I NEED TO SEE YOU TO BE YOU: EXAMINING THE RELEVANCE OF ROLE MODELING ON FEMALE STEM CAREER CHOICE

A Thesis

Presented to the faculty of the Department of Teacher Education

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Submitted in partial satisfaction of the requirements for the degree of

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in

Education

(Behavioral Sciences Gender Equity Studies)

by

Cindy J. Lewis

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Department of Teacher Education
Abstract

of

I NEED TO SEE YOU TO BE YOU: EXAMINING THE RELEVANCE OF ROLE MODELING ON FEMALE STEM CAREER CHOICE

by

Cindy J. Lewis

Did you know that Hildegard proposed a heliocentric universe 300 years before Copernicus? That she wrote of universal gravitation 500 years before Newton? But who would listen to her? She was just a nun, a woman. What is our age, if that age was dark? (Cedering, 1986).

Statement of Problem

This study was conducted to analyze the effects of role modeling, connected curriculum and mentoring on females’ choice of Science, Technology, Engineering and Math (STEM) career fields. This study addresses the following questions; might role modeling, or lack thereof, affect females’ career choices? Did respondents’ experience a lack of connected curriculum in the classroom? What steps can be taken to encourage increased female participation in STEM? The purpose of this study was
to establish the importance of increased female STEM role modeling and connected curriculum as a source of positive affirmation of girls STEM abilities and choices.

**Sources of Data**

The data analyzed were student responses to a survey conducted in three sections of a general studies university course. The survey was designed to measure student responses regarding the effects that mentoring, role modeling, and connected curriculum have on females’ future STEM career choices.

**Conclusions reached**

Results of this study demonstrated that role modeling and connected curriculum can influence students’ career choice. Findings also indicated that connected curriculum, role models and mentoring had greater influence on female students’ STEM interest than male students’ STEM interests. Female student’s interest in STEM, or lack thereof, were dramatically linked to exposure to, or lack thereof, the representation of females in STEM. A substantial proportion of the female survey population identified the need for early prominent exposure of students to female STEM role models as a method of connected curriculum.
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I also thank my son Toren and my daughter Tara for being my absolute inspiration and motivation, all I do is for you. In addition I would like to thank my family, friends, Denise Cornish, and Linda Nowell for being consistent sources of guidance and support, thank you all!

Lastly, I would like to acknowledge the work of the American Association of University Women, which has provided decades of research and data acknowledging the vast importance of the contributions of females to all fields of study, especially STEM.
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Chapter 1

INTRODUCTION

Men still hold roughly nine of every ten highest-paid management and board positions, and in addition, females still earn between 69 and 80% of men’s salaries (Bureau of Labor Statistics [BLS], 2008). Opening more opportunities to Science, Technology, Engineering and Math (STEM) careers for females is essential to closing the pay gap (Bell & Norwood, 2007). Because STEM related careers, such as engineers, mathematicians, and computer scientists comprise a significant portion of the high-salary occupations; it is crucial that girls and women have equal opportunity to pursue these job options. Advancements in female STEM connected curriculum and increased focus on increasing role modeling opportunities have the potential to increase the number of females entering STEM related careers.

Information from the Harrisburg University of Science and Technology (HUST) showed that STEM fields are predicted to be among the highest paying starting salaries for 2010 college graduates (HUST, 2010). Research shows that future jobs requiring STEM training will increase approximately 24% in the next four years, while a growing need of STEM trained individuals is needed to fill this upcoming lucrative job market (BLS, 2007). A National 2004 Science Board report showed that while females make up 46% of the U.S. workforce, they represent only 25% of the STEM workforce, including social sciences.
While several factors have been indicated, most significant issues can be traced back to early educational STEM exposure in which adequate gender-connected curriculum representation was distinctly absent from the curriculum. In addition, a lack of representation for females in standard STEM texts coupled with the fact that most higher education institutions do not require pre-service training in educational equity, lends to a chilly classroom climate. Female students can feel unrepresented, outnumbered, and uncomfortable with the STEM subject matter. Most educators have nominal, if any, training in instructional methods (Sandler, Silverberg, & Hall, 1996). Specially relating to gender-inclusive training, Carinci’s (2002) study evaluated three selected California teacher credential programs found that multiple subject post-credential students had received instruction on gender equity issues for an average of 50 minutes, and the single-subject students had an average of 1 hour and 55 minutes. As such, there is a need to further examine these factors and further studies that continue to contribute to female’s success in STEM educational choices in order to improve the chances their chances to pursue STEM careers.

This study will analyze whether females would have chosen to pursue STEM educational and/or career choices if provided with higher access to gender-inclusive STEM curriculum and a more positive classroom climate. This study noted the stories of females who overwhelmingly tell the tales of missing visual and textural representations of females in STEM curriculum, corresponding with a lack of teacher training in gender-inclusive pedagogy. This study examined whether females would be
more likely to see themselves in STEM related careers had they experienced a higher degree of educational gender-inclusivity.

**Statement of Problem**

Often females see little evidence of themselves in STEM in the form of connected curriculum or role models. A new U.S. Department of Commerce study found that though constituting half of all college-educated workers in the economy at large, female employees make up less than 25% of STEM careers (Beede et al., 2011).

Recent data highlights the importance of encouraging female interest in careers that include STEM. Recommendations include examining course content in regard to connected curriculum (Dey & Hill, 2007). Even with strong recommendations such as these there is still very little gender related connected curriculum regarding females’ contributions to STEM. Today, there are still very few gender inclusive course materials available to teachers. Furthermore, what is available has little relevance to the actual lesson content, and females still find it challenging to connect to STEM studies and career aspirations. This lack of relevance is particularly problematic for females (Noddings, 2006).

**Significance of Study**

Research suggests that role models are available in all areas of study (American Association of University Women, AAUW, 1992). There are females in STEM who have voices and stories that would demonstrate relevance and importance to females in any curriculum setting. Unfortunately the voices, stories, and accomplishments of
females in STEM are typically not available in current classroom materials. As such, very few studies have been conducted that might demonstrate the effectiveness of using gender-inclusive curriculum as a tool for connecting females to STEM.

This study examines the theory of recommendations set out by the AAUW (1992) report such as the inclusion of role models and gender connected curriculum in all levels of education. Ideally, current curriculum would include female role models who are missing from the existing curriculum which would then be delivered in a way as to encourage a more gender-inclusive classroom climate. Through a survey, this study measured students’ comments on the effects of role modeling and a more connected curriculum might have had on their current career paths (see Appendix A).

Limitations

The survey was given to a sample of approximately 200 undergraduate students in varied classrooms at the California State University, Sacramento. Seventy-two surveys were returned to the researcher. This sample is not representative for all students in the state of California. Some difficulties might occur when interpreting the data; some of the open questions may have answers which do not fall into the broad categories that this researcher defined. The issue of external validity is a limitation to this study. Another limitation is the fact that not all students have a full understanding of was role modeling as defined in this study.
Methodology

The Likert scale was developed by Rensis Likert in 1932. It requires the individuals to make a decision on their level of agreement, generally on a five-point scale (ie. Strongly Agree, Agree, Disagree, Strongly Disagree) with a statement. The number beside each response becomes the value for that response and the total score is obtained by adding the values for each response, then, the respondent’s score is found by summing the number of responses. Dumas (1998) suggests the Likert scale is a favorable tool for assessing participants' opinions of usability. This researcher used a sampling survey containing a Likert scale with quantitative and qualitative analyses as well as open-ended questions, as the method of statistical analysis for this study. This study began with a review of relevant literature on role modeling, connected curriculum, and the associated relation to girls in STEM.

The researcher developed a series of quantitative and qualitative questions based on the reading and related topics. The development of the survey questions also included consideration of the connected curriculum and role modeling. Data shows that using a qualitative in addition to a quantities approach yields more potential for generalization (Babbie, 1998, Schram, 2006). The researcher used data gathered from surveys that include open-ended questions and questions using a five point Likert scale. This research utilized both quantitative and qualitative methods. Personal interviews were also included as part of representative data collection. Surveys have been found to be an efficient way of collecting information from a large number of
respondents; in addition, statistical techniques can be used to determine validity, reliability, and statistical significance (Bailey, 1978).

**Theoretical Basis for the Study**

The works that framed this research and the foundation that led to this study came from a variety of general and feminist theorists and theories regarding role modeling, social learning, including connected knowing or curriculum (Gilligan, 1993). This author examined early pivotal works of Sadker and Sadker (1995) balanced with recent STEM progress reports by the AAUW that provided the author with specific references to the disparity between girls’ high educational achievements versus later entry into low paying career fields (AAUW, 2000).

STEM courses are typically taught using the banking system where the instructor deposits information to students for later retrieval or testing (Freire, 1993). The content is usually science specific but not gender inclusive, and therefore has minimal relevance to any aspects of students’ current or future lives. Author bell hooks (1994) also indicates the importance of educating the whole person. STEM is usually presented as a set of skills and problems solving and little else. Moreover, STEM skills are usually presented as male-centric. By studying the lives of women involved in STEM, female students have an opportunity to become engaged and draw a connection from STEM to their own lives. Offering students the chance to truly relate to the subject could break the established pattern and offer each student an
opportunity to see someone like herself successful in a marketable and high paying
career that employs STEM trained individuals.

**Definition of Relevant Terms**

*Chilly Classroom:* “The emotional climate of the classroom is directly related
to the attainment of academic excellence”, therefore, the *chilly classroom*-- “the subtle
ambiance in which many small inequities, can create a negative atmosphere for
learning, for teaching, and for fulfilling professional roles on campus” (Sandler,

*Classroom Climate:* “The type of environment that is created for students by
the school, teachers, and peers” which includes classroom structure, power dynamics
within the classroom, different pedagogical styles, the curriculum, and the
relationships between male and female students (WikEd, 2012, para. 1).

*Connected Curriculum Learning:* “Learning occurs as individuals discover
and build connections between nodes.” A way of learning that is personal and mostly
experience based (Veletsianos, 2010).

*Gender (Schema) Theory:* “Refers to the theory that children learn about what
it means to be male and female from the culture in which they live. According to this
theory, children adjust their behavior to fit in with the gender norms and expectations
of their culture” (About.com, Psychology, 2012).
**Mentoring**: A training system in which a senior or more experienced individual (the mentor) is assigned to act as an advisor, counselor, or guide to a junior or trainee (Businessdictionary.com, 2010).

**Role Modeling**: Strategy for transmitting professional attitudes and behaviors from [learned one] to students (Bidwell, 1989).

**Role models (Invisibility of)**: “(Through the early 1970s) underrepresentation of women in science combined with the general historical invisibility of women scientists to rob many women science students and young women scientists of present and past role models. Through the same period women were told not only that they could not become first-class scientists but also that they could not combine science and family. The invisibility of role models of married women scientists, in particular, left girls and women susceptible to internalization of the latter message.” (Pycior, Slack, & Abir-Am, 1996, p. 28)

**Self-Efficacy**: A student’s belief about their ability to perform certain tasks (Bandura, 1997).

**STEM (Professional Career Success Factors)**:

1. “A strong technical background in a subject;

2. The ability to be a good team member;

3. Excellent communication skills, both oral and written;

4. A childhood interest in science and mathematics supported by parents;
5. If married, strong support from her husband for her technical career”
(Bailey, 1998, pg. xxv).

Title IX: The federal law prohibiting sex discrimination in education. “No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving Federal financial assistance” (United States, Department of Labor, 1972).

Organization of the Study

This thesis follows the guidelines established in the Graduate Student handbook through the College of Education, Teacher Education program, and contains five chapters.

Chapter 2 includes a review of the relevant literature on role modeling, connections in role modeling, mentors, and STEM and on relevance of connected curriculum and its influence on females choosing STEM. Chapter 3 provides details of the methodology utilized in the process of this research. This discussion includes an examination of the research question, hypothesis, and the research design. This chapter also includes details of the students utilized for the study. Information on the instrument used for data analysis, the experimental design, and the procedure used for data collection is also included.

While Chapter 4 is a discussion of the data collected in the surveys, Chapter 5 provides an analysis of the findings and an interpretation of those findings in light of
the relevant literature included within the thesis. This chapter also includes a discussion of the limitations, recommendations, and conclusions found by the researcher. Immediately following Chapter 5 is the appendix and a comprehensive list of all references used in this study.

**Background of the Researcher**

Cindy Lewis’s parents both have degrees in Education and Social Work. Cindy was the only female in her class at ITT Technical College in 1987 when she received an A. A. in Computer Electronic Technology. In 2008, she received her B.A. degree in Vocational Education from Sacramento State University in Sacramento, California. During her time in school, she was also a full time employee at the University of California, Davis. In 2009, she entered the Master of Arts in Education, Gender Equity program.

During her first year of study in the Master of Arts in Education, Gender Equity program, Cindy continued to pursue her alternate interest in computer technology, in various office settings. Continued recognition of the dominant male culture in STEM led her to wonder if there was a correlation between the gender disparity of females in STEM educational programs and careers and gender inclusive pedagogy and role modeling. She decided to focus her study on role modeling and the inclusion of gender in the curriculum for STEM courses.

Cindy continues to work for the University of California, Davis as a academic assistant in the Department of Physics, she is on several committees dedicated to
Women’s issues and technology, The Status of Women at UC Davis, and the Physics Website oversight committee. Cindy is an advocate in the drive to emphasize the importance of increase awareness of connected curriculum and female role modeling in current primary and secondary curriculum.
Chapter 2

REVIEW OF RELEVANT LITERATURE

History has long lacked accurate female representation in STEM innovations, development and representation in education. Recent studies have found unsatisfactory progress and have been made to remedy unequal examples of females in educational texts. For example, it was found that the amount of content dedicated to gender issues in introductory Teacher Education textbooks was between 1%-7% (Sadker & Sadker, 2000). And while gender fairness was verbalized in several of these texts, specific resources and strategies to achieve that goal are mostly absent (Sadker, 2002).

Certain aspects of socialization that limits females’ access to careers in STEM fields begins with gender related training at very early ages, and will continue throughout a woman’s life (Des Jardins, 2010). Role modeling at an early age has been shown to enhance and advance girls’ choices in STEM (AAUW, 1992). Therefore, this review of the literature is an examination of the spectrum of the dearth of equal representation of females in STEM and also of the literature on connected curriculum and role modeling as it affects female students. Possible solutions will also be annotated and analyzed.

When a student chooses a path of study in high school, the choices they are presented with and encouraged to take have the potential to affect the rest of their lives. Since so many high-salary careers are STEM, technology-based, it is logical to
note that high school STEM courses make up the foundation for future study in STEM related fields in college. Although the numbers of females enrolled in STEM courses in college has grown, females are still outnumbered in STEM courses (UC Davis Graduate School of Management, 2010). Therefore, the key is to identify the factors that determine whether females choose to enroll in STEM courses (which ties into the topic of this thesis) and what are the effects of connected curriculum and role modeling on students’ STEM choices and careers?

The first section of this review focuses on the historical background of females in STEM. Following, is a brief glimpse of the current statistics of females in STEM careers and college majors. Next, data on why females make STEM or non-STEM choices, specifically examining interest level, evidence of mentoring, gender bias in education, teacher training, and role modeling. Also included, is a discussion of the constructs of knowledge that shape one’s ability to learn, using role modeling, and exposure to connected curriculum or connected curriculum theory. Another section discusses what conclusions, solutions, and options scholars have studied, analyzed, and endeavored to put into practice. Also in this section is the suggestion of an educational research method that could be put into practice, one in which the components of a more gender specific and gender equitable approach to teaching may be necessary. In adhering to such a gender equitable practice, further and far-reaching teacher training, as well as supplemental learning of the heritage of females in STEM is examined.
Historical Background of Females in STEM

The mention of females’ contributions to STEM has historically been excluded from history books. Even Marie Curie, the first person to win two Nobel prizes, was not admitted to the Academie des Sciences in Paris until the early part of this century (Quinn, 1995). Coincidentally, Marie Curie is one of the few females to be chronically referred to as ‘contributing’ to the sciences, whilst the contribution of females remains buried or invisible. Females have actually worked in STEM fields for over two millennia. Hypatia of Alexandria was the daughter of Theon, scholar and director of the Library of Alexandria. She is said to have written texts on such topics as geometry, algebra and astronomy and is credited with several inventions including an astrolabe (Dzielska 1995).

Some of the most inspiring females in STEM include ancient, historical, and present day figures, such as:

Ada Lovelace

Ada Lovelace is often cited as the world’s first computer programmer. Her notes on Charles Babbage’s Analytical Engine (originally known as the Difference Engine) are that of a description of a computer and software; and apparently she designed a ‘reading machine’ for a Dr. Kay to instruct low income Battersea school children (Doren, 2001; Woolley, 2000). Lovelace “was fascinated by the meaning of those mathematical curiosities that can send non-mathematical minds spinning” (Woolley, 2000, p. 261). October 7 is Ada Lovelace Day.
Marie Curie

Marie Curie is a physicist and chemist famous for her pioneering research in radioactivity. In 1898, she “discovered that radioactivity was an intrinsic property of the atom. It was a discovery that changed the world” (Alic, 1986, p. 191) -- naming that first chemical element she found polonium after her birth place. She then won the 1903 Nobel Prize in Physics with her husband P. Curie and with Becquerel — the Presentation Speech for the award offered a public/formal endorsement for spousal collaboration in science (Pycior, 1996). The Curies’ had “a fertile collaboration” due to a complex complementarily mix in fields and styles (he was a cautious slow thinker and she was quicker and bolder in the experiment/published hypnoses process) (Pycior, 1996). After her husband’s death, in 1911 she was the sole winner of the Nobel Prize in Chemistry for the isolation of pure radium; founded the Curie Institutes in Paris and Warsaw; and won numerous awards: Davy Medal, Matteucci Medal, Elliot Cresson Medal, and the Franklin Medal of the American Philosophical Society.

Rosalind Franklin

Rosalind Franklin was a biophysicist, x-ray crystallographer, and critical contributor to the understanding of fine molecular structures of DNA, RNA, viruses, coal, and graphite.

Hedy Lamarr

Hedy Lamarr, of the Lamarr-Anthiel patent (a frequency-switching system for torpedo guidance—radio control) was the co-inventor of the early technique for spread
spectrum communications and frequency hopping (Rhodes, 2011). Three years after the Lamarr-Anthiel patent expired (and 22 years after the U.S. Navy declined its use in weaponry), the modified concept was installed on ships and today it is part of the U.S. government’s defense communication satellite system (Braun, 1997).

Naomi E. Pierce

Harvard entomologist and molecular biologist, curator of Lepidoptera in the Museum of Comparative Zoology,

Pierce has taken an active role in encouraging females to rise in the scientific establishment. She credits her relationship with mentor Remington with helping her achieve a strong start in what can be sometimes a challenging career choice for females. An active teacher with a preference for individual and small –group teaching, Pierce leads a laboratory that she says follows a cooperative rather than a hierarchical model. (Chiacchia, 1998, p. 367)

As a museum collaborator with the Center for Tropical Forests Science, Pierce and her lab members survey insect biodiversity and natural history in Southeast Asia (Pierce Lab, 2012).

Chien-Shiung Wu

Chien-Shiun Wu “earned a reputation as one of the world’s foremost nuclear physicists” and “is best known for a classic experiment on beta decay” (Newton, 1998, p. 502) based on a revolutionary theory by two colleagues, Tsung-Dao Lee and Chen Ning Yang. As Wu was an authority on beta decay, Lee and Yang presented their
unpublished theory to her. Immediately, she began to design experiments to test their ideas. Working with colleagues at the National Bureau of Standard’s Low Temperature Physics Group, Wu labored almost without rest for six months. In January of 1957, she announced her results: clear evidence for the violation of parity conservation. However, only Lee and Yang in 1957 were awarded the Nobel Prize in physics for the theory/experiment while Wu was excluded (Newton, 1998). Before she died in 1997, Wu had taught at Smith College, Princeton, and Columbia. She joined the Manhattan Project in 1944.

**Mae Carol Jemison**

Mae Carol Jemison (physician, astronaut) became the first woman of color in the world to travel in space (Bailey, 1998). Jemison is also the founder/director of Jemison Group a company providing space-based telecommunication to facilitate health care in West Africa as well as supporting endeavors in science literacy and social responsibility, including the Dorothy Foundation for Excellence which has presented the educational forum: “Reality leads to Fantasy: Celebrating Women of Color in Flight” (Jemison Group, 2012). “She credits her success to her parents, who nurtured their children, and her teachers, who allowed her to explore ideas on her own” (Bailey, 1998, p. 195). Particularly though not exclusively, Jemison would like to inspire African American children “to strive to realize their goals, however unrealistic they might seem” (Bailey, 1998, p. 195).
Etta Zuber Falconer

During her lifetime, algebraist Etta Zuber Falconer had “encouraged hundreds of... African-American women to study mathematics and sciences” through her teaching and program work at Spelman College (Hodgkins, 1998, p. 156). Her overall desire was to change the prevailing pattern of limited access and success for African American women in STEM. Falconer attributed her own growth and encouragement in mathematics to three life mentors: Dr. Evelyn Boyd Granville (seeing an African American woman teaching among men was inspiring), Dr. Lee Lorch (encouraged her pursue her education to teach at the college level), and Dr. Trevor Evans (encouraged her growth in algebra and her study of quasigroups and loops at the doctoral level). She was the director of Spelman College’s NASA Women in Science and Engineering Scholars program (WISE), one of the founders of the National Association of Mathematicians, and was honored with many awards: the Louise Hay Award; Giants in Science Award; Presidential Faculty Award for Distinguished Service; and the United Negro College Fund Distinguished Faculty Award (Bailey, 1998; Hodgkins 1998).

Delia Derbyshire

A musician and composer of electronic music: Delia Derbyshire, worked more recently with Sonic Boom, but also is known for her earlier work on the sound tracks for Yoko Ono’s Wrapping Event, Peter Hall’s Work is a 4 Letter Word (1967), and The White Noise LP An Electric Storm (1968). She is best known for producing the
futuristic “sound” for Dr. Who; she was regarded by its composer as justified to half the royalties—though she never received any (Hodgson, 2001). She worked for 40 years for the BBC at a time when no synthesizers, multi-track taper recorders, or samplers were used: individual sounds were recorded, repeated and then re-recorded again and again. For her, sound was mathematical (Derbyshire, 2008).

**Hypatia of Alexandria**

Greek scholar and mathematician, Hypatia of Alexandria, advanced the study of algebra, was an espouser of Greek scientific rationalism and an influential political figure, and has come to symbolize the end of ancient science (Alic, 1986).

**Limor Fried**

Limor Fried, graduate of MIT in computer science and electrical engineering with her Master’s thesis titled: *Social Defense Mechanism: Tools for Reclaiming Personal Space* (Fried, 2005); founder/owner of Adafruit Industries, awarded the Most Influential Women in Technology Award in 2011, the first woman on the cover of *Wired* magazine, and who goes by the hacker handle ladyada, inspired by Ada Lovelace.

While these females have made very important, notable contributions to STEM, little if any mention of them (and definitely with not as much frequency or in-depth information as their male colleagues) is found in history textbooks (Henrion, 1997) or pre-service teaching manuals.
However, it is extremely beneficial that students know their own heritage as well as that of others (Maher & Tetrault, 2001). Knowing the struggles and triumphs of ancient to present day females in STEM can help students better prepare for their future and better understand the world around them. Incorporating females’ heritage in STEM courses is a component in circumventing a chilly classroom environment by providing a more gender equitable education with relating the past to the present (connected curriculum).

Historically, to become notable or achieve recognition, most females have had to hide behind their husbands or coworkers achievements, as in the case of Ada (Byron) Lovelace, daughter of Poet Lord Byron. Encouraged by her mother in the study of mathematics, so as not to end up a poet like her father, she underwent much mathematic tutelage and showed great promise. She went on to write the first description of a computer and of software, but for fear of retribution for being a female in STEM, never used her real name on her published works.

Using pseudonyms became common practice for females who were often seen as unfit to been seen in a ‘man’s world’ (Henrion, 1997). Some ‘scholars’ even went so far as to state that females’ brains were inferior to males, and that female’s ovaries would suffer from blood being rerouted to the brain by overall vigorous scientific thought (Sadker & Sadker, 1995). Myths such as these prevented and discouraged many females from pursuing STEM fields, granting them minimal access to education and careers in other than those deemed ‘traditional’.
Once some of the misconceptions of female intellectual inferiority were quelled, females entered the educational system in far greater numbers than ever before (Sadker & Sadker, 1995). However in the early path of the 20th century, the modern trend towards vocational education quelled any hope for career or salary equity. Females were guided into courses that set them on ‘traditional’ female career paths such as home economics, teaching, and secretarial work, while males were groomed towards lucrative STEM career choices (Sadker & Sadker, 1995).

Females continued to be tracked for gendered careers until the late 1960s and early 1970s with the exception of filling in for men at war during WWII. Females again entered the STEM workplace once the feminist movement of the 1960s and 1970’s highlighted and redefined female’s roles in society (O’Kelly & Carney, 1986). In 1965, Sister Mary Kenneth Keller from Cleveland, Ohio, became the first woman to receive a Ph.D. degree in computer science in the United States.

The enactment of Title IX, a federal law prohibiting sex discrimination in any federally funded program, has encouraged girls to enroll in STEM courses. (US Department of Labor, 1972). Programs were developed to encourage girls to pursue math and science, with hopes that they would also choose to major in STEM. Early inspection of Title IX showed some promise; however, upon closer examination it was noted that bias still went unchecked (Sadker & Sader, 1995). Continued gender inequity in texts, education, and teaching training continues to contribute to an inequity in career and pay opportunities for females.
Females in STEM-Related Careers

Careers today in STEM comprise the majority of lucrative careers. Although females have approached the glass ceiling and are now earning more than in subsequent years, the wage gap still exists. According to recent data, “Women's earnings were 77.4 percent of men's in 2010, compared to 77.0 percent in 2009, according to Census statistics released September 13, 2011” (National Committee on Pay Equity, 2011). More opportunities to STEM careers for women is essential to closing the pay gap (Bell & Norwood, 2007; UC Davis GSM, 2010).

According to a 2010 UC Davis report, out of approximately 24,010 undergraduates, the ratio of graduates is 55% women to 45% men and is just under the 56%–44%-national average. Numbers at UC Davis show that female enrollment numbers in still lag, especially in engineering, while teaching remains a predominately female occupation (UC Davis, 2010). The social value of a woman and her work continues to emerge as one of the largest factors in determining pay differences between men and women (Hill, Corbett, & St. Rose, 2010). Males were found to be twice as likely to major in computer science and five times as likely to major in engineering as females (National Science Foundation, 2008).

Educators and sociologists point to a variety of factors in the lag in female choice of STEM as an educational and/or career choice. One highly cited theory is that of the leaky pipeline. The leaky pipeline is a metaphor frequently used to describe the fact that females are under-represented in science, technology, engineering, and
mathematics (STEM) careers (Blickenstaff, 2005). This pipeline leaks students at various stages: students who express interest in science careers sometimes change their minds when applying to colleges and universities and select other areas of study. Others begin their post-secondary education in a STEM program, but change majors before graduation. Finally, some students leave the pipeline after graduating with a STEM degree when they select another field as a career (Blickenstaff, 2005).

A variety of factors seem to contribute to the leaky pipeline theory: gender stereotyping as well as cultural, personal and societal pressures. The lack of female role models and mentoring opportunities is often cited as problematic, along with work/life challenges and a perceived lack of flexibility (Keller, 1985). Often the nature of a female countenance is frequently seen as counterproductive to a STEM atmosphere. Often in the workplace, women believe they are subjected to higher standards than men and have to work harder to have others accept the same level of competence as their male peers. Female executives tend to focus more on positioning themselves in external networks, whereas male leaders put the major thrust of their efforts into building and nurturing networks within the company (Ryan, Haslam, Hersby, Kulich, & Atkins, 2007).

Another significant predictor of female’s choices of STEM in education and career paths is self-efficacy. A landmark report by the AAUW (1992) revealed that girls’ confidence in their academic abilities drops dramatically from elementary to high school. The decline is particularly significant in girls’ and young women’s belief
in their STEM abilities (AAUW, 1992). At every age, from elementary to high school, boys are more confident in their math abilities than are girls. For example, in a science class, a girl might view a ‘B’ on an exam as a poor grade, indicative of her lack of science ability. A boy receiving a ‘C’ on this same exam might view the grade as passing and therefore indicative of his strong science ability (Seymour, 1995).

Research also shows that young women and girls who receive high grades in STEM are generally modest while young men and boys are generally self-congratulatory. By high school, one in four boys thinks he is good at math but only one in seven girls thinks she is (AAUW, 1992).

This relationship between self-efficacy and enrollment in STEM is a crucial factor when considering the relationship between the effects of classroom climate, gender-connected curriculum and mentoring. Self-efficacy itself can positively predict performance beyond prior performance and ability (Bandura, 1997). This finding helps explain why many girls and young females lose interest in STEM even though they do not lack STEM abilities. What they lack is the belief that they are capable of attaining STEM goals—such as certain grades, majors, or professions—which leads to decreased interest in pursuing STEM (Seymour, 1995).

The need for teacher-training (role modeling) in gender equitable STEM topics should not go unnoticed as research on self-efficacy suggests that teachers should pay as much attention to students’ self-efficacy—their perceptions of capability—as they do to students’ actual capability (Zeldin & Pajares, 2000).
Gender Bias in the Curriculum

In the study ‘Failing at Fairness’, gender bias is referred to as "a syntax of sexism so elusive that most teachers and students were completely unaware of its influence" (Sadker & Sadker, 1995, p. 2). Identifying gender-bias in textbooks is critical, since the effects of offending texts can lead to subtle, unintentional, and damaging effects. The study of curriculum enables us to understand what is possible to think about and who can think about it. The nature of curriculum materials used in the schools and their relationship to the world of female and male students gives us a critical window into the knowledge conveyed by schools.

Researchers surveyed science and math education professors and found that more than 90% considered gender equity an important social issue; yet they devoted less than two hours of instructional time per semester to the topic. Notably, these teacher educators cited the absence of information in teacher education textbooks as a critical obstacle to their teaching of gender equity (Campbell & Sanders, 1997).

Gender bias is also taught implicitly through the resources chosen for classroom use. Using texts that omit contributions of women, that tokenize the experiences of women, or that the stereotype gender roles, further compounds gender bias in schools' curriculum. Although research shows that the use of gender-equitable materials promotes gender-balanced knowledge, flexible attitudes towards gender roles and gender neural role models, schools continue to use gender-biased texts (Klein, 1985). Researchers at a 1990 conference reported that even texts designed to
fit within the current California guidelines on gender and race equity for textbook adoption showed subtle language bias and neglect of scholarship on women. The texts also showed omission of females as developers of history and initiators of events, as well as the absence of women from accounts of technological developments (AAUW, 1992).

A review of U.S. history textbooks found that in one textbook, there were four men for every woman mentioned, and less than 3% of the history was about females. In a review of science textbooks, researchers found that the texts contained minimal information regarding the accomplishments of females in science (Sadker & Sadker, 2000). Beyond basic frequency of representation, researchers have also examined both the explicit and implicit derogatory ways in which females are portrayed visually. One such study had found that men were more often portrayed as dominant or having higher status than females in textbook images. For instance, when a doctor and nurse are pictured together, the doctor is typically shown as a man, while the secondary role of the nurse is typically shown as a woman (Hogben & Waterman, 1997).

When students are unable to connect to the curriculum content or unable to make any personal connections, they are less likely to value or pursue that curriculum (Noddings, 2006). As a final example, females are not as likely to pursue advanced courses in STEM or pursue a STEM related major in college (Hill et al., 2010).
Solving the Problem

Much attention is paid today in addressing the dearth of girls in STEM. Notably, in November 2009 President Obama launched "Educate to Innovate" (Whitehouse.gov, 2009). This initiative is nationwide and includes three objectives: increasing STEM literacy especially in critical thinking and in depth learning; moving Americans from the middle to the top in global achievement in STEM fields in the next decade; and increasing focus on STEM learning and career pathways for underrepresented groups including women and girls (Whitehouse.gov, 2009).

After school programs seem to be highly suitable to enable girls to acquire needed support, access, and mentoring of STEM topics. In terms of technology, AAUW's Commission on Technology, Gender, and Teacher Education recommends creating school-home-community links and partnerships to increase computer access for girls. It seeks to assist in developing intergenerational learning activities and to reconfigure informal spaces for computers, so that all students feel welcome. The program also infuses computing into a range of clubs and activities; offering single-sex programs for girls to socialize and work on computer-related projects together; and starting early (most programs tend to reach out to high school students) (AAUW, 2000).

Several studies and reports have established recommendations for educators. These recommendations stress the importance of gender fair teaching strategies and include exploring STEM topics in a more gender neutral and creative manner as well
as developing informal teacher training opportunities on gender-neutral STEM approaches. Teachers must also consider increasing connected curriculum relevance in order to better connect girls with subject matter (Belenky, Clinchy, Goldberger, & Tarule, 1997).

Connected curriculum, as a teaching tool, provides another way for female students to relate the curriculum to something in their own life experiences (Noddings, 2006). Research suggests that for students to succeed and continue to choose STEM, they need to experience STEM from a more relevant perspective (AAUW, 2000). Connection to the curriculum is essential to girls’ learning style. Connected learning is what females experience when they are able to associate the content into knowledge (Belenky et al., 1997).

Due to the onset of web-based information, the prominence of visual and textual representation of females in STEM is more readily available than ever before. Many professional organizations such as NASA, The White House, AAUW, Women in Science.org, Women in Science and Engineering at UC Davis (WISE), offer information and programs that encourage and educate girls in STEM programs, activities, educational and career choices.

Role modeling or vicarious learning has also been shown to improve self-efficacy (Bandura, 1997). One common way to convey to females that they can be successful in STEM is to expose them to a STEM role model, or someone who is successful in these fields and can be emulated. Gender roles shape the way people see
themselves, and females report feeling dissimilar from people who fit STEM stereotypes (Cheryan, Plaut, Davies, & Steele, 2009). Accordingly, the aforementioned dearth of research lends credence to the positive effects of role modeling, mentoring, and connected curriculum, and the importance of further research in these areas.

**Conclusion**

Attracting and retaining more females in the STEM workforce will maximize diversity as well as innovation, creativity, and competitiveness. Today scientists and engineers are working to solve some of the most difficult challenges of our time, and engineers design many of the things we use on a daily basis. When females are not involved in science and engineering, experiences, needs, and desires that are unique to women may be disregarded. For the good of science and engineering, we need to recruit the most talented people to STEM fields. Not including half the population (female) in the pool of possible scientists and engineers is short-sighted and self-limiting. As Myra Sadker said, "If the cure for cancer was in the mind of a girl, we might never discover it" (Sadker & Sadker, n.d.).
Chapter 3
METHODOLOGY

Introduction

This study was conducted to establish the effects of role modeling, connected learning, and mentoring on girls educational and career choices in STEM. The recommendations included the incorporation of role models in STEM courses to increase females’ overall interest in STEM. Data for this study was collected from college students by the administration of a survey. The responses were analyzed utilizing both a quantitative and qualitative approach. This chapter examines the methodologies used to conduct the research completed by this researcher. The chapter includes sections on the study design and data collection, the research question, research instrument, participants, setting, and the procedure for completing the study.

Research Questions

The research question for this thesis was, what effects do mentoring, gender inclusive curriculum, and role modeling have on females’ STEM career choice? The basis for the use of this question was to examine how a lack of gender inclusive curriculum and role modeling effects females’ future STEM choices. (Belenky et al., 1997; Gallagher et al., 2000, Sadker & Sadker, 1995.)
Research Design and Data Collection

Both quantitative and qualitative approaches were applied to best examine the variables addressed in this study. The researcher presented students with surveys. The surveys included demographic questions, Likert scaled and open-ended questions and utilized both quantitative and qualitative methods. By utilizing a qualitative as well as quantitative approach, results held more potential for generalization (Babbie, 1998, Schram, 2006). The researcher used quantitative questions to address the demographic information of sex, age and educational level. Several open-ended questions were included to better assess the qualitative data, such as student attitude and opinions related to STEM interest, career interest, and effects of curriculum (Patton, 2002).

An informed consent accompanied the survey (see Appendix B). This informed consent provided for the use of all information given in the completed survey without further consent. The informed consent also insured that the act of the completion of the survey granted use of the survey information. The researcher obtained no other form of consent.

Participants

Participants in this research were all students attending a northern California public University in variety of college enrollment levels. The school community included a diversity of ethnicities, (not recorded for this report). This sample consisted of 54 female students, and 18 male students, enrolled in a variety of courses. The students were a mix of undergraduate and graduate students.
Table 1

*Highest Educational Level*

<table>
<thead>
<tr>
<th>Education level</th>
<th>High School</th>
<th>AA/AS Degree</th>
<th>BA/BS Degree</th>
<th>MA/MS</th>
<th>Tech/Trade school</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
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<td>41</td>
<td>11</td>
<td>6</td>
<td>4</td>
</tr>
</tbody>
</table>

**Demographic Description of the Participants**

The demographics of the participants represent a variety of ages, sexes, and educational levels. The age of the participants in this study ranged from 17 through 58 years. The breakdown of the students by age and educational level shows that females make up the majority of the students. There were 72 participants total in the survey (see Table 2).
Table 2

Participant Demographics

<table>
<thead>
<tr>
<th></th>
<th>Female</th>
<th></th>
<th>Male</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Age</td>
<td>#</td>
<td>Age</td>
<td>#</td>
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<tr>
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<tr>
<td>30</td>
<td>1</td>
<td></td>
<td></td>
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</tbody>
</table>

Total Females 54 Total Males 18

Setting

A university classroom was the physical setting for the survey. The instructor was present during all phases of this research. The research took place during a period
of 16 weeks. The course instructor administered the survey prior to the standard class session. Classes with students interested in education were targeted, and a total of five classes participated.

**Procedure**

The researcher presented the survey (see Appendix A) through the course instructor to the students in a section of their various courses during the weeks of July 10, 2010-Oct 15, 2010. The researcher instructed the course instructor to explain the Informed Consent (see Appendix B) to the students and asked the students to read the Informed Consent prior to completing the survey.

The researcher presented the students with a basic introduction to the researcher and the researchers affiliations. The researcher then presented the students with a basic overview and purpose for the study as well as an overview of the processes with which they would be involved. The course instructor collected all completed surveys and delivered them to the researcher after dismissal of the class. The instructor did not assign course related grades and/or points for completion of the survey, participation in lectures or related activity.

**Conclusion**

In order to determine what effects role modeling, connected curriculum, and mentoring STEM courses have on a girls’ future educational/career choices, a 16-week study was conducted that involved 72 students from a local university. This researcher used a sampling survey containing a Likert scale with quantitative and
qualitative analyses as well as open-ended questions, as the method of statistical analysis for this study. A survey was conducted with questionnaires measuring variables that were examined for this study. Incorporating data from a standard five-point Likert-scale with qualitative data from open-ended questions, the researcher was able to collect sufficient data.
Chapter 4

FINDINGS

This study examined 72 university students enrolled in a variety of majors. The purpose of this study was to examine the effects of role modeling, mentoring, and connection to curriculum on female STEM career choices. A Likert-scale survey and an open-ended questionnaire were utilized. During the process of examining the effects of role models, mentoring, and connection to curriculum on female STEM career choice, the research often evoked questions such as; “Is there a correlation between a lack of connected curriculum and a female’s STEM choice?” and “Do early role models matter in female’s STEM choices?” The answers are evident in many of the qualitative and quantitative responses obtained by the research for this thesis. One hypothesis was that if females had encountered few female role models in STEM, fewer females would choose STEM as a career. The secondary hypothesis on this is that participants would recognize and report on the correlation of female role models and females choosing STEM.

Quantitative and Qualitative Analysis

This chapter examines the student response to questions related to the students’ level of experience with role modeling and connected curriculum in regard to career choice. First, this chapter examines the quantitative responses and the levels of observed variation between female and male responses. This chapter also includes a statistical analysis of responses based on the themes within the survey. Secondly, this
chapter provides the researcher’s analysis of the qualitative portion of the survey and observed themes in the responses to the open-ended questions presented to the students. Finally, this chapter examines overarching themes between both the quantitative and qualitative sections of the survey.

The first set of questions was of the quantitative nature using Likert-style rated questions. These questions asked the student to respond to a series of statement based on their personal level of agreement with the statement with a range of one (strongly disagree) to five (strongly agree). The statements fell within several themes to determine student’s perceptions of gender-based role modeling effects on career choice. Relevant themes that emerged from this survey included correlation to role modeling and female choice of STEM, agreement that educators were valued as role models, and concurrence that connected curriculum could be improved in order for females to choose STEM. A second set of qualitative questions specifically targeted the demographics of the participants including age, gender, and educational or career directional course toward STEM. Qualitative methods included five open-ended questions used with the intent to reveal influences on the participant’s opinion in themed categories similar to those used in the quantitative section of the research.

Survey Results

Exposure to Role Modeling

Themes addressed in the survey attempted to gauge students’ exposure to and measure of value placed given on role modeling/mentoring either through family or
In identical surveys, male and female participants to the questions 3 and 11 were asked to indicate their level of agreement with statements relating to early exposure to role models. Question 3 stated, “Growing up, I had female rode models in STEM”, while question 11 stated, “Parents and family play an important role in female choice to pursue STEM”. In question 3, both female and male participants responded with a low level of agreement with 10% (male and female) (see Table 3). In question 7, 53% of females were agreement vs. 35% of males (see Table 4). It is important to note that while males and females agreed at a corresponding rate to question 3, 5% of the male & female participants also strongly agreed with the same question, further showing that very few students, male or female encounter female STEM role models.

Table 3

*Exposure to Role Modeling*

<table>
<thead>
<tr>
<th>Score</th>
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<th>Male</th>
</tr>
</thead>
<tbody>
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</tr>
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<td>3</td>
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</tr>
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<td>2</td>
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</tr>
<tr>
<td>1</td>
<td>5%</td>
<td>35%</td>
</tr>
</tbody>
</table>
Table 4

*Importance of Role Modeling*

<table>
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<th>Male</th>
</tr>
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<tbody>
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</tr>
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<td>3</td>
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</tr>
<tr>
<td>1</td>
<td>5%</td>
<td>3%</td>
</tr>
</tbody>
</table>

*Effects of Connected Curriculum*

In questions 12 and 16, the participants responded to statements specific to their exposure to connected curriculum and females in STEM. These concepts established the students’ understanding and self-awareness of gender within the curriculum and concepts in regard to STEM role modeling. Question 12 specifically asked about the number of females in STEM the student was able to identify 8% (see Table 5) of the females responding in agreement with the statement, while 2% of the males agreed and 1% (see Table 5) strongly agreed with this same statement. It is important to note that 10% of females were undecided as were 7% of males, (see
Table 5) indicating a possible conceptual misunderstanding of who or what qualifies as a female STEM role model.

Table 5

*Effects of Connected Curriculum (Question 12)*

<table>
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</tr>
</thead>
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<tr>
<td>1</td>
<td>65%</td>
<td>75%</td>
</tr>
</tbody>
</table>

The participants answering question 16 were asked to indicate their level of agreement with a statement concerning the showcasing of females in STEM found in school curriculum. In this statement, female participants responded with a high degree of disagreement, 65%, to question, and 60% of males in disagreement. Correlating values were found with 0% of men and females agreeing with question 16. It is important to note that the resultant gender inclusive data demonstrates an across-the-board, lack of visible females in STEM curriculum.
Table 6

*Effects of Connected Curriculum (Question 16)*

<table>
<thead>
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<th>Score</th>
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<td>12%</td>
</tr>
<tr>
<td>2</td>
<td>65%</td>
<td>60%</td>
</tr>
<tr>
<td>1</td>
<td>22%</td>
<td>18%</td>
</tr>
</tbody>
</table>

*Statistical Significance of the Study*

Statistical significance in any study is often based in the size of the study. This was evident in the test of this survey. The sample size for this study was only 72 participants and was statistically insignificant in consideration of the large total population of students. While generalization of the results of this study to the larger population is not possible due to the limited size do the sample, the interesting comparison is in the qualitative responses of the survey.
Qualitative Analysis

This section addresses the qualitative questions included in the surveys. These questions specifically included inquiry into past experiences in role modeling and connected curriculum and mentoring. Matching themes of the qualitative questions, three emerging themes were found when examining the qualitative answers: (a) Exposure to role modeling, (b) Importance of role modeling, and (c) Effects of connected curriculum. Surprisingly, a fourth theme surfaced when students were asked how curriculum could change to encourage more girls to choose STEM. The themes emerged from the following three questions: Did you have a role model growing up and if so whom? How might you change curriculum to encourage more girls to choose technology classes? How important is teacher input into student’s future career choices? Results from the open-ended questions detected students concerns regarding gender connected curriculum in the classroom, evidenced in all themes, including role modeling and future implications of STEM career choices.

The open-ended questions on the survey inquired about effects of connected curriculum and role models. Females and males alike were in agreement regarding the importance of teachers as role models. One of the questions asked was: How important is teacher input into student’s future career choices? A 23-year-old female student answered, “Very. They spend huge blocks of time together.” Another said, “Very important-teacher expectorations can make the difference in whether you have confidence in your abilities or not.” A 21-year-old male student responded, “Teachers
have a huge influence in student’s preferences.” The lowest amount of support for the question still responded as, “Fairly important.” The respondents in this survey conveyed that students will be interested in a career their teachers show passion and enthusiasm for. Evidence shows that mentors and role models matter to students, and perhaps, in particular, highlight the need for teacher training, since teachers are also seen as mentors and role models (Sadker & Sadker, 1995).

Another question asked, “How might you change curriculum to encourage more girls to choose technology classes? Answers ranged from, “No clue!” (18-year-old female) to, “Make it seem ‘fun’ rather than tedious, explain how them knowing more about it can benefit their own lives outside of ‘work’ (44-year-old female), to “I would highlight all women who have contributed to technology and make sure the curriculum is gender neutral.” Data points to a clear affirmative distinction between chilly classroom conditions and student’s perception of a more gender friendly classroom. While the explanations varied, most of the responses pointed to two factors, classroom climate and gender connected curriculum. Gender in the curriculum allows the student to see one’s self within context of the curriculum (Koch, 2007).

Participants were queried “Did you have a role model growing up and if so whom? Respondents offered mostly one or two word answers of family members as role models: mothers, fathers, “My great aunt”, parents, grandparents and “Yes, Spanish teacher” was the response from one respondent. The most expressive student (38 yr-old-female), answered, “My role model was always my mother. She was the
one who raised my brother and I while my father was away at sea as part of his military careers. My mother raised me, worked full-time, and went back to school to get her Bachelor’s degree, because she really wanted to be a preschool teacher.” The findings suggest the strong influence a role model can have on a student.

**Summary**

The findings of this study demonstrated the hypothesis that classroom climate, connected learning, and mentoring can and do affect girls’ educational and career choices in STEM. Many of the students in this study reported that the curriculum they had experienced as students was lacking in female representation in STEM, or as one 66 yr-old-female student stated, “Since I’m older it may be obvious, but females were not even encouraged to think about technology in the 60s.” The students’ perception seemed to have been affected by simply thinking about the questions while they were taking the survey. The observed impact of the lesson is seen in the trends in the responses from the participants and provided important insight into the views of the participants. The participants’ responses demonstrated that exposure to connected curriculum affects students’ perceptions of females in STEM and also verified the importance of teachers as role models. Findings from this study demonstrated statistically significant results that clearly indicated the potential correlation between role models, connected curriculum, and females’ choices of STEM related fields.
Chapter 5

DISCUSSION, CONCLUSIONS, LIMITATIONS, AND RECOMMENDATIONS

Discussion

The basis for this research was to address the question: Do role modeling, connected curriculum, and mentoring have effects on female STEM career choice? This study was also designed to examine students’ exposure to and value of role modeling and connected curriculum. Data shows that connecting students to course content will in turn raise student’s interest level (Singh, Granville, & Dika, 2002). Questions were addressed through the use of a survey that addressed specific thematic issues in these questions through the use of quantitative and qualitative methods. One hypothesis presented was that increasing females’ exposure to female role models in STEM could potentially increase their STEM career interest level. This study lends credence to the importance of role modeling and connected curriculum on female students’ STEM interest level.

Qualitative Analysis

The importance of increasing female STEM achievements in curriculum is evident in the observed responses presented in the survey results. This section of this chapter responds to the quantitative findings of Chapter 4 from the surveys in qualitative form, in thematic groups. It provides an overall comparison of the surveys based on established themes. Finally, this section analyses the limitation of statistical significance of the quantitative data collected.
The quantitative portion of the research focused on a variety of specific themes. These themes included student’s exposure to role modeling, the importance of role modeling, the effects of connected curriculum on a female students choices of STEM, and finally, students’ proposed methods for increasing females STEM curricular exposure. In the survey (see Appendix A) six questions dealt with the theme of role modeling, six survey questions addressed issues regarding connected curriculum, and a final six questions addressed effects of role modeling and connected curriculum on STEM careers. As previously noted, consequently, when students are unable to connect to the curriculum content or unable to make any personal connections they are unlikely to pursue that curriculum (Noddings, 2006). Ultimately, females are not as likely to pursue advanced courses in STEM or pursue a STEM related major in college (Hill et al., 2010).

**Exposure to Role Modeling**

The first theme addressed in the survey was exposure to female role models in STEM. Questions three and 11 asked participants to state their level of exposure to female role models in STEM. The varying percentage of 53% female and 35% males responding positively indicates that females tend to experience more female role models than males. For the student participants of this survey, this experience has provided a statistically significant change in opinion about understanding of how role modeling affects a female’s choice of STEM. Prior to taking the survey, many participants came to realize they had experienced a lack of female STEM role models
in school curriculum texts. Further analyzing their past role models led some students to the conclusion that mentoring might have actually changed their future career plans. It’s not surprising that participants didn’t consider their past devoid of positive female STEM role models. One only has to recall Sadker & Sadker’s work on gender bias, referred to as "a syntax of sexism so elusive that…. students were completely unaware of its influence" (Sadker & Sadker, 1995, p. 2).

**Importance of Role Modeling.**

In questions 3, 4, 5, and 7, 11, and 13 participants respond to statements specific to the concept of family/educator as role models. These concepts are important because they established the students understanding of role modeling. The participants stressed low or undecided scores regarding whether teachers strongly showed support for girls choosing STEM. Specifically in response to question 7, over half of all females were in agreement the statement, “Parents and family play an important role in female choice to pursue STEM.” High numbers of female agreeing with this statement, demonstrate a females’ early exposure to STEM choices, or lack thereof. Students surveyed often referred to the strong role of a parent or a family member in reference to role modeling. Family members provide bias towards a young person’s choices, in shades of positive and negatives. Often, as seen in the results of this survey, having a strong female role model not related to STEM, often has positive correlations. Survey participants expressed gratitude and reverence for any strong positive role models, whether it be the single mother working two menial jobs, or the
grandfather that encouraged them to study math. The effects of positive role modeling seem powerful and lasting.

**Effects of Connected Curriculum**

Questions 9, 12, 14, 16, 17, and 18 provided participants response to statements specific to the concept of connected curriculum. In these questions, the participants were asked to indicate their level of agreement with statements such as, “I can name five women who have contributed to science and technology,” and “Females have been as successful as males in science and technology.” The responses to this statement indicated a high level of either disagreement or uncertainty. By incorporating this multifaceted view of the world we provide the students with context to place their own encounters with issues of gender on a global level (Hansen, Fliesser, Froelich, & McClain, 1992). The need to ‘see you to be you’ can be a powerful force within an educational setting. When reading about history for the first time, and when encountering no one who is like you, one might begin to doubt one’s future place in history. If all the STEM role models a student finds are white and male, and most of the women are either absent or inconsequential, how will a young girl find her place and voice in the past-paced world of STEM? Study participants seemed to realize the importance of early role modeling in curriculum, and expressed a desire to update and further the importance of future school texts. As noted previously one student described her wish to “… highlight all women who have contributed to technology and make sure the curriculum is gender neutral.”
Statistical Significance of the Study

While overall the study does not provide statistical significance, it does provide an insight into this particular student population. More females than males express dissatisfaction regarding the lack of connected curriculum for a female audience. However, the common factor of the importance of teachers as role models demonstrates its importance within all genders. Opinions expressed by both genders regarding how to encourage more girls to choose STEM is a sign that future implications of connected curriculum can be addressed globally. The data gathered and opinions expressed by students present a strong case for further research on the correlation between role modeling and Females’ STEM choice.

The lack of exposure of females in STEM and the related issues of connected curriculum on a personal and global level is exemplified by the current lack of females in STEM careers. This follows the AAUW report which expressed concern that females still fall within specific fields that lead to lower paying jobs (Dey & Hill, 2007).

Exposure to Role Modeling

One question asked students, “Did you have a role model growing up, and if so whom?” Responses varied, as many students reported varying levels of experience with or exposure to role modeling. One student (a female age 42) stated “Yes, my father + mother, my neighbors, my first boss”. Another female aged 23, simply answered, “No”. Other questions in the survey dealt with the idea of teacher as role
model. One survey statement was, “How important is teacher input into student’s future career choice?” Answered by a 22-year-old female, “Teachers input to me is very important in a student’s career choice. Teachers help map student’s lives.” Many of the student participants had little or no experience with feminist studies in STEM. Recent studies have found that, for young female students at the beginning of college, who are considering STEM majors and careers, having contact with female scientists and engineers as professors or, amazingly, even through websites, plays a role in helping them to see themselves as scientists. Interestingly, however, for male students, the professor’s gender is less important, but for female students it makes a big difference in STEM classes (Stout, Dasgupta, Hunsinger, & McManus, 2011).

**Importance of Role Modeling**

This theme addressed the issue of change that might be made to curriculum to ensure more females choose STEM. Overall, many students indicated that their instructors had not even discussed gender within the context STEM. However the majority of students had plenty to say on the topic of curriculum improvement. To the researcher, this was the moment when all the research showed the greatest effect on the participants. Answers such as, “Show more successful famous or up and coming women in the fields, promote more than just the typical nursing or teacher professions”, and “Speak highly of women and encourage them to pursue any job, not just the one that society feels in appropriate based on gender.” The responses to this question echoed the same responses throughout. Most of the students indicated that
discussing the topics of role modeling and connected curriculum together helped them see how gender affects global patterns of career choices.

Effects of Connected Curriculum

Another question asked students to ponder the issue of connected curriculum and females pursuing STEM careers. A 17-year-old female answered that she wasn’t in a STEM career, and stated, “No, I am not, maybe seeing more female teachers and famous females in the field. The majority of my science and technology teachers K-12 were male and even now I’m taking CSC1, my teacher is male. I can’t recall any famous women scientist or technologists except Marie Curie, that’s about it.” She goes on to say, “Women in society also do not get encouraged to be scientists, engineers or technologists, they’re pushing nursing, teaching, secretary.” This follows the AAUW (Dey & Hill, 2007) reported concerns that females still fall within specific fields that lead to lower paying jobs. The participants also stated that gender often determines “who is more interested in technology” and who is “given more opportunity.” Issues of gender have long established trends that are supported by research indicating social context and societal pressures change the value of a person’s work (Dey & Hill, 2007). The participants in this research recognized the gender based value of female role modeling and state this as more of a fact than as an issue to be addressed through the educational process.
Conclusion

The overarching theme in student responses seems to focus on the influence of role modeling and connected curriculum, and those people in their lives who have made issues of gender evident in multiple contexts including the educational process. This survey indicates that the individuals most likely to be affected less by a lack of female STEM role models and connected curriculums were the male students. Regardless of context, the theme in student responses was that female figures of influence created the base knowledge for furthering females in STEM careers. This was true both in education where students learn about the important roles females have played throughout history or in the home where education through socialization begins. This coincides with issues of gender education in a larger sense. The question remains is the dearth of female role modeling and connected curriculum (still) effecting females and if so how can we alter this pattern to improve female’s future STEM career success? The glass ceiling and pay gap are two of the leading indicators of the social state of female workers. While formal education of females has changed this context to a great extent, there remains an additional curricular gender gap that divides the future career opportunities of males and females. Through a gender enriched process of highlighting female achievements in STEM curriculum, females as a whole will begin to diverge from historically gender specific career pathways. If we encourage equally we educate equity and thereby institute change in the fabric of curriculum.
Limitations

The focus on curriculum as a source for change would have been greater for the researcher. The opportunity to provide a pre and post survey could have enriched this study as well as the researcher’s learning process. The recommendation of this researcher is to include a presentation highlighting historical female STEM contributions prior to taking this survey.

Future Recommendations

In this process, the researcher anticipated a certain level of uncertainty from the participants in this study, male and female, in regard to the importance of role modeling and promotion of females in STEM. The input from students on the methods of what and how to support inclusion of gender issues within curriculum content was truly gratifying. Further research is highly warranted, specifically in the field of female related STEM curricular development and teacher education.

Reflection

In reflection, the factors stated above became clues to the past and present effects of role modeling, connected curriculum and females’ choice to pursue STEM. The responses of the participants study raised further questions for the researcher, and provided the basis for further research. How can we improve and highlight past, present and future female STEM achievements to share with future generations? How can we alter current curriculum to address the emergent issue; the lack of female representation in STEM contributions? How can we strongly encourage the future of
women in STEM? This study showed that parents and family have been and always will be a brilliant source of inspiration and role modeling for students. However, ultimately, our educators and schools have an obligation to promote a gender diverse curriculum, in order to advance gender diversity as well as future STEM research and development. If we don't generate interest in science and technical fields in all, irrespective of gender, how can we, as a nation, expect to succeed, globally? Why outsource science, technology, engineering and math when we can cultivate it right here, at home?
APPENDIX A

Questionnaire: Choosing Technology
Questionnaire: Choosing Technology

Name (optional): _________________________________

4 Digit Month/Day - Birth date (for coding purposes): (example 05/24) _________

Occupation: _________________________________

Gender: _________________________________

Age (optional) _________________________________

Education Level: (Circle highest level completed)

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<th>Undergraduate</th>
<th>Graduate</th>
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<td>Technical/Trade School _________ (certificate / degree)</td>
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Please rate your response to the following statements. Use the following scale to mark your responses. Please choose only one response per question. Thank You

1 = Strongly Disagree  2 = Disagree  3 = Undecided  4 = Agree  5 = Strongly Agree
1. I currently work in a science or technical-related field.
   1  2  3  4  5

2. My current career path is one of my choice.
   1  2  3  4  5

3. Growing up I had female role models in science & technology.
   1  2  3  4  5

4. I was interested in science & technology earlier in life.
   1  2  3  4  5

5. I was encouraged to explore science & technology.
   1  2  3  4  5

6. I wish my career were challenging/ interesting.
   1  2  3  4  5

7. I was discouraged to explore science & technology.
   1  2  3  4  5

8. I wish my career were more lucrative.
   1  2  3  4  5

9. If I had more exposure to women in science & technology, I may have altered my education/career plans.
   1  2  3  4  5
10. Women lack support systems in technical careers.
   1 2 3 4 5

11. Parents and family play an important role in female choice to pursue science & technology.
   1 2 3 4 5

12. I can name 5 women who have contributed to science & technology.
   1 2 3 4 5

13. Teachers and the academic community strongly support girls who want to study science & technology.
   1 2 3 4 5

14. There is a gender pay gap in science/technological careers.
   1 2 3 4 5

15. Women can earn a good living in science/technological careers.
   1 2 3 4 5

16. School curriculum and texts showcase females in science & technology.
   1 2 3 4 5

17. Females have been as successful as males in science & technology.
   1 2 3 4 5

18. Women have been involved in technology since its creation.
   1 2 3 4 5
1. Did you have a role model growing up, and if so whom?

2. How might you change curriculum to encourage more girls to choose technology classes?

3. Do you think if you had seen role models of women in science/technology curriculum, it might have influenced you to pursue a career in that field?

4. Are you involved in or plan to work in a science/technology field? If so what influenced your interest in this career? If not, what factors would have influenced you to pursue a career in science/technology?

5. How important is teacher input into student’s future career choices?

6. Do you think men or women tend to like Technology better and why?
APPENDIX B

Consent Letter
CHOOSING TECHNOLOGY: AN ANALYSIS OF HOW SOCIAL CONSTRAINTS AFFECT CAREER CHOICES

Informed Consent for Participation in a Research Study

My name is Cindy Lewis and I am a graduate student in the Masters of Arts in Education and Gender Equity program at California State University, Sacramento. You are being asked to participate in a study that will be examining the effects of connected learning on females in non-technical careers. This is an exploratory study that has not been conducted before. Your participation involves filling out a questionnaire that will require up to thirty minutes of your time. I will be responsible for dropping off and picking up your submitted packets. I am interested in your honest response and opinions. Your participation is completely voluntary. You may quit at any time with no negative consequences. Although none of the questions were designed to cause you discomfort, you may leave a question unanswered if you are uncomfortable with it for any reason. However, only completed questionnaires will be useful to me. Your responses will be completely anonymous. In order to maintain anonymity, please do not put your name anywhere on the questionnaire. Putting your name on the questionnaire is strictly optional. You may use a pseudo name if you desire to. Your time and participation are greatly appreciated and much needed.

Here is my contact information: cjklewis@gmail.com feel free to contact me if you have any questions. I will be happy to be of any assistance. Thank You.
REFERENCES

http://psychology.about.com/od/gindex/g/def_genderschem.htm


