and misperceptions about girls and ability to excel in STEM related subjects. Studies show that women lose confidence from middle school (Pajares, 2005) through doctoral programs (Cohoon, 2007). Helping to instill confidence in our young women is crucial. The women in this study agreed that they would not consider themselves confident, but did describe themselves as strong, tenacious, stubborn, driven, competent, and
competitive. These may be the attributes we need to nurture in young women in order to help them succeed. Studies show lower job satisfaction as one reason women leave IT and engineering careers (Trower & Chait, 2002). This study found that many of the participants in this study were less satisfied with their industry jobs. They are happy to have traded their high stress/high demand jobs for positions as community college faculty members. They do not feel the flexible work schedule that community college teaching offers diminishes an employee’s work ethic or value to the organization. They enjoy the academic atmosphere and the opportunity to help people change their lives. Serving as role models and mentors is an important part of their faculty positions.

What strategies do they use to overcome barriers that would inhibit their satisfaction with their jobs? Why do they stay in their IT/engineering careers? Many studies show (Mason et al., 2009; Xie & Shauman, 2003; Xu, 2008; Society of Women Engineers, 2006; Frehill et al., 2008; McKinney, et. al., 2008) that family-related issues cause women to leave the field. This study found that most participants are seeking more of a family/career balance in their lives. They have found community college teaching a way to practice their profession and add balance to their lives. Other barriers include loss of confidence and inability to cope with failure. Participants agree that teaching students to persist as well as build survival strategies so that failure will not attribute to them losing confidence is important.

This study focuses on community college female faculty because of their ability to influence the next generation of IT and engineering professionals. These women will impact our next generations of female faculty and professionals in IT and engineering.
Society needs to support successful women in their efforts to help their students identify strategies for success, especially in fields like information technology and engineering where men are well represented.
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Title of Research: Female Information Technology and Engineering Faculty Members from the Statewide We Are IT! Consortium in Ohio Public Community Colleges: Strategies for Success and Overcoming Barriers

Researcher: Patricia Ross

You are being asked to participate in research. For you to be able to decide whether you want to participate in this project, you should understand what the project is about, as well as the possible risks and benefits in order to make an informed decision. This process is known as informed consent. This form describes the purpose, procedures, possible benefits, and risks. It also explains how your personal information will be used and protected. Once you have read this form and your questions about the study are answered, you will be asked to sign it. This will allow your participation in this study. You should receive a copy of this document to take with you.

Explanation of Study

Women are under-represented in Information Technology (IT) and engineering careers. The purpose of this study is to explore characteristics and behaviors of female community college IT and engineering faculty. Insight into persistence, success, and strategies that women in these fields use to overcome barriers may help us develop ways to nurture younger women.

Risks and Discomforts
No risks or discomforts are anticipated

Benefits

Female community college faculty members serve as role models to young women pursuing careers in IT and engineering. Increasing the number of women pursuing IT and engineering careers will increase the qualified labor pool that the United States depends on to drive innovation and product development in IT and engineering that is so key to the United States economy.

This study focuses on community college female faculty because of their ability to influence the next generation of IT and engineering professionals. More attention needs to be paid to the experiences of successful women to discover whether they identify strategies and circumstances that facilitate or hinder women’s careers, especially in male-dominated fields like information technology and engineering.
Confidentiality and Records

Your study information will be kept confidential, but I cannot guarantee that other members of the group won’t share the information. Audio files will be stored securely in a locked cabinet in my office. They will be destroyed no later than October 2011.

Additionally, while every effort will be made to keep your study-related information confidential, there may be circumstances where this information must be shared with:

* Federal agencies, for example the Office of Human Research Protections, whose responsibility is to protect human subjects in research;
* Representatives of Ohio University (OU), including the Institutional Review Board, a committee that oversees the research at OU;

Contact Information
If you have any questions regarding this study, please contact Patti Ross, pross@edisonohio.edu or 937.778.7887.

If you have any questions regarding your rights as a research participant, please contact Jo Ellen Sherow, Director of Research Compliance, Ohio University, (740)593-0664.

By signing below, you are agreeing that:

- you have read this consent form (or it has been read to you) and have been given the opportunity to ask questions and have them answered
- you have been informed of potential risks and they have been explained to your satisfaction.
- you understand Ohio University has no funds set aside for any injuries you might receive as a result of participating in this study
- you are 18 years of age or older
- your participation in this research is completely voluntary
- you may leave the study at any time. If you decide to stop participating in the study, there will be no penalty to you and you will not lose any benefits to which you are otherwise entitled.

Signature_________________________________________ Date______
Printed Name___________________________________________
APPENDIX B: PRE-FOCUS GROUP QUESTIONS

This study focuses on community college female faculty because of their ability to influence the next generation of IT and engineering professionals. More attention needs to be paid to the experiences of successful women to discover whether they identify strategies and circumstances that facilitate or hinder women’s careers, especially in male-dominated fields like information technology and engineering. Please answer the questions below and return to me at pross@edisonohio.edu. I’ve also attached a consent form for you to sign and return to me. It says that you are participating on your own accord. Your comments will remain confidential and I assure that no one will be able to identify you in our results.

1. Name:
2. Birth date:
3. Current institution:
4. List your educational degrees, discipline(s), institution(s), and dates received.
5. Did you attend Community College?
6. How long have you been employed in academia? How long have you been employed at your current community college?
7. What courses do you teach? What academic division are you part of?
8. What is your present academic title or rank?
9. Were you employed in industry in the fields of IT/engineering prior to joining the faculty? If so, what was your position?
10. What attracted you to a community college faculty position?
APPENDIX C: FOCUS GROUP GUIDE

Guiding Research Question: What are the educational, social, and familial experiences that women in IT and Engineering cite as influential in their decision to pursue a faculty position in an IT and Engineering field?

Focus Group Questions:

8. Statistics show that girls are less interested than boys in careers in computing and engineering. What characteristics or previous life experiences have you had that led you to become interested in your IT/engineering career? What attracted you to IT or engineering? From your own past, what drives you to do this work?

9. Studies show that women lose confidence from middle school through doctoral programs. How do successful IT and/or engineering women stay confident? Who was influential in helping to instill confidence in you?

10. Do you think it’s important to have mentors? Who have been your most important mentors in your career? How have they influenced you?

Guiding Research Question: What strategies did these female IT and Engineering faculty members develop to help them to overcome barriers they encountered along the way?

Focus Group Questions:

11. Studies show lower job satisfaction as one reason women leave IT and engineering careers. Are you satisfied with your job? What strategies do you use to overcome barriers that would inhibit your satisfaction with their job? Why do you stay in your IT/engineering career?

12. Studies show that isolation can also be a factor in the retention of women in IT and engineering. Do you feel isolated? If so, how do you overcome or compensate for those feelings?

13. Many studies show that family-related issues cause women to leave the field. How have you managed the balance? What would you say to someone who
assumes that teaching in a community college will allow her to more easily balance work/family?

Guiding Research Question: What are the characteristics and behaviors of female community college IT and Engineering faculty that enabled them to build strategies for success?

Focus Group Questions:

14. As a female community college faculty member in IT or engineering, what is your role in this whole challenge of the lack of women in IT and Engineering? How do you see your role as influencer of young women? What is your role in encouraging young women? What are you going to do to replicate yourself?

As we end our session, I’d like each of you to provide a summary statement about strategies you have developed for yourself that have helped you to succeed.