THE SOCIAL AND EDUCATIONAL FACTORS IMPACTING ATTITUDES ABOUT TECHNOLOGY FOR FEMALE STUDENTS IN THE FIFTH AND EIGHTH GRADES

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By
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CERTIFICATION OF APPROVAL

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Dr. Dawn Poole Professor of Educational Technology	Date
Dr. Susan M. Neufeld Professor of Education	Date

DEDICATION

This study is dedicated to my children Amelia and Xavier. I am proud to be your mother. Your generous hearts and curious minds are an inspiration to me.

Amelia, this study was for you. It is a tribute to your fierce, strong and determined nature. You will grow and change over the years, but always remember that young girl inside of you who knew she could change the world.

"Though she be but little, she is fierce" – William Shakespeare

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This study could have never occurred without all the women who were trailblazers in Science, Technology, Engineering and Math. It is because of you that this conversation about young women's future in STEM is even possible. I was lucky to be raised by one of you. Thank you Mom for being one of the only "girls" in Science class. You not only helped blaze the trail for my generation and your granddaughter's generation with the educational path you chose, you dedicated your career to educating the next generation of scientists as a teacher.

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ABSTRACT

The purpose of this study was to examine the social and educational factors impacting attitudes about technology for female students in the fifth and eighth grade. The survey was given to fifth grade students and eighth grade students in the same district in the central valley of California. Focus groups were conducted with both the fifth and eighth grade students in an attempt to gain a better understanding of the survey results. The results of the survey and focus groups showed that both fifth and eighth grade students felt comfortable in their ability to use technology and used technology on a regular basis. The fifth grade students expressed fewer negative stereotypes about people interested in technology. The fifth grade students reported greater excitement and interest in the idea of technology education and a future career in technology. A discussion of the result is presented, along with implications of the findings.

CHAPTER I

INTRODUCTION

STEM is a word often used in the media and by educators to describe education and jobs in the areas of science and technology. STEM is a relatively new concept in education first introduced in the early 2000s by the National Science Foundation (Duggar, n.d.). STEM stands for science, technology, engineering and math. STEM can be further explained in the relationship that is created between science, math, engineering and technology education. Science is the study of the natural world. Technology is the study of the alteration of the natural world to meet human needs and desires. Engineering is the use of math, science and technology to create products to benefit people. Math is the study of relationships and patterns. Math is the language used to explain and create technology, science and engineering (Duggar, n.d.). STEM is not a fleeting trend in education, or the news story of the day, it is a growing and important field of study and career path vital to the American and global economy. STEM classes can include anything from algebra and biology to robotics and computer coding.

STEM education is vital to the American economy and participation in the world market. Between 2010 -2020 the projected growth for jobs in the United Stated is 14%. The projected growth for STEM related fields is 16% to 62% (Science, Technology, Engineering, and Math Education for Global Leadership, n.d.). STEM careers include mathematics, natural sciences, engineering and technologies. (Chen,

2009). President Obama stated that American students must, "move from the middle to the top of the pack in Science and Math" (Science, Technology, Engineering, and Math Education for Global Leadership, n.d., para. 4). In 2013 the Executive Office of the President along with the National Science and Technology Council created a five year strategic plan to increase STEM education in schools. (STEM Education National Science and Technology Council, 2013).

The push for STEM education is evident in the programs and classes that are being offered in schools across the country. Schools are offering specialized programs, classes and clubs to recruit students into STEM education. Secondary school males are taking STEM classes and joining programs and clubs, while female students appear to be less interested in STEM classes than their male counterparts. Secondary school males and females are taking mathematics and biological sciences at a similar rate but females are falling behind in participation in physics and are 6 times less likely to enroll in engineering classes (State of Girls and Women in STEM, n.d.).

A number of organizations are concerned about our country's future in technology because of the lack of females in STEM and are creating incentives for young women to get involved in STEM classes. The National Girls Collaborative Project, National Math and Science Initiative, Women in Engineering Proactive Network, American Association of University Women, Association of Women and Science, The Clinton Foundation, and Women @ NASA are just a few of the national organizations creating opportunities, recruiting and researching best practices to

increase the number of young women in STEM classes. These organizations have significant deficits in the number of females in STEM to battle. Male students are over 3 times more likely to be interested in STEM majors and careers, compared to female students. (Startling Statistics, n.d.). Young women report that they do not feel that they are being encouraged to consider a career in STEM. More than half (57%) of all girls say that they don't typically consider a career in STEM. (Startling Statistics, n.d.). Not only are they not interested in STEM, young women are not being encouraged to consider STEM by their parents either. Twenty-one percent of girls say their parents encourage them to become an actress, while 10% of girls say their parents have encouraged them to think about an engineering career (Startling Statistics, n.d.).

Statement of the Problem

In elementary school 74% of female students report to be interested in math and science classes (Dockterman, 2014a). By the time these same young women have reached junior high and high school they have lost interest in STEM classes. Female high school students are higher achieving than their male counterparts across the core curriculum yet concurrently are choosing not to take computer science classes. Although females are higher achieving in almost every subject in high school they continue to fall behind in STEM classes; female students make up 54% of Advancement Placement test takers in 2012 but only 19% of the students who took the Advanced Placement Test in computer science were female (Ashcraft, Eger, & Friend, 2012). Something is happening in the educational lives of these young women

between the science and math minded elementary school students to high school students who are no longer interested in a STEM education. They are still leading the class in overall grades and participation but falling behind in math, science and technology.

These young elementary school scientists and mathematicians who lose interest in the subject throughout junior high and high school are unlikely to major in a STEM career in college. In 2011 females earned 57.3% of Bachelor's degrees but only 18.2% of computer science degrees, 19.2% of engineering degrees, 19.1% of physics degrees and 43.1% of math degrees (State of girls and women in STEM, n.d.). There are more women graduating from college but men continue on into STEM careers at even a higher rate in college than in high school. Women make up about half of the total U.S. college educated work force, but they represented only 26% of the college educated workforce in science and engineering occupations in 2008 (Startling Statistics, n.d.).

The lack of females in STEM classes and ultimately in STEM careers is not only a matter of gender equity but is a matter of global concern. Google is so concerned with the future of females in STEM, the company invested $50 million to teach young women how to code hoping to ultimately interest them in a career in computer science (Dockterman, 2014b). Google is educating young women because of the lack of women in their own company; only 17% of Google employees are women. More compelling are the number of jobs that STEM educated women are needed to help fill. By the year 2020, 1.4 million new computing jobs will be created

with only 400,000 computer science graduates. Of those 400,000 computer science graduates, only 12% are projected to be women (Dockterman, 2014b).

> At current graduation rates, we can only fill about 30% of those jobs with U.S. computing graduates. Young women bring great potential for filling this gap, yet to date, many factors dissuade them from choosing these majors and careers. Furthermore, women already employed in the technology industry are leaving at staggering rates. Failing to capitalize on this talent threatens productivity, innovation, and competitiveness. (Ashcraft, Eger and Friend, 2012, pg. 3, para 1)

Somehow over the course of an education the 74% of elementary school girls with an interest in science and math became a small percentage of women graduating with a STEM degree. The purpose of this study was to further explore what factors are influencing female students' lack of interest in technology and computer science.

Significance of the Study

By not facilitating young women's interests in technology we are losing the potential of half of the population in computer science. Apple employs women for 20% of technical jobs, and 28% of positions in leadership (Guglielmno, 2015). Twitter employs women for 10% of technical jobs, and 21% of positions in leadership. Microsoft employs women for 16.6% of technical jobs and 23% of positions in leadership (Guglielmno, 2015). These numbers show a very small influence of women on the technical community. The United States is not going to be able to compete in technology at a global level if more women do not join the

workforce in the field of computer science. Beyond not having enough employees to fill the growing need in the technology field, the absence of female workers takes the females' contributions and influence out of the largest growing field in the United States. The lack of female workers maintains the current status quo of a male dominated field creating male influenced products and workplaces that may in turn further alienate female contribution.

The field of technology may need young women to succeed but young women are not interested in becoming a part of that field. Why are young women not interested in technology? The answer to this question is the solution of how young women can be recruited into the STEM classes that will make it possible to major in computer science. But a more pressing question is the key to the answer. What happened to the young women in elementary school who were once interested in math, science, and technology? When did they lose their interest? What changes can be made in education to keep the interest of these young women?

It is important for teachers and districts to know what interests female students in the field of computer science in order to create curriculum that will successfully recruit female students into this field. The statistics are daunting and so may be the task of changing the attitude of young minds but it is essential to stay globally current in technology. It is vital to answer the question of why females are not participating in STEM to have the ability to answer how females can be successfully recruited into STEM classes. It is not just a matter of educational importance it is a matter of the United States' success in the global market.

Research Question

What are the social and educational factors impacting attitudes about technology for female students in the fifth and eighth grades?

Hypotheses

H1. As female students age from the fifth to eighth grade they are less able to identify with the computer scientist stereotype.

H2. As female students age from the fifth to eighth grade they are less likely to foresee themselves in computer science and technology classes or careers because female students identify computer science and technology as masculine.

H3. As female students age from the fifth to eighth grade they begin to perceive that computer science and technology curriculum are designed to appeal predominantly to male students. Female students begin to lose motivation to enroll in computer science and technology classes.

Theory

For the purpose of this study, female students' formation of personal identity and gender identity needs to be addressed. The school years are not only a time of education and learning, they are also a time when young women are exploring who they are and what it means to be female. Their identity is not only their individual uniqueness it is also an exploration of their sameness within their social group and their gender.

Albert Bandura's Social Learning Theory explains that children learn appropriate and socially acceptable behavior by both observing and evaluating the

behaviors of the people around them, actions are managed by likely consequences (Bandura, 1977). Children watch, encode, and imitate the behaviors of the people in their daily lives such as their family, teachers, peer group and even the characters on their favorite shows. Children tend to repeat behaviors when they receive positive reinforcement and notice what behaviors other children receive positive reinforcement for (Bandura–Social Learning Theory, n.d.).

Young people are not only learning about their personal identity but they are also forming ideas about what it means in their culture to be a man or a woman. Sandra Bern introduced the idea of Gender Schema Theory. Gender Schema is an explanation of how children form their gender identities based on what they perceive as the societal norm for male and female traits, a system of observations that determine and guide behavior (Bern, 1981). Like Bandura, Bern theorized that children are making constant observations of the people around them and changing their behavior based on what they understand to be socially acceptable. As children are forming their gender identity, they are observing the physical differences between genders, societal roles, distinguishing traits of each gender, and how each gender is treated by society (Cherry, 2015).

Female students as they mature from young girls to young women are forming their identity of who they are and what it means to be female. As this identity forms they start to separate themselves from areas in education and career preparation that they consider male or masculine. Many young women can no longer identify with the stereotypical computer programmer. They do not relate to being Steve Jobs or

Bill Gates when they grow up. They are no longer wanting to participate in male dominated computer classes. They do not consider it feminine to create robots and program. Many female students are not motivated by the curriculum presented in the computer classes offered at their schools. It does not appeal to them and they cannot identify with it. Female students are exploring their place in education based on their understanding of their identity, what it is a female student should do, and what motivated them to learn.

Summary

STEM, the study of science, technology, engineering, and math is a growing area of education that is vital to a growing American economy and workplace. Female students report high levels of interest in STEM education in elementary school. By the time female students leave junior high school their interest and participation in STEM courses dwindles at alarming rates. The focus of this study was to explore why female students are losing interest in STEM education.

CHAPTER II

REVIEW OF LITERATURE

Children are growing up surrounded by technology. They live in homes with computers and internet service, they go to school and complete work on computers, and many have parents who work with technology or in a technology related field. Those young children begin school excited about technology. They have dreams of being scientists, engineers, and computer programmers, but then something happens during their educational career. Those same children who were once excited about science and technology in elementary school begin to lose interest in middle school and continue to lose interest through high school. This is a phenomenon many researchers refer to as the "leaky pipeline" (Sadler, Sonnert, Hazari, & Tai, 2012). This phenomenon is particularly prevalent among middle school and high school females. The trend is troublesome for women in technology fields. As the demand for computer scientists continues to rise the number of females pursuing a computer related career declines (Papastergiou, 2008). Research is being conducted to try to find out why females are choosing not to take computer science classes and what drives their lack interest in entering careers in technology. Researchers have studied female perceptions of computer science classes, stereotypes of computer scientists, and career choices in computer science.

Female Perceptions of Computer Science Classes

Sainz and Lopez Saenz (2010) studied the attitudes of males and females towards computer science. They studied students' attitudes based on a variety of influences in the students' lives: rural vs. suburban, social class, and parents' occupations. They surveyed the students' cognitive, behavioral and affective attitudes towards computer science. The participants consisted of 550 secondary students, 252 males and 298 females, with a mean age of 15 in the country of Spain. The students were from a variety of socioeconomic backgrounds (42% rural and 58% metropolitan) with future interests ranging from technology (34%), nature and health (34%), humanities and social science (16%), the arts (12%) to no further educational plans (3%). A majority of the students studied (88%) had a computer at home.

The researchers collected all of their data through a survey. They surveyed participants on outside influences in their lives with questions about sociodemographic, father's type of job, and whether or not their mother worked outside the home. The cognitive influence was surveyed using 17 questions. The students' answers ranged from complete agreement to complete disagreement. The affective influence was surveyed with two questions about comfort and enjoyment using computers. Behavioral influences were measured by students recording their daily and weekly computer use. The main effect on gender was affective influence (F (1,521) = 14.531, p <.001) and behavioral influence was (F (1, 519) = 10.666, p <.001). Males reported more positive feelings towards technology than females and used computers more frequently. The students were finally asked if they had intended

to pursue a career in the computer sciences. The researchers concluded that males overall spent more time engaged with computers than females and found females who scored the lowest on all the questions that reflected positive attitudes about computer science

Beyer (2014) studied what influences female students to take computer science classes. Beyer based her research on the theory that influences such as stereotypes of computer scientists, and previous classroom experiences influence the students' confidence in how successful they would be in computer science classes. Female students are more likely to believe that they lack natural ability in computer science and other male dominated fields. They tend to have less computer experience than male students and are exposed to computers at a later age. Beyer wanted to gain a greater understanding of the gender differences that exist in connection to computer science. In studying the difference that exist between male and female students Beyer hoped to develop strategies for best recruiting practice for female students to encourage enrollment in computer science classes. The participants were 1319 (872 female and 447 male) first year students at a small liberal arts college in the Midwest.

The students in the study were given a survey to determine stereotypes about computer science, experiences in computer science classes, computer experience and self-efficacy, and personality variables. Female students reported that they looked to careers that provided opportunities to help others, the ability to interact with coworkers and the freedom to combine career and family ($F(1,1251) = 38.59$, $p < .0001$). More female than male students considered careers based on the availability

of job opening in the field ($F(1,1247) = 25.47$, $p < .0001$). Female students evaluated their computer skills much lower that male student evaluated theirs to be ($F(1,1264) = 87.35$, $p < .0001$) and reported they were much less likely to take a computer science class in the future ($F(1,720) = 35.79$, $p < 000.1$). Beyer concluded that the social psychological variables that influence why female students are not taking computer science classes need to continue to be studied. Underrepresentation of females in computer science is not unavoidable but needs further attention to solve.

Female Perceptions of Stereotypes of Computer Scientists

Mercier, Barron, and O'Connor (2006) were interested in studying students' perceptions of technology users and how these stereotypes influenced their own feelings about technology. The researchers wanted to attempt to find out the relationship between students' engagement with technology and their perceptions of what it means to be experienced with technology. The researchers hypothesized that there would be greater disparity of perceptions within gender groups than there would be between the genders. The students' self-perception would be based on their own experiences and access to technology as well as the influence of the values of technology in their homes, schools, and community. The participants in the study were middle school students from two Northern California schools. The students studied included 145 sixth graders and 160 eighth graders. The sixth graders were interviewed in the fall as they began middle school and the eighth graders were interviewed in the spring as they prepared to leave middle school.

The students filled out a survey and participated in interviews. The students were asked about home access to technology, their personal educational history with technology, and their interest in technology. Students were asked to imagine someone who is really interested in technology and draw what this person might look like. The drawings were then coded for description of characteristics of personality, clothing, and gender. The most common drawing among the students was a male wearing glasses. Both male and female students were more likely to draw a male, 21% of the female students drew a female and 60% drew a male, while 6% of the male students drew a female and 56% drew a male. The 6th grade students were more likely to draw a female. A majority of students, 78% of the males and 75% of the females believed that there was a personality type for people who were interested in technology ($F(1,74) = 51.98$, $p < 0.05$). A computer type person was described as knowledgeable about technology and devoting a lot of time to computers. Both genders exhibited confidence in technology use if they identified themselves as a computer type person, ($F(2,64) = 6.27$, $p < 0.01$). Female and male students identified themselves as computer type people at a similar rate.

Friend (2015) studied the underrepresentation of females in computer science related fields and majors. Based on previous research Friend looked at whether or not males' earlier experiences with technology, the stereotype of computer scientists as male, nerdy and anti-social, and lack of role models influence females' desire to pursue a career in computer science. The participants in Friend's study were 71 eighth graders attending an all-female school in the Silicon Valley. The Silicon

Valley is known for its technology industry where many of the females' parents worked. All of the participants had completed three years of classes in computer science in which their computer science teachers were also female. Friend chose the school to be included in her study because of the unique background of the students and the large presence of female computer scientists in their lives.

Friend (2015) collected data by survey. The survey was given at the end of the school year. The questions on the survey asked about motivation to take technology classes, prior experience and access to technology, availability of technology resources for learning, and identification with perceived traits of computer scientists. The students were asked how often they participated in computer related activities, the depth of their computer experiences, and if they could envision themselves in a computer related field. They were asked to express their feeling on confidence, interest and value of their computer skills. Friend found that 35% of the students noted some interest in a career in the computer sciences with only 6% reporting a definitive yes to wanting to have a career as a computer scientist. Students who were interested in a computer science career were more confident in their technological abilities, were more likely to have parents in computer science careers, and were more likely to have other adult mentors in the field ($t(65) = 2.39$, $p = .02$). Students who were interested and not interested in the field of computer science used similar vocabulary to describe the computer science field and attributes of a computer scientist ($t(68) = 2.75$, $p < .01$). Friend concluded that perception of the field and its participants were not a factor of influence on the students.

Master, Sapna, and Meltzoff (2015) studied stereotypes of computer scientist and whether or not stereotypes influenced the enrollment of females in computer science classes. The stereotype of a computer scientist was defined by the researchers as someone who is male, technologically oriented, and socially awkward. He lives and works in isolation and is not involved in working towards communal goals. The researchers looked at the influence of academic environment in order to better understand its influence on female students. The academic environment was tested for influence of stereotypes on students, how the design of the classroom influences student interest and what can be changed in current classroom environments to move away from the influence of stereotypes. The data were collected from 165 students at two high schools in the Northwest United States. The participants were approximately half male and half female students.

The students studied were shown photos of two potential classrooms in which to participate in a computer science class. The classrooms had the same teacher, curriculum and students. The difference between the classrooms was the physical environment of the classroom. One classroom was a standard, stereotypical computer science classroom decorated with Star Wars/ Start Trek items, video games and computer parts. The second classroom was filled with nature pictures, art, lamps, and plants. The results showed that there was a significant difference in choice based on gender (x^2 (1, N=146) = 6.34, p = .12). Females chose the non-stereotypical classroom 68% of the time as compared to 48% of males. Females were significantly more interested in taking a computer science class if it was to be held in the non-

stereotypical classroom ($F(1,145) = 9.11$, $p = .003$, $d = .36$). Females reported significantly more concerns about the stereotypical computer science class than males. The researchers found a significant influence of environment on female students' desire to participate in a computer science class and more specifically the negative influence of computer science stereotypes felt by female students.

Female Perception of Careers in Computer Science

Fuller, Turbin and Johnston (2013) studied a program called Computer Club for Girls (CC4G). The purpose of their study was to further understand what they determined were major reasons females were underrepresented in Information Technology (IT) careers and if a club designed to give females access to technology would interest females in IT careers. The researchers were looking at the club to determine how females participated in computer related activities, what influenced females to be interested in IT careers, and if a females-only computer club could change how females felt about a future in IT. The participants in the study were females ranging from 14 to 16 years old. They all were in enrolled or previously enrolled in CC4G, a free females-only computer club available to female students in South east England. The club was designed to appeal to females by creating activities that were considered to appeal to feminine interests. The creators of the CC4G wanted to have a female-friendly environment where females could explore computer programs without the influence of their male classmates.

The data collected were a mix of interviews and data analysis done in three stages. In Stage 1, 20 participants were interviewed. The results of the interview

determined how the researchers would proceed with the interviews and surveys in Stage 2 and 3. In Stage 2 a questionnaire was distributed to 166 current and 89 past club participants. The results were recorded and organized using spreadsheets. In Stage 2 the researchers also observed and conducted staff and group student interviews at nine different school sites. In Stage 3 solo interviews were conducted with 54 first year and 41 second year club members. The study found that although the females were attracted to and enjoyed a female computer club it did not change how they perceived themselves in a future IT career. The participants reported being more interested in computers than in the past (88%) and having a clearer understanding of IT careers and what they entailed (79%). The participants concluded what they would definitely need and use IT skills in future careers, but most of the club members were not specifically interested in IT careers.

Sadler et al. (2012) studied high school students' interest in STEM careers. They conducted a study to find out how high school students begin to form career choices and more specifically how they become interested or disinterested in a STEM career. The researchers felt that research on high school career choice was a vital piece of information missing when studying students' educational path. The study looked at whether or not career interests stayed stable over the course of high school and whether or not a fluctuation in career interest varied by gender. The study was a retrospective cohort study of students who were in the first year of college. The researchers collected information from 6,860 students in mandatory English classes.

The researchers used a 50 item survey to collect data. The survey questions were intended to help the researchers understand what career interests the students had at the beginning and end of high school. The researchers found that at the beginning of high school 39.5% of males and 15.7% of females were in interested in STEM careers at a rate of 2.5 to 1. By the end of high school 39.7% of males and 12.7% of females were interested in STEM at a rate of 3.1 to 1. During the high school years the researchers found that 12% of the males that were originally interest in STEM were no longer interested at the end of high school, while 12% of males that were not interested in STEM careers in the beginning of high school were interested in the end of high school. Female students interested in STEM from the beginning to end of high school had a 9% loss and only a 6% gain leaving female students with an overall 3% loss in interest. At the end of high school, the students who were interested in STEM careers were 75% male and 25% female.

Papasterigiou (2007) studied the career choices high school students were beginning to make regarding future computer science careers. The researcher was interested in the circumstances that influence those career choices. Papasterigiou was specifically interested in the influence of career choices based on gender in an attempt to explain the underrepresentation of women in computer science. The researcher believed that if she understood what influences females' career choices she could better understand what can be done to influence more young women to consider a career in computer science. The study followed 358 high school students (177 males and 181 females) in Greece.

Data was collected by questionnaire. The students were asked six questions relating to their background, future career choices and attitudes about computer science. The results were analyzed using descriptive statistics. The researcher found that 16.5% of the students were interested in computer science which included positive responses from 37.9% of the males and 11.7% of the females ($\chi^2 = 21.4$, $df = 1$, $p < .001$). Males reported that a career in computer science would be interesting, respected, innovative and lucrative, while females reported that a career in Computer Science would be challenging and dull. The majority of the students surveyed did not believe that a career in computer science would be more likely or appropriate for one gender versus the other ($t(356) = 6.74$, $p < .001$).

Koch and Gorges (2012) studied the effect that an after school program called Build IT (Industrial Technology) would have on female students and teachers attitudes towards future careers in the technology field. The researchers were concerned with the current lack of women in technology in the United States. Computer careers are the fastest growing field in the United States with women holding less than a quarter of those jobs, with Latina and African American women holding even fewer. The researchers were motivated to explore whether or not creating curriculum that reflected the interests of female students would increase the students' positive perception of computer science. The Build IT curriculum was designed to develop computer literacy, increase interest in mathematics and create awareness of the careers in technology.

The researchers focused on both the experiences of the teachers and students in the program. The researchers used mixed method to evaluate the program. The teachers and students were observed, interviewed and given surveys. The researchers found that the program effectively changed female students' perspectives about technology and motivated the students to further explore technology. Both the students and teachers reported an increase in computer use and increased comfort with technology. In addition the teachers reported increased confidence in capability to teach technology skills and increased confidence in the ability to build curriculum around technology in way that would appeal to their female students.

Robnett and Leaper (2012) studied how friendship groups influence adolescents' future career interest in STEM. Concerned at the critical shortage that the United States will soon experience in people with training in the STEM fields the researcher wanted to study what influences adolescents' academic choices. The researchers felt that identifying what factors support adolescents' interest in future STEM careers is critical to solving the potential shortage in the STEM fields. The researchers based their work on the expectancy-value theory which explains that students are motivated to succeed in the areas in which they feel that they are expected to achieve and that they give value to. Using this theory Robnett and Leaper theorized that adolescents would look to the academic values and interests of their peer groups when weighing their future career options. The researchers studied students from five high school in Northern California from both Advanced Placement

and regular classes. They had 468 participants (204 male and 264 female) ranging from ages 13 to 18 from diverse ethnic backgrounds.

The students were asked to complete a survey called "What it Means to be a Student". The questions in the survey focused on the student's backgrounds, peer group characteristics including friendship groups, academic self-concepts, and academic achievement. The results showed a significant influence on individual choices from peer groups, especially for female students. There was a significant three way interaction between Science Value, Group STEM Climate and Group Importance. The interaction was especially strong when studying the influence of the student group values ($\beta = 1.04$, $p < .001$). As friendship group value of STEM increases the individual interest in STEM increased ($\beta = .46$, $p = .039$). The female students were less like to be interested in STEM careers and all of the females in the sample who valued STEM reported a low proportion of female friends.

Summary

The research on female perceptions of computer science is consistent across the studies. Female students begin elementary school with a high interest in science and technology but by middle school, female students are generally not interested in computer science classes. Not only are the majority of female students not interested in computer science at a middle school or high school level, most do not go on to college with an interest in pursuing a career in computer science or technology. The majority of female students do not identify with the qualities they relate to being a computer scientist. They do not necessarily see computer science as a career for

males only, they are just not interest in computer science for themselves. I feel that it is valuable to find why this disconnect to computer science is happening as females advance in their school career. It is important to find out what factors are influencing the change in interest in computer science from enthusiastic elementary school students to disinterested high school students. Further research is needed to help understand the disconnect that happens to female students in between elementary school and secondary school.

CHAPTER III

METHODS

The purpose of this study was to explore the attitudes of young female students at the fifth and eighth grades in relation to computer science classes, technology use, and the possibility of future careers in a technology related field. The participants were female students attending elementary and middle schools in the Central Valley of California. The students' attitudes about technology, computer science classes and the possibility of future careers in tech-related fields were explored first through surveys and then followed up with several focus group interviews to discuss the results of the surveys.

Sample

The students chosen for this study were from fifth grade and eighth grade classes from a single school district in the Central Valley of California. The city in which the school district resided had a population of 71,248 residents (Census, 2014). The population of the city was 52.8% Caucasian, 36.4% Hispanic, 5.6% Asian and 1.7% Black. Many residents, 44.3%, spoke a language other than English at home. In the city, 22.9% of residents had earned a Bachelor's degree or higher and 80.7% of residents had earned a high school degree or equivalent.

The school district was comprised of nine elementary schools, two middle schools, two high schools, one alternative high school and one K-12 charter school. The district enrollment included 1000 fifth graders and 999 eighth graders

(Ed-data, 2014). Children living below the poverty level made up 27.1% of the population (City data, 2013). The school district offered free and reduced lunch to 63% of its students (CDE, 2015).

The students in this study were chosen from seven elementary schools and both middle schools in the school district. The schools were organized and labeled A to K based on the percentage of students who received free and reduced lunch (CDE, 2015). Before schools to be studied were selected, two schools, School I, a math and language arts academy, and School E a dual immersion Spanish/English school were removed from consideration because of the specific foci that those schools addressed with their students. The schools that were selected from the remaining elementary schools were the elementary schools A, B, C, D, F, G, H, and middle schools J and K.

Before teachers could be asked to participate, the study had to be approved by the district. The study was first reviewed after an application was submitted to the Assistant Superintendent. After the Assistant Superintendent approved the application it was then approved by an executive cabinet. Principals at each of these schools noted above were invited to have their school participate in the study. Teachers at the schools who received their principal's permission to participate in the study were contacted.

All fifth grade teachers from participating schools were contacted and asked if they would be willing to allow their female students to participate in the study. The eighth grade classes were chosen from all English Language Arts (ELA) classes attended by eighth graders at the middle schools J and K. All eighth grade ELA

teachers were contacted. All students of teachers who responded to the request to participate, and who completed the required consent form, participated in the survey.

Table 1

Schools Invited to Participate in the Study

School Name	% Free and Reduced Lunch	Included in Study
Elementary School A	96.7%	Yes
Elementary School B	92.9%	No
Elementary School C	85.5%	Yes
Elementary School D	73.3%	Yes
Elementary School E	66.3%	No
Elementary School F	57.7%	Yes
Elementary School G	55.3%	Yes
Elementary School H	43.8%	No
Elementary School I	22.7%	No
Middle School J	63.3%	Yes
Middle School K	64.6%	Yes

The focus group students were selected by their teachers. Teachers were chosen based on their willingness to have students participate in focus group and availability of their students on the days selected for focus groups to be conducted. Teachers selected 4 to 5 girls from their classroom they felt were good candidates for

a focus group. Teachers were asked to pick students with diverse academic strengths and weaknesses. The diverse strengths and weaknesses were determined by the teacher and not through formal assessment.

Method

The study was a mixed-methods research design using both survey and grounded theory research. The data were collected via survey with follow-up interviews with two fifth grade and two eighth grade focus groups. Focus group interviews were conducted to get reactions to the results of the female students' survey responses in order to continue to explore the subject and increase understanding of the female students' views.

The study was approved by the CSU Stanislaus Institutional Review Board. The study took place in the spring semester of 2016. The survey was conducted over a three week period. The survey results were tabulated and the results were part of the focus groups discussions. The focus groups took place over a two week period of time.

Focus Groups

The four focus groups were selected from among the students surveyed. The focus groups were each made up of four to five students. Two of the focus groups were made up of fifth graders from schools F and G. The other two focus groups were made up of eighth graders from schools J and K. The purpose of the focus groups was to further explore the results of the survey. The focus groups lasted approximately 20 minutes and were audio-recorded. Each focus group was asked the

same set of question. The conversations focused on the students' reactions to the results.

Instruments

Survey

The students were given a three-part survey. The survey was conducted in class in a paper and pencil format and took approximately 15 minutes to complete. In the first part of the survey, the students were given a series of 10 adjectives relating to technology, such as "nerdy" and "interesting". The students responded to the survey on a five-point Likert Scale. The options ranged from "strongly agree" if they felt the adjective strongly related to technology to "strongly disagree" if they felt the adjective did not relate to technology at all. In the second part of the survey, the students were asked to answer questions that related to interest, access and experience (Barron et. al. 2010) with technology. The questions focused on interest in using technology, prior experience, identity of someone interested in technology and potential future career in technology. The second part of the survey included a five-point Likert Scale to address interest. The options ranged from "strongly agree" to "strongly disagree". When asked about access and experience the students responded to the statements with four options ranging from "never" to "more than 6 times." The last part of the survey addressed the type of technology the students used at their home and in school. It included an inventory of what types of technology and internet services the students had access to in their daily lives. The students checked the boxes next to the items on the list that they had access to. The surveys were

administered by the classroom teacher over a two week period near the end of the third trimester of school. (See Appendix A)

The survey was based on a survey created by Barron, Walters, Martin, and Schatz (2010) and used in survey research in 2002, 2004, 2006, and 2010 to survey middle school students about technology. The survey was used by Friend (2015) to survey female middle school students. The survey was modified for the purpose of this study to meet the ability levels of both fifth and eighth grade students. A Cronbach Alpha was run on the results of the survey. The scores for fifth and eighth grades were .74 and .66 respectively.

Focus Groups

The four focus groups were selected from among the students surveyed. The focus groups were each made up of four to five students. Two of the focus groups were made up of fifth graders from schools F and G. The other two focus groups were made up of eighth graders from schools J and K. The purpose of the focus groups was to further explore the results of the survey. The focus groups lasted approximately 20 minutes and were audio-recorded. Each focus group was asked the same set of question. The conversations focused on the students' reactions to the results.

Data Analysis

Data were entered into the Statistics Package for the Social Sciences, v. 23.0., and a Chi Square test of Independence was run for each of the survey questions to determine whether or not there were differences in the responses between the fifth

and eighth grade students. An alpha level of .05 was used for all analyses. Further analyses were run to find connections between how students rated their academic abilities or languages spoken affected how they answered survey questions. The focus group discussions were transcribed and the answers were coded to look for similarities and differences in responses for the fifth and eighth grade students.

Summary

All of the information from the survey and focus groups was gathered and organized in order to make connections between what factors influence of the attitudes of the fifth grade students and what factors influence of the attitudes of the eighth grade students. The analysis will be further explored in Chapter IV.

CHAPTER IV

RESULTS

The purpose of this study was to explore the changing attitudes of female students in relation to technology. It is crucial for both the fields of education and technology to understand how to create curriculum that will appeal to female students and influence them to enroll in technology classes in greater numbers. Surveys were used in order to gain understanding of the social and educational factors impacting attitudes about technology for female students in the fifth and eighth grades. Some students' attitudes were explored deeper in focus groups focusing on the results of the survey.

Findings

H1. As female students age from the fifth to the eighth grade as they are less able to identify with the computer scientist stereotype.

Fifth and eighth grade students were asked to rate vocabulary that may or may not describe people who are interested in technology. They were asked to rate the words on a five point Likert scale from strongly agree to strongly disagree. The words *fun* (χ^2(4, N = 146) = 18.92, p = .001), *friendly* (χ^2(5, N = 147) = 21.70, p = .001), and *serious* (χ^2(4, N = 146) = 10.87, p = .028) showed significant differences based of grade level. The majority of fifth graders agreed that the words *fun* and *friendly* were good descriptions of someone who is interested in computers and disagreed that *serious* was a good description. The majority of eighth grade students

neither agreed nor disagreed with the descriptions. The words *smart*, *interesting*, *nerdy*, *gamer*, *quiet*, *creative* and *awkward* showed no significant differences based on grade level. See Table 2 for the distribution of responses.

Table 2

Survey Results Indicating How Well Each Word Describes Someone Interested in Computers and Technology

	M 5th Grade	*M* 8th Grade	χ^2	*p*
Creative	4.04	3.80	4.20	.38
Friendly	3.97	3.38	21.70	.001
Smart	3.93	3.77	2.86	.42
Fun	3.80	3.22	18.92	.001
Interesting	3.75	3.47	8.76	.07
Gamer	3.55	3.69	6.32	.18
Serious	3.21	3.07	10.87	.03
Quiet	3.08	3.06	3.73	.44
Nerdy	2.80	3.17	4.72	.32
Awkward	2.38	2.60	1.85	.76

When speaking about people interested in technology during focus group interviews, both fifth and eighth grade students used similar vocabulary. The words "smart" and "intelligent" were used in every conversation when describing personality traits of a computer scientist. The word "nerdy" was used as a description

by both eighth and fifth grade students, but eighth grade students used the word 3 times more than fifth graders. The students in both the fifth and eighth grades both described someone who was serious and introverted. The description of "glasses" was mentioned in 38% of the responses, and "button – up shirt" or "lab coat" was used in 44% of the students' responses. When describing someone interested in technology not one eighth grade student described someone who was potentially female. As a group, 40% of the descriptions did not identify a gender, 45% of the descriptions were of a male, 10% of the descriptions were specified as potentially male or female and only one student (5%) described a female when discussing a person who might be interested in technology.

H2. As female students age from the fifth to eighth grade they are less likely to foresee themselves in computer science and technology classes or careers because female students identify computer science and technology as masculine.

Fifth and eighth grade students were asked to rate how much they agreed or disagreed with each statement about how much they enjoyed and felt comfortable working with computers. They were asked rate the words on a five point Likert scale from strongly agree to strongly disagree. The *statements learning what computers can do is fun* (χ^2(5, N=147) = 19.37, p = .002), *computers are interesting to me* (χ^2(4, N=147) = 10.12, p = .035, and *I would like to learn more about computers* (χ^2(4, N=148) = 11.27, p = .024) showed significant differences based on grade level. Fifth grade girls were more likely to have a favorable opinion. The *statements I feel confident about my abilities to use computers, I find working on computers difficult, I*

am good with computers, and *it is important that I know a lot about computers* showed no significant differences based on grade level. The majority of both eighth grade and fifth grade students agreed that they were *good with computers.* Eighth graders were more likely to report that they were *confident* with computers and fifth graders were more likely to report that computers were *important*. In all of the scenarios a large number of the eighth graders reported neither agree nor disagree. See Table 3 for the distribution of responses.

Table 3

Survey Results Indicating how much a student agrees or disagrees with a statement

	M 5th Grade	*M* 8th Grade	χ^2	*p*
Computers are interesting to me	3.88	3.36	10.17	.04
Learning about what computers can do is fun	3.66	3.57	19.36	.002
I feel confident about my ability to use computers	3.64	3.57	6.27	.18
I would like to learn more about computers	3.61	3.54	11.27	.02
It is important that I know a lot about computers	3.48	3.42	1.09	.90
I am good with computers	3.34	3.22	2.07	.72
I find working on computers difficult	2.52	2.75	2.14	.71

H3. As female students age from the fifth to eighth grade they begin to perceive that computer science and technology curriculum is designed to appeal predominantly to

male students. Female students begin to lose motivation to enroll in computer science and technology.

Fifth and eighth grade students were asked to rate how likely they were to see themselves participating in computer science activities or education in the future. They were asked rate the possibilities on a five point Likert scale from strongly agree to strongly disagree. The fifth grade students had a more favorable opinion about the future possibilities in a technology related field. The future possibilities of *becoming a computer teacher* χ^2(5, *N*=148) = 12.66, *p* = .027, *becoming a computer game designer* χ^2(4, *N*=148) = 26.82, *p* = <.001, *working on computer projects* χ^2(4, *N*=146) = 13.62, *p* = .009, *going to a computer summer camp* χ^2(4, *N*=148) = 9.73, *p* = .045, *joining a robotics or coding club* χ^2(4, *N*=148) = 10.43, *p* = .034, and *majoring in computer science in college* χ^2(4, *N*=148) = 23.44, *p* = <.001 showed significant differences between grade level. The possibility of *taking a class about computers* showed no significant differences between grade levels. With the exception of working on computer projects eighth graders disagreed or strongly disagreed with all of the listed future possibilities with computers. In sharp contrast, fifth grade students agreed or strongly agreed with all the future possibilities with the exception of *summer camp* and *becoming a computer teacher*. See Table 4 for the distribution of responses.

Table 4

Survey Results Indicating interest in future technology related careers

	M 5th Grade	*M* 8th Grade	χ^2	*p*
Working on computer projects	3.77	3.18	13.62	.009
Becoming a computer game designer	3.07	2.03	24.42	<.001
Joining the robotics or coding club	3.01	2.44	10.43	.03
Taking a class about computers	3.00	2.89	2.49	.65
Majoring in computer science in college	2.97	2.07	23.44	<.001
Going to a computer summer camp	2.41	1.94	9.37	.05
Becoming a computer teacher	2.37	1.78	12.66	.03

Fifth and eighth grade students were asked to report how often they have participated in computer related activities. They were asked to report whether or not they participated in the activities 0, 1-2, 3-6, or more than 7 times. The activities including *created a presentation using a computer* (χ^2(3, *N*=147) = 48.56, *p* = <.001), *made a publication like a newsletter using a computer* (χ^2(3, *N*=146) = 9.60, *p* = .022), and *used a social media site* (χ^2(3, *N*=147) = 22.01, *p* = <.00)1 showed significant differences between grade levels. Eighth grade students were much more likely to have used *social media, created a computer publication* or *made a computer presentation*. The activities including *written a computer program using computer language, created my own blog and discussion online, created a website, created a piece of art or music using a computer, built a robot or created an invention using a*

computer, *created a movie or animation using a computer*, and *created a computer game* showed no significant difference between grade levels. Both eighth and fifth grade students had very little experience using computers outside of social media or the classroom to create a creative project, program, use robots, or engage in gaming. See Table 5 for the distribution of responses.

Table 5

Survey Results Indicating the Number of Times Students Participated in an Activity

	M 5th Grade	*M* 8th Grade	χ^2	*p*
Use a social media site (Facebook, Instagram, SnapChat, Vine, Twitter)	2.64	3.56	22.01	<.001
Created a presentation using a computer (Power Point, Google Slide)	2.15	3.43	48.56	<.001
Created a piece of art or music using a computer	2.15	1.89	4.75	.19
Written a computer program (code) using computer language	1.69	1.43	3.07	.38
Created a movie or animation using a computer	1.57	1.83	2.93	.40
Created a computer game	1.39	1.25	2.39	.50
Created my own blog or discussion online	1.37	1.54	4.60	.20
Built a robot or created an invention using a computer	1.36	1.25	0.96	.81
Made a publication like a newsletter, using a computer	1.33	1.74	9.56	.02
Created a website	1.25	1.29	1.40	.71

Summary

As a group, eighth grade students were more likely to have computer experience than fifth graders. Fifth grade students were more likely to have positive

feelings about technology and could see themselves using technology according to both survey responses and focus groups. Eighth graders chose neither agree nor disagree on the majority of responses. Eighth grade students both in survey responses and focus groups had few strong opinions to share on the subject of technology interests and chose to remain neutral. The strong opinion eighth graders did express was their lack of interest in pursuing a future career in technology.

CHAPTER V

DISCUSSIONS AND RECOMMENDATIONS

Overview

This study was designed to explore the thoughts, feelings, and opinions of female fifth and eighth students about technology users, technology education and the possibility of a future career in a technology related field. The students were given a survey and focus groups were conducted based on the results of the survey. The opinions of the fifth and eighth grade students often differed but common themes also emerged between the two groups. The research results told a story of change between the bold and carefree opinions of the fifth grade students to the guarded and more careful opinions of the eighth grade students.

Summary of Results

A survey was conducted of 75 fifth graders and 72 eighth graders, all female, who were all students in the same district in the Central Valley of California. The students were surveyed in an attempt to have a better understanding of female students' attitudes towards technology and how their attitudes change as students age from the fifth to eighth grade. Four subsequent focus groups from among survey participants were conducted to discuss the results of the survey. The focus groups included two groups of four students each of eighth graders and two groups of four students each of fifth graders. In both the survey and focus groups, fifth grade students had a more positive view about technology and the possibility of a future

career in the field. The eighth grade students presented more neutral opinions. They appeared to express fewer strong feelings about technology or a future career in technology. They regularly communicated that their opinion was choosing not to express an opinion. But, after looking more thoroughly at each item surveyed and dissecting the language of the focus groups, the opinions of the eighth graders told a more complex story.

Discussion

The female students in this study represented two grade levels, across a variety of socioeconomic and ethnic backgrounds, languages spoken and academic ability. They were tied together by a common thread; they were all part of what is most commonly called Generation Z. They are the first generation of true digital natives and have never lived in a non-digital world (Hawkins, 2015). Generation Z makes up 25% of the US population (Hawkins, 2015). They have grown up in a post-9/11 world and many of their families have endured the economic hardship of the Great Recession (Hawkins, 2015). Unlike the Millennials who came before them and grew up in a time of economic boom and relative peace (Williams, 2015) or their Generation X parents who grew up as the first generation of divorce and latchkey kids but never participated in an active shooter drill or worried about terrorism (DeMarco, 2004), Generation Z is existing in a time unlike any other in the past. Their lives are influenced by fears and uncertainty in the world around them, looming ecological crisis, economic instability and the constant influence of technology. They are more educated, worldly and accepting than any generation before them (Williams,

2015). Generation Z has been categorized as "conscientious, hard-working, somewhat anxious, and mindful of the future" (Williams, 2015). At the same time they refuse to be defined. They don't want anyone to label who they are as a generation and are quick to distrust the ideals of anyone over the age of 20 (Kingston, 2014). This dichotomy of technological savvy and the refusal of being defined were evident when studying female students' attitudes towards technology.

The eighth grade students in both the survey and focus group wanted to present themselves as neutral, never judging and not wanting to be labeled. "You can't blame a neutral party", an eighth grade student expressed during a focus group when asked why eighth grade students often stated that they neither agreed nor disagreed with a statement in the survey. "I think it is easy to be neutral" said another student. Another summarized the survey results as "We just don't want to offend someone or stereotype someone…We just marked neutral." At first glance the eighth grade students did appear to be taking a neutral stance on the survey as a whole and specifically on the description of a person interested in technology. The eighth grade students answered neither agree nor disagree at the rate of 28% on questions about current interest in computers, 20% on questions about future possibilities of future use of computers and computer related careers and 36% on adjectives that may be used to describe someone interested in technology. But on further examination there were opinions to be extracted from their survey and conversations.

The eighth grade students spoke of neutrality but their true opinions began to emerge on the survey items that listed adjectives describing someone interested in

computers and technology and further discussion in focus groups. As Mercier, Barron and O'Connor (2006) concluded in their study, the eighth grade students had a preconceived personality type for people who were interested in technology. They believed the adjectives *smart* and *creative* described people interested in this field. Fifty percent of the eighth grade students agreed or strongly agreed with the adjective *smart*, and 67% of students agreed or strongly agreed with the adjective *creative*. When asked about the adjective *serious*, 45% of eighth graders disagreed or strongly disagreed the description fit a person with this career interest. In focus groups they used the adjectives "nerd", "nerdy", "intelligent", "smart", and "a mess" to describe someone interested in technology. They described someone who was anti-social, disheveled, and working alone. The students most often described this person as a man and never as a woman. The eighth grade students' answers changed dramatically when they were asked to describe someone interested in technology who was female. The fictional female who was interested in technology was "creative", "designing things", "animator", and "into art and a lot of tattoos." Unlike the fictitious and potentially male person whose description produced groans and giggles from the focus group, the female was exciting and interesting. One student described the fictional female by pointing to another girl in the room and explained "In the future, she is the girl….She would probably be more successful than any guy."

When asked about their current interest and confidence relative to technology, the eighth grade students marked *neither agree or disagree* 28% of the time. As with the list of adjectives, the eighth graders answers were often neutral. But, a few

opinions were evident. Students reported 47% of the time that it was important to learn more about computers, 65% of the time that they felt confident using computers, and 50% of students thought computers were interesting. In focus groups the eighth graders explained that they were confident in using computers because they use them on a regular basis. Fuller, Turbin and Johnston (2013) found similar results. The female students in their study found value in computers for the functions they perform but not in computers as an area of study. They just aren't that interested in using computers as anything but a tool for school and a way to access social media. "Maybe we just aren't that excited about it," said one student. "Some girls might be more focused on other stuff," said another student. One student explained that it is just a matter that there are other things in their lives, "You might be less interested in technology because you are doing your sport." Then there is the distraction of boys and their influence of the young women in this study. One student summed up the conversation the group was having about boys, "You see these boys and you might be attracted to them and it's a whole new thing."

The eighth grade students voiced the strongest opinion on the survey when asked about future possibilities in technology related to career and education. The eighth grade students' responses indicated that they had very little interest in a technology related future career or education. When asked about joining a technology club or going to a computer camp, 68% disagreed or strongly disagreed with the idea of joining a club and 71% disagreed or strongly disagreed with attending a camp. The students could also not see themselves in a future technology

career; 71% disagreed or strongly disagreed with becoming a game designer and 88% disagreed or strongly disagreed with a future as a computer teacher. When surveying female students on future career aspirations, Beyer (2014) found female students are interested in careers that help others and give them the opportunity to interact with others. The eighth grade students in this study don't feel that those opportunities will be available in a technology related field.

In eighth grade focus groups the topic of male students was as much a part of the conversation as technology and computers. Master, Cheryvan and Meltzoff (2015) found in their study that environment had significant influence on a female student's desire to participate in technology classes. The female students had strong opinions about the behavior of their male counterparts and their role in the classroom atmosphere. "They (male students) are louder. Like loudly obnoxious," one student contributed to the conversation. Another student said, "The boys like to make jokes about girls. The teacher (male) laughs at the jokes too. We are like that is not even appropriate." All of the students in the focus group agreed. They discussed the inappropriate images that the male students look up on Google to show the female students. The conversation ended with the statement, "If there was a male in this room, there would be a lot less conversation (from the female students)."

The fifth grade students in both survey answers and focus groups had more definite and positive attitudes toward technology than their eighth grade counterparts. In the survey section about adjectives used to describe a person interested in technology the fifth graders agreed or strongly agreed with all of the

positive words on the list. Fifth graders agreed or strongly agreed with the adjectives *smart* at a rate of 75%, *interesting* at a rate of 67%, *fun* at a rate of 68%, *friendly* at a rate of 64%, and *creative* at a rate of 78%. In focus groups, like the eighth grade students, when describing a person interested in technology fifth grade students cited the male gender or lack of gender identity at about the same rate as eighth grade students with the exception that one student who specifically describe the fictional person as a female. When discussing the fictional person interest in technology the fifth grade students described a person who was more often male and socially awkward. "He would be really nerdy because he works on computers a lot," one fifth grader noted. Another student said, "I imagine him being really serious." The fifth graders were then asked to picture this technology minded person as a female. Just as with the eighth grade students, the conversation turned. This fictional woman was exciting and interesting. "She would be fun," was one student's observation. "She is very smart and you always want to be around her," another student added. As for what the fictional woman would be doing with technology one student said, "making an app or something." Another student thought she might have more creative endeavors, "She might be using the computer to look up artsy or crafty stuff."

When asked about their current interest in and confidence with technology, the fifth grade students had more positive responses than the eighth grade students. The survey statements of *Computers are interesting to me* and *I would like to learn more about computers* received a positive response of 72% and 70% respectively. Sixty-four percent of students reported using computers to be *fun*.

Fifty–three percent of students agreed that they were *good at using computers* and 53% thought it was important to *know a lot about computers*.

The fifth grade students had the least positive responses to the section of the survey on the possibility of future career and education but still were more positive than the eighth graders. The fifth grade students' responses were evenly split between agree, neither agree or disagree, and disagree when asked whether or not they would major in computer science. They were less positive about the possibility of becoming a computer teacher; only 13% of fifth graders responded agree or strongly agree, but still gave more positive responses than the eighth graders whose rate of agreement was less than 1%. The 5th grade students were positive about working on a computer project at the rate of 63% but 59% could not see themselves attending a computer camp. The fifth grade students were evenly split between agree, neither agree or disagree, and disagree when asked about joining a robotics club or becoming a game designer.

Similar to their eighth grade counterparts the fifth grade students had strong feelings and opinions about the male students in their classes. "The boys go wild," one student commented. "Boys are like more immature and speak out," added another student. They nodded in agreement, giggled and rolled their eyes discussing the male students in their class. "The boys are trying to get attention," expressed one of their students. Another student summed up the discussion by adding, "The boys are not mature yet. They become like second graders." The fifth grade students had strong opinions about their male classmates' behavior just as the eighth grade students had

strong opinions about their male classmates' behavior. Unlike the eighth grade students, the fifth graders feelings about their male classmates' behavior did not appear to influence their opinions about technology.

Implications

The attitudes of female students changed in many ways between fifth and eighth grade students. On the survey the fifth grade students used more positive words to describe people who use technology, technology education, and future technology-based careers. In focus groups the fifth grade students spoke enthusiastically about how they use technology in their lives. They spoke in general more positively and freely than the eighth grade students. The fifth graders were more eager to share information than the eighth graders. The fifth graders' less guarded, more positive and enthusiastic nature might be the key to understanding why the students' attitudes appeared to change between the fifth and eighth grade.

Looking at the statistics between the fifth and eighth graders studied, they have more commonalities than differences. The students lived in the same neighborhoods; the eighth grade students once attended the same school the fifth graders were attending. The majority of students in both groups considered themselves good students. The majority of students in both groups had technology at home. Both fifth and eighth graders reported using computers at the age of 5 or 6. The main difference between the fifth and eighth grade students was the three years of age that separated them.

The change in attitude the three brief years between the fifth and eighth grade brings may be attributed to both Bandura's Social Learning Theory and Bern's Gender Schema Theory. The eighth grade students have observed and evaluated the world around them (Bandura, 1977). They have watched movies with the "nerdy" computer programmer. They have seen the news or read magazines about the male giants of the tech industry such as Bill Gates, Steve Jobs, and Mark Zuckerberg, but they have probably have had little or no exposure to the leading females in the tech industry such as Susan Wojacki, Ursula Burns or Virginia Rometty (Howard, 2016). The eighth grade students have little to identify with in the technology world. They are not observing females in the technology field getting recognition and praise for their work. They are not surrounded by female technology teachers or hearing stories of the technological advances women are making in the world. The fifth grade students do appear to be influenced yet by the lack of female role models in the tech field. The fifth grade students are interested in technology solely because it is something they like to do, rather than defining their interests as feminine or masculine.

The eighth grade students are learning what it means to be a woman by studying the societal norms for male and female traits (Bern, 1981). If they perceive male students to be loud, immature, and demanding of attention they will turn away from areas and curriculum they deem masculine. If an eighth grade female student's perception of a person interested in technology is someone who is socially awkward and an outcast they will not identity with that person. The fifth grade students still

profess that girls can do or be anything. The lines that the eighth grade students have drawn between masculine and feminine behavior are blurred for the fifth grade students.

Female students are in need of more technology driven female role models in school, in their social media, and in their news and entertainment if they are going to identify with what it means to be a woman in the technology field. They need technology curriculum to address their idea of how technology could be used. Female students want to use technology to create, design, make art and communicate. Female students are also in need of curriculum that appeals to their generation. They need technology that appeals to their eco-friendly, social justice and intellectual ideals. They are not impressed with technology itself, as it has been around since they were born. The female students studied were driven by the connections that they could make with technology and the ideas that technology could make a reality.

Recommendations for Further Research

If this study were to be conducted again, the study should include several additions. The study should include a high school student perspective. The same survey and focus groups should be conducted with 11th grade female students. The 11th grade would be the ideal next step to include because the students would represent the same three year age gap that was between the fifth and eighth grade. It would be important to see how the attitudes of female students evolve after three more years of both educational gain and social maturation. The study should include

a minimum of four focus groups per grade level in order to study the attitudes of more students. In this study focus group were essential to looking deeper into the survey answers of the study participants. A larger number of focus group participants would provide an in depth picture of how female students are identifying with people in the technology field, curriculum, and future career and education.

Another recommendation for further research would be to include questions about more stereotypically female careers. The questioning about female dominated careers would give the researcher more perspective as to whether the students were shying away from the idea of male dominated careers or declining to give an opinion on future careers. The option neither agree or disagree would be removed from the survey forcing the students to select an opinion. The combination of including 11th grade students, having the opportunity to speak with more students about their answers, adding in additional questions about career, and removing the ability to remain neutral would give a more complete picture of the changing attitudes of female students towards technology. This information is essential to produce programs and curriculum to recruit female students into the technology field.

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APPENDIX

APPENDIX A

SURVEY ON TECHNOLOGY

Part 1
Here is a list of adjectives that might be used to describe a person your age. How well do you think these words describe ***someone who is interested in computers and technology***?

	Strongly Disagree	**Disagree**	**Neither Agree or Disagree**	**Agree**	**Strongly Disagree**
Smart	1	2	3	4	5
Interesting	1	2	3	4	5
Fun	1	2	3	4	5
Nerdy	1	2	3	4	5
Friendly	1	2	3	4	5
Gamer	1	2	3	4	5
Quiet	1	2	3	4	5
Creative	1	2	3	4	5
Serious	1	2	3	4	5
Awkward	1	2	3	4	5

Part 2

In the future, I can you see myself …

	Strongly Disagree	**Disagree**	**Neither Agree or Disagree**	**Agree**	**Strongly Disagree**
Taking a class about computers	1	2	3	4	5
Becoming a computer teacher	1	2	3	4	5
Becoming a computer game designer	1	2	3	4	5
Working on computer projects on your own time(outside of school)	1	2	3	4	5
Going to a computer summer camp	1	2	3	4	5
Joining a robotics or coding club	1	2	3	4	5
Majoring in computer science in college	1	2	3	4	5

How much do you ***agree*** with each statement?

	Strongly Disagree	Disagree	Neither Disagree or Agree	Agree	Strongly Agree
I would like to learn more about computers	1	2	3	4	5
I feel confident about my ability to use computers	1	2	3	4	5
Computers are interesting to me	1	2	3	4	5
Learning about what computers can do is fun	1	2	3	4	5
I am NOT the kind of person who works well with computers	1	2	3	4	5
I am good with computers	1	2	3	4	5
It is important that I know a lot about computers	1	2	3	4	5

Have you ***EVER*** done the following computer-related activities?

	Never	Once or Twice	3 or 6 Times	More than 6 Times
Created a presentation using a computer (Power Point, Google Slides)	1	2	3	4
Written a computer program (code) using computer language	1	2	3	4
Made a publication like a newsletter, using a computer	1	2	3	4
Created my own blog or discussion group online	1	2	3	4
Created a Website	1	2	3	4
Created a piece of art or music using a computer	1	2	3	4
Built a robot or created an invention using a computer	1	2	3	4
Created a movie or animation using a computer	1	2	3	4
Created a computer game	1	2	3	4
Used a social media site (Facebook, Instagram, SnapChat, Vine, Twitter)	1	2	3	4

Part 3

1. How old were you when you first used a computer? _____

2. How many working computers does your family have at the place that you live?

- ☐ 0 (My family does not have a computer at home)
- ☐ 1
- ☐ 2
- ☐ 3 or more

3. Please mark any items your family has at the place where you live

- ☐ Printer
- ☐ Game Console (Xbox, PlayStation, Wii)
- ☐ Digital Music Player (iPod, etc.)
- ☐ Tablet (iPad, Galaxy Tab, Amazon Fire)
- ☐ Smart Phone

4. What sort of internet access do you have at home?

- ☐ I do not have internet access at home
- ☐ Internet access of smart phone only
- ☐ DSL or cable that I plug into
- ☐ Wireless I can use throughout my home
- ☐ I do have internet access at home but I don't know what kind

5. I consider myself

- ☐ A good student
- ☐ Neither a good student nor struggling student
- ☐ A struggling student

6. Do you speak a language other than English?

☐ Yes ☐ No

7. What other language(s) do you speak?

_____

8. What language do you most like to use?

_____

Thank you for your help!