STEM ACADEMY: A CASE STUDY OF GIRLS' STEM SELF-EFFICACY

by

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Dedication

"Education is the most powerful weapon we can use to change the world."- Nelson Mandela

I dedicate this dissertation to all the young girls who may have been told they cannot be scientists, computer programmers, engineers, or mathematicians because they are girls. My hope is that you never listen to the people who say you must choose a job that is suitable for a girl. May you find the strength and confidence to overpower those negative stereotypes and be the person you were created to be. May you always be thinking about how to change the world around you and always solving problems in your communities.

To my nieces, may you always have the confidence and self-assurance to be anything you want to be and not be limited to what society expects you to be. Whatever your dreams are, don't let go of them. Strive hard, work hard, and achieve that dream, even when others try to discourage you from pursuing them. You are all confident, strong, and creative young ladies with a powerful mind to change the world and achieve greatness. May you soar to the highest of heights and steer clear of those who try to bring you down.

"There's nothing wrong with being a princess, we just think girls can build their own castles too."- Debbie Sterling

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ABSTRACT

STEM ACADEMY: A CASE STUDY OF GIRLS' STEM SELF-EFFICACY

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Women are underrepresented in STEM fields and careers. This population is not being encouraged, supported, or exposed to STEM learning as often as their male counterparts. The purpose of this sequential mixed- methods study was to examine the influence of participating in a STEM Academy on girls' mathematics, science, engineering and technology, and STEM self-efficacy. This study included a quantitative and qualitative component. Sixth grade girls intending to participate in the STEM Academy were individually matched with sixth grade girls not intending to participate in the STEM Academy. There were two participant sample groups for the quantitative component, girls in the STEM Academy and girls not in the STEM Academy. Both participant sample groups were given the *Student Attitudes toward STEM (S-STEM)-Middle and High School* survey using the Likert 5-point scale. Only girls in the STEM Academy participated in a focus group. The quantitative data was analyzed using an independent samples t-test, while the qualitative was analyzed using a blend of priori and inductive thematic coding process. Results of the quantitative data indicated that the STEM Academy program did influence girls' mathematics and science self-efficacy, but not their engineering and technology and STEM self-efficacy. Results of the qualitative data indicated that girls' perceptions were affected by their participation in the STEM Academy program.

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CHAPTER I:

INTRODUCTION

Women are underrepresented in STEM related fields. According to the National Science Board (NSB) (2016), in 2013, 31% of physical scientists, 25% of computer and mathematical scientists, 11% of physicists and astronomers, 24% of computer and information scientists, 8% of mechanical engineers, 11% to 12% of electrical and computer hardware engineers, aerospace, aeronautical and astronautical engineers, and 42% of mathematical scientists were women. This reflects a large gender disparity in many of the STEM careers. There tends to be more men in these fields than women, where women are typically the minority population. There was an increase of women in engineering fields from 9% to 15% and in physical science fields from 21% to 31% (NSB, 2016). This is a positive increase in the number of women in these careers, but not a significant one. Larger strides need to be made so that gender representation in STEM fields is more equitable among men and women.

There are a number of concerns related to Science, Technology, Engineering, and Mathematics (STEM). This paper focused on one particular issue, STEM self-efficacy in girls. If a teacher were to ask students how they felt about science, technology, engineering, or mathematics courses, boys usually would respond that they love these courses and feel that they are good at them. On the other hand, girls may indicate that they are not particularly adept in STEM subjects. This is a problem that schools have faced for years. If girls are less confident about their abilities in STEM, then are they less likely to choose STEM careers? If they are less likely to choose STEM careers, then men will continue to outnumber women in STEM.

Unfortunately, STEM is not the only field where men are overly represented. The Nobel Peace Prize is an award given to individuals who have made great achievements or accomplishments, but it also tends to be awarded to men more often than women. From 1901-2018, the Nobel Prize has been awarded 590 times, but only 51 honorees were women (Nobel Prize Awarded Women, n. d.). Again, that is a lot more men being awarded than women. What can be done to bridge this gender gap? How do schools motivate their girls to select or pursue STEM careers? Is it possible to help girls build self-confidence or self-efficacy in these courses so they can believe that they too can pursue the same STEM careers that boys enter into?

Martinez Ortiz, Bos, and Smith (2015) found that the United States needs more undergraduate and graduate students in STEM fields because of the rapid increase in the number of these jobs. If there is a push to graduate more students in STEM, why not target the underrepresented population, women? Females should be given the same opportunities that males are given for the purpose of filling these jobs. It should not matter that they are female, instead it should matter that both genders are equally represented and challenged. To make this happen, girls need a safe place in which to positively build their self-efficacy in science, technology, engineering, and mathematics so they are more equipped to take on STEM fields. For most girls, building this self-efficacy in STEM happens in school.

This study examined the STEM self-efficacy of sixth grade girls in the hope that their self-efficacy can be increased through their participation in a STEM Academy. But, first what is a STEM Academy and the history behind it? Texas Education Agency (TEA) allows school districts to apply for one of the following STEM designations: Texas STEM Academy (T-STEM) or Industry Cluster Innovative Academy (ICIA). Before the 2011-2012 school year, if a school district wanted to be designated as a T-STEM Academy, there was only one option for this. It had to receive a T-STEM grant from TEA or from a private partner in the Texas High School Project (Texas Education Agency, 2016).

At the start of the 2011-2012 school year, TEA offered another way for schools to become a T-STEM Academy. Schools were permitted to apply to be a T-STEM Academy if they were able to use local or other funding sources and were willing to follow the T-STEM Design Blueprint consistently and precisely (TEA, 2016). After a school was designated as a T-STEM Academy, it was provided with professional development and support so it was able to provide rigorous and innovative learning to its students. A T-STEM Academy is one that demonstrates and models STEM learning where students are able to showcase their innovation and creativity in STEM instruction (TEA, 2016). T-STEM Academies may serve students from sixth through twelfth grades or ninth through twelfth grades (TEA, 2016).

On the other hand, the Industry Cluster Innovative Academy (ICIA) is a designation for school districts with a secondary school that offers students a college and career readiness pathway, industry certification(s), and an Associate's Degree when they graduate from high school (TEA, 2016). This designation was started in 2017 to provide more opportunities for high school students to choose a job that is considered high-demand in one of the following industry clusters: Advanced Technologies and Manufacturing; Aerospace and Defense, Biotechnology and Life Science (including Health Care); Energy, Information and Computer Technology; or Petroleum Refining and Chemical Products. The ICIA provides students with more rigorous STEM learning with the opportunities to participate in internships, externships, mentorship programs, and career counseling to prepare them for one of the industry clusters. A school district receives this ICIA designation when at least one of its high schools can comply with these criteria and requirements, but only the high school is considered part of the ICIA.

Other schools in a school district may establish a STEM Academy within their schools, but it is not part of the ICIA. A STEM Academy functions separately from the ICAI in that it does not have a TEA designation so it does not follow the same criteria that the T-STEM or ICIA schools are required to follow. This chapter includes the research problem, significance of the study, research purpose and questions, and definition of key terms.

Research Problem

Gender disparity in STEM related careers does, in fact, exist. What causes this disparity? One major factor that interferes with girls entering STEM careers or majors is gender stereotypes (Packard & Wond, 1999). Women are viewed as being associated with certain jobs, while men are seen as being more suited to other, different jobs. Mulvey and Irvin (2018) found that young boys typically associate ‘boy jobs’ with doctors and engineers, whereas ‘girl jobs’ were associated with careers such as nursing and library science. Even at a young age, children have it in their minds that boys will have certain jobs and girls will have other jobs. This is a stereotype that can negatively impact girls’ self-perception and limits career choices to those deemed socially acceptable to them, according to society’s norms. It restricts them from being interested in anything other than what is deemed a ‘girl job’. These stereotypes influence their interests and decisions, which in turn limits the number of women in STEM careers.

These stereotypes are detrimental to the number of women in STEM careers. According to the NSB (2016), in 2013, 31% of physical scientists, 25% of computer and mathematical scientists, 11% of physicists and astronomers, 24% of computer and information scientists, 8% of mechanical engineers, 11% to 12% of electrical and computer hardware engineers, aerospace, aeronautical and astronautical engineers, and 42% of mathematical scientists were women. This distribution of women holding STEM related positions clearly illustrates gender misrepresentation in STEM careers. But, why does this misrepresentation exist? Bian, Leslie, and Cimpian (2017) found that children as early as six years old express stereotypical attitudes including the notion that boys are smarter than girls, which can negatively impact girls' confidence in STEM subjects in school. Society teaches young children that boys are smarter than girls in STEM and that girls should prepare themselves for one set of careers and boys for another. These stereotypes play a role in shaping children's interests and guiding them toward specific careers.

Another reason why girls tend to have a lower self-efficacy in certain STEM related courses is because they are not provided the same opportunities to engage in STEM learning that boys are provided. In many K-12 STEM classes, boys are more likely than girls to be given opportunities to engage with materials, problem solve, and communicate their findings (Chatman, Nielson, Strauss, Tanner, Atkin, Bullitt Bequette, & Phillips, 2008). Girls need to be given the opportunity to explore STEM in the same manner the boys are provided. Petroff (2017) found that girls become interested in STEM subjects at the age of 11 but become disinterested by the time they reach the age of 15. If these girls are granted the opportunity to engage in STEM, develop STEM skills, and explore STEM learning early, then perhaps their interest would be sustained throughout their high school careers and beyond. Similarly, Chen and Zimmerman (2007) found that girls, who were not exposed to STEM lessons, tend to lose interest and have a lower self-esteem in STEM by the time they reached the fifth grade. It is critical to allow these girls the chance to explore STEM so they might be motivated to pursue STEM careers.

Libarkin and Kurdziel (2003) reported that boys are more confident in their math and science skills than girls. This STEM overconfidence held by boys tends to contribute to the misconception that they are more competent in STEM than girls. Fenema (2000) found that boys were more confident and assertive than girls in mathematics and science classrooms which reflected a lower self-efficacy or confidence in girls when they are learning mathematics and science. But, again, where does this lack of confidence stem from? According to Steinke (1999), this self-doubt and lower self-efficacy regarding STEM develops at an early age when girls believe they are not as smart as the boys in their classes. Building girls' self-esteem and confidence will improve their STEM academic success and they will realize that science, engineering, and mathematics may, in fact, be viable career choices (Frize, Frize, & Faulkner, 2009).

To make this happen, it is imperative for educators to provide an environment that is conducive to learning and building girls' interests and abilities in the sciences (Chatman et al., 2008). In doing so, girls will begin to build a more positive outlook, attitude, and aptitude for science (2008). Young girls' self-efficacy and self-confidence need to be strengthened so they might believe they also can achieve whatever it is they want to achieve, and pursue any career they select no matter what gender dominates that career. Girls cannot be forced to pursue STEM fields, but they should be given the opportunity to participate in STEM lessons and activities (Clewell & Campbell, 2002). In addition, these opportunities to explore and experiment with STEM will aid in creating a stronger STEM foundation and should take place at an early age (Moomaw, 2013). It is critical to empower girls as much as boys in STEM so they will have a heightened self-efficacy related to STEM. They need to be able to dream of having whatever career they want, not simply the 'girl jobs'. If girls are not given these learning experiences, then the STEM gender gap may broaden.

Significance of the Study

There are several reasons why this study is significant. First, there is a large gender gap in STEM related fields that needs to be diminished or eliminated. According to a study conducted by the NSB (2016), 31% physical scientists, 25% computer and math scientists, 11% physicists and astronomers, 24% computer and informational scientists, 8% mechanical engineers, 12% electrical and computer hardware engineers, and 42% mathematics scientists were women. This is quite a large gender disparity across many STEM careers and it is too large of a gap to ignore. Girls need to be a targeted population in order to help eliminate this gender gap related to STEM. Klobuchar (2014) stated that in the next 10 years, over one million STEM jobs will be available in the United States and there is expected to be a shortage of STEM workers. That is a significant number of STEM jobs and men should not be the only ones to populate them. Women need to be encouraged and motivated to pursue these predicted STEM job openings. According to Martinez, Bos, and Smith (2015), due to the rapid increase of STEM jobs, the United States is in need of more people with undergraduate and graduate degrees in the science, technology, engineering, and mathematics (STEM) fields. As such, it is imperative to educate and prepare girls, as well as boys, to pursue these open STEM positions.

Secondly, if the United States wants to increase its mathematical and science standings compared to the rest of the world, then girls need to be the focus of STEM education. According to Froschl and Sprung (2014), the United States cannot afford to allow the STEM gender gap to continue to broaden and further damage its global standing with regard to science and mathematics. If the United States wants to improve its global standing with regard to STEM, then STEM education needs to focus on the minority population, females. If only boys are encouraged to pursue STEM fields or girls are discouraged because of gender stereotypes, then as a nation, the United States will not flourish. Wallace and Hattingh (2014) found that in order for the United States to flourish in STEM, there needs to be more innovators, developers, researchers, and engineers who are women. A country will not flourish economically if only one gender is encouraged to pursue STEM careers. If women are included in a push for STEM, then the United States will see a growth in their STEM standings and a decrease in the present STEM gender gap.

Finally, gender stereotypes and misconceptions need to be eliminated. Stereotypes and misconceptions related to STEM and gender can begin in early childhood and progress into adulthood. Mulvey and Irvin (2018) found that young children often possess the stereotype that boys will have "boy jobs" like engineers and doctors and girls will have "girl jobs" like nurses and librarians. Who decided these are gender specific jobs? When repeatedly exposed to these stereotypes as children, girls may believe that they cannot be a computer programmer or an engineer because those are perceived as "boy jobs." They may believe they have to pursue careers traditionally associated with females such as teachers, nurses, librarians, or even stay at home moms. Bian, Leslie and Cimpian (2017) found that even at the age of six, children can possess the misconception that boys are intellectually superior to girls in STEM subjects, which can influence advanced STEM course enrollment and career selection. If girls believe that misconception, they are less likely to pursue the notion of becoming an engineer, doctor, scientist, or astronomer because they are perceived as being less capable in STEM as compared to boys. Even at an early age, girls develop negative perceptions related to science and mathematics which can increase their self-doubt as far as their abilities to succeed in STEM subject areas (Steinke, 1999) is concerned. Girls often believe they cannot be good at STEM subjects and that self-doubt can prevent them from pursuing

STEM careers. This stereotype is detrimental to girls' STEM self-efficacy and perceptions of their STEM abilities. Thus, these stereotypes and misconceptions need to be eliminated so that all children might possess the perception that they can have whatever job they want, no matter their gender.

STEM learning involves science process skills such as investigating, building, creating, and communicating, (often natural skills for children) (Genalo, Bruning, & Adams, 2000). Since these are natural skills for all children, and since they are linked to STEM, it should be a priority to increasingly expose girls to STEM explorations that focus on these skills. If girls are expected to be successful in STEM, then educators need to provide a safe learning environment and utilize instructional strategies that build their interests and skills (Chatman et al., 2008). Elementary schools are where the foundation in any subject is built. Wolverton, Nagaoka, and Wolverton (2015) found it is critical to begin encouraging girls in STEM education and providing hands-on learning in elementary schools because that is when their educational foundation is built and future learning can be built upon that foundation. Many people may believe that young children are not ready for STEM learning or that they cannot grasp an understanding of it. However, Martinez Ortiz (2014) found that even very young children are capable of learning and being inspired in STEM education. If schools are the place to introduce STEM learning, then it is imperative to expose girls to STEM experiences to help build their self-efficacy.

Research Purpose and Questions

The purpose of this sequential mixed-methods study was to examine the influence of participating in a STEM Academy on girls' STEM self-efficacy. This study addressed the following research questions:

1. Does participation in a sixth grade STEM Academy influence girls' self-efficacy in mathematics?
2. Does participation in a sixth grade STEM Academy influence girls' self-efficacy in science?
3. Does participation in a sixth grade STEM Academy influence girls' self-efficacy in engineering and technology?
4. Is there a statistically significant mean difference in girls' STEM self-efficacy between pre- and post-survey data in the STEM Academy?
5. How does participating in a sixth grade STEM Academy affect girls' perceptions of STEM self-efficacy?

Definitions of Key Terms

For purposes of this intended study, the following terms were utilized throughout the document.

Afterschool Programs: Afterschool programs are also called Out-of-School-Time (OST) programs and refer to programs for students that are not part of their school day (Afterschool Alliance, 2009).

At-Risk: Students are given this identification if they under 21 years old and meet at least one of the following criteria: (a) was not advanced to the next grade level for one or more school years; (b) is in grades 7-12 and did not maintain a grade of a 70 or more in two or more subjects during a semester; (c) did not meet state standards on the state assessment; (d) is in pre-kindergarten- grade 3 and did not meet standards on the readiness test or the assessment instrument; (e) is pregnant or is currently a parent; (f) was placed in an alternative education program the previous or current school year; (g) has been expelled during the previous or current school year; (h) is currently on parole, probation or deferred prosecution; (i) has dropped out of school; (j) is a limited English proficient student; (k) is in the custody or care of the Department of Protective and Regulatory Services; (l) is homeless; or (m) resided the previous year or the current school year in a residential placement in the district (TEA, 2018).

Attitude: Can be defined as an individual's feeling about carrying out specific behaviors (Ajzen, 1991).

Economically Disadvantaged: Students are given this identification if they receive free or reduced lunch (TEA, 2018).

Engineering Self-Efficacy: Can be defined as an individual's belief in his or her ability to successfully complete an engineering curriculum to become an engineer (Jordan, Amato-Henderson, Sorby, & Donahue, 2011).

Likert Scale: For the purpose of this study, it is a rating scale used to measure self-efficacy. The scale ranges from 1 through 5 (Strongly Disagree to Strongly Agree) (Likert, 1932).

Mathematics Self-Efficacy: Can be defined as an individual's belief in his or her abilities to complete mathematical tasks (Bong & Skaalvik, 2003).

Perception: How an individual sees a particular task or problem (Brumby, 1979).

Science Self-Efficacy: Can be defined as the belief an individual has in his or her abilities to get good grades in science or complete tasks related to science (Chen & Usher, 2013).

Self-Efficacy: Can be defined as the belief an individual has related to their abilities to complete a given task (Bandura, 1994).

Self-perception: Can be defined as an individual's belief or view of his or her abilities in creativity, intellect, and academics (Bineham, Shelby, Pazey, & Yates, 2014).

STEM: Originated in the 1990s at the National Science Foundation (NSF) as an acronym for science, technology, engineering, and mathematics (Bybee, 2013).

STEM Education: STEM education can be defined as the interdisciplinary approach to learning that removes the traditional barriers separating the four disciplines of science, technology, engineering, and mathematics and integrates them into real-world, rigorous, and relevant learning experiences for students (Vasquez, Sneider, & Comer, 2013).

Student Attitudes towards STEM (S-STEM)-Middle and High School survey: "Is intended to measure changes in students' confidence and efficacy in STEM subjects, 21st century learning skills, and interest in STEM careers. The survey is available to help program coordinators make decisions about possible improvements to their program" (Friday Institute for Educational Innovation, 2012, p 1).

Technology Self-Efficacy: Can be defined as an individual's perception of his or her abilities to integrate computers or technology in his or her life (Downey & Zeltmann, 2009).

Conclusion

The literature contains a plethora of research regarding girls' self-efficacy, yet few studies exist related to girls' self-efficacy in a STEM Academy. Gender stereotypes do exist and begin in childhood (Bian, Leslie, & Cimpian, 2017), thus it becomes the responsibility of schools to provide girls the opportunity to further explore and study STEM, thereby increasing the chances of eliminating gender stereotypes (Petroff, 2017). This study provided an understanding of building and developing girls' self-efficacy within a STEM Academy. This chapter acknowledged the importance of examining girls' STEM self-efficacy. It also identified the significance of the problem, research purpose and questions, and key definitions related to this study. The next chapter is a literature review of the topics related to this study.

CHAPTER II:

REVIEW OF THE RELATED LITERATURE

Historically, there have always been a far greater number of men in science and engineering fields than women (National Science Board, 2016). However, the number of women in these fields has doubled over the last 20 years, but not enough to eliminate the gap (2016). Over the next 10 years, there will be a need for about one million additional new STEM professionals than what the United States will produce (Klobuchar, 2014). In a report to former President Obama, the President's Council of Advisors on Science and Technology (PCAST, 2012) suggested that if the United States wants to sustain their global placement in science and engineering, the number of graduates in STEM degrees needs to increase by 34% annually from the current rate.

Since there is a projection that one million new STEM workers will be needed by 2022, the number of women achieving a STEM degree should increase to help address that projected shortage (Klobuchar, 2014). Out of the 70% of women and minorities enrolled in college, only 45% of them graduate with a STEM degree (PCAST, 2012). According to Wallace and Hattingh (2014), the United States' economy will flourish when more innovators, engineers, researchers, and developers are women. K-12 education is a critical time period for motivating girls in STEM. Girls need to have a strong foundation in mathematics and science in order to become motivated to pursue STEM degrees and certifications (Klobuchar, 2014). But, typically boys are given more opportunities than girls to engage in STEM learning (Clewell & Campbell, 2002). According to Mead and Metraux (1957), most high school students consider scientists to be 'white, nerdy males'. Some males study specific subjects that are perceived more as masculine while females study subjects that are perceived as more appropriate for females (Coulter, 1993).

Chatman et al. (2008) stated that in order to help girls be successful in science, we, as educators, need to ensure that we are effectively supporting them so that they might develop the STEM skills and abilities needed for success in these areas. Unfortunately, Frize, Frize, and Faulkner (2009) found that many girls in schools are still discouraged from pursuing a career in engineering because it is often considered a field for males only. Discouraging girls from pursuing engineering careers is a discriminating practice that needs to stop. Packard and Wond (1999) noticed that girls are dissuaded from choosing science careers because of the gender stereotypes associated with those careers. We cannot expect girls to choose STEM fields when they are discouraged from them. This literature review will examine the gender inequality in STEM, girls' STEM self-efficacy, and inspiring girls in STEM.

Theoretical Framework

The theoretical framework for this study was based on Bandura's *Social Cognitive Theory* (1986). Social cognitive theory (SCT) relates to how an individual thinks and processes information and reacts to a given environment (Bandura, 1986). Individuals' cognitive ability to understand and process information directly relates to how they respond to the environment they are in. Bandura (1999) stated that people are considered "agentic operators in their life course, not just on-looking hosts of brain mechanisms orchestrated by environmental events" (p. 22). This implies that individuals control their own paths and are not submissive beings controlled by their environment. According to Bandura (1999), human behavior can be explained using a triadic reciprocal causation. In this model, personal factors, behavior, and environmental factors interact seamlessly to influence one another. Personal factors consist of cognitive, affective, and biological events. Behavioral patterns relate to how one reacts or behaves.

Environmental factors include the imposed environment, selected environment, and constructed environment.

One component of Bandura's Social Cognitive Theory (SCT) is self-efficacy. Bandura (1999) explained that self-efficacy is critical in SCT because of how people are able to change their behaviors or actions according to what they believe. As such, he stated that "efficacy beliefs influence how people, feel, think, motivate themselves, and behave" (Bandura, 1993, p. 118). Self-efficacy is formed through the interaction of personal factors, behaviors, and environmental factors. An individual cannot have only one part of the triadic reciprocal causation to form self-efficacy. All three components work together to construct an individual's self-efficacy. Bandura (1994) defines self-efficacy as the belief an individual has related to his or her abilities to complete a given task. Generally, individuals are likely to perform only as well as their expectations. Those with a higher self-efficacy believe that they can be successful in a given task, thus they strive to achieve that goal. Those with a lower self-efficacy feel that they may not be as successful, so they may give up or not even try (Bandura, 1993). As such, individuals' internal personal factors, behavior, and environmental factors influence their self-efficacy. This triadic reciprocal causation helps to construct an individual's self-efficacy. For example, a student may have a lower self-efficacy in a certain subject (personal factor) and may avoid or drop out of a class (behavior) if the class is made up of one specific demographic (environmental factors).

Perceived self-efficacy can also play a role in Social Cognitive Theory (SCT). Bandura (1989) stated that how people perceive they will do on a task influences the degree to which the task is completed or if the task is completed. Again, self-efficacy is intertwined with personal, behavioral, and environmental factors. Perceived self-efficacy is formed when the triadic reciprocal causation components interact with one another.

Individuals who perceive themselves to have a higher self-efficacy typically take on more challenging tasks, while those with a lower perception of self-efficacy may avoid them (Bandura, 1989). As such, perceived self-efficacy can influence individuals' actions or behaviors based on the environment they are in.

Social Cognitive Theory (SCT), specifically the concept of self-efficacy, is selected as the theoretical framework for this study because research demonstrates the predictive influence self-efficacy has on confidence in academic tasks and making decisions such as career choices. Because SCT elucidates and foresees learned behaviors, it is a natural fit for this study. According to Fenema (2000), boys are more confident than girls in specific subjects, like mathematics and science. Girls typically have a lower self-efficacy than boys, which correlates with Bandura's research on self-efficacy. The triadic reciprocal causation that Bandura mentions is instrumental in girls' self-efficacy because it is that interaction among their personal, behavioral, and environmental factors that helps to construct their self-efficacy. In the study of girls' self-efficacy in STEM, Bandura's triadic reciprocal causation relates. Each of the factors is intertwined where they interact with one and influence one another. The behavioral and environmental factors influence each other and in turn, influence girls' self-efficacy in STEM. An individual's thoughts, beliefs, and self-perceptions are all parts of their personal factors (Bandura, 1977). Specific to this study, a girl's self-perceptions and beliefs in her abilities to achieve or perform a STEM task or activity are all personal factors for her. An individual's skills and actions relate to his or her behavior (Bandura, 1977) so a girl's skills or abilities in a STEM task are part of her behavioral factors. Environmental factors can be either externally physical or social in nature (Bandura, 1977). This study focused on the social aspect of the environment where girls participated in a STEM Academy.

Gender Inequality in STEM

Historical Roles of Women

To fully understand the current gender inequality in the United States in STEM, one must go back in history to examine the gender roles that have been consistently demonstrated in American society. Girls were expected to learn how to become wives and mothers and to effectively take care of a household in the 16th century (Frize et al, 2009). In the 17th century, mothers discouraged their daughters from pursuing a formal education, believing it would not be useful in their future so instead they were taught practical skills associated with female tasks (Frize et al., 2009). Women were expected to learn how to cook, sew, perform basic medical skills, and balance the household budget (O'Day, 1982). By the 18th century, some women attempted to find ways to study science and mathematics, and have their work associated with STEM published, but this was not an easy task for them during that time (Frize et al., 2009). During the 19th century, schools for women were founded and higher educational institutions for women became more prevalent. Women were able to enroll in mathematics and science courses in universities in the 20th century, but many chose not to pursue fields of engineering, physics, or computer science partly because those fields were dominated by males. So, as a result, most women studied education, nursing, or other fields that were dominated by women.

Even though there have been many changes throughout history to the roles of females in the house, the role of the female can be a difficult one to chance. Lyon (2014) stated that it is the mothers who are the primary caregivers in the house. They pass on their personal and cultural values or perceptions to their children. These values and perceptions can help their children be successful or hinder their achievement. Mothers influence the career decisions of their children and thus can be instrumental in encouraging their daughters to consider and ultimately pursue STEM related careers (Lyon, 2014).

STEM Gender Disparity in College Majors and Careers

According to the National Science Board (2016), 31% physical scientists, 25% computer and math scientists, 11% physicists and astronomers, 24% computer and informational scientists, 8% mechanical engineers, 12% electrical and computer hardware engineers, and 42% mathematics scientists were women. Over the past twenty years, the percentage of women in engineering rose from 9% to 15%, and in the physical sciences from 21% to 31%. Unfortunately, STEM is not the only field where males are overly represented. The Nobel Peace Prize is an award given to individuals who have made great achievements or accomplishments, but it also tends to be awarded to males more often than females. From 1901-2018, the Nobel Prize was awarded 590 times, but only 51 honorees were women (Nobel Prize Awarded Women, n. d.). Was this due to the lack of women in these fields to nominate or because women were overlooked because of their gender?

Wolverton et al. (2015) conducted a qualitative case study of women with STEM careers. They interviewed a variety of women holding a vast range of STEM degrees. One particular engineering professor at Massachusetts Institute of Technology (MIT), Dr. Cynthia Barnhart, said in her interview that women are not as likely to choose STEM majors as an undergraduate and if they do, they are less likely than males to remain in STEM majors until graduation. She also stated that women are more noticeable in engineering majors because there are so few of them enrolled in those courses. Dr. Barnhart continued to say that because most people think that engineering is a nerdy profession, women do not tend to choose that pathway. However, at MIT, she and her colleagues work with girls in middle school through their STEM program in the attempt to inspire and excite girls in engineering.

Gender Stereotypes

As previously mentioned, Wolverton et al. (2015) interviewed a variety of women in STEM careers. Dr. Radia Perlman, a software designer and network engineer, was questioned and she conveyed that women tend to avoid STEM fields because of the misconceptions often associated with STEM careers. Dr. Perlman also stated that the number of women in STEM fields is limited because people have preconceived notions about who should hold certain positions. Dr. Perlman also stated that the reason there are fewer women in STEM careers is because of their perceptions that they will not be successful in STEM jobs.

Coulter (1993) wrote about gender equity in the classrooms. She believed that because of gender stereotypes and sexist attitudes, many girls underestimate their skills in STEM subjects even though they may be performing at the same level as boys. She also found that girls tend to stop enrolling in mathematics and science courses, especially physics, when they get to high school because they are not interested in learning those subjects. She stated that gender stereotypes are so typical and perceived as normal that people do not even realize they possess these stereotypes regarding girls' success in STEM subjects. These gender stereotypes are so unconsciously innate in individuals that they are not easily recognized.

Baumgartner-Papageorgiou (1982) conducted a study in which girls between 8 and 17 years of age were asked how they would feel if they woke up the next morning as boys. They were also asked what careers they would choose as boys. The girls believed they would be valued more by their parents and teachers. They also believed that they would have the constant encouragement and support of their parents to pursue any career they desired. These girls said that the careers that they would most likely select, as boys, would be engineers, pilots, athletes, forest rangers, or sportscasters. When asked why they would choose one of these career options, most of the girls said it was because these were careers that most boys entered into and they felt that they would get the career support they needed.

Additionally, Baumgartner-Papageorgiou (1982) conducted this study with boys in the same age group. They were asked the same question: how would you feel if you were to wake up as a girl the next morning and what careers would you choose? The young boys admitted that they would be very upset if they were to awaken as young girls. They said they would have to learn how to put on makeup, do nails, and cook. They continued to state that they would not feel valued or supported by their parents and knew that there would be certain jobs that they would be expected to pursue. These young boys also stated that they would feel it necessary to choose a career that is typically dominated by females, like secretaries, flight attendants, or social workers. The study was repeated 10 years later and received very similar results (Frize et al., 2009).

Archer, Dewitt, Osborne, Dillon, Willis, and Wong (2010) conducted a similar study to explore the attitudes and interests that elementary aged students have regarding science. They held six focus groups for 42 students and 60 students were followed over the course of five years. Based on their analysis, the data was broken into two categories: “doing” science and “being” a scientist. In relation to “doing” science, they found evidence that until the age of 10, students’ interests in science was high with little gender difference. The young men, though, tended to describe the actions of doing science using what was considered masculine words such as “risky,” “dangerous,” and “explosion.” Girls, on the other hand, showed an interest in science but were less interested in pursuing science as a career because it appeared to be dangerous and risky. In the “being” a scientist category, it was found that girls did not want to grow up to be scientists because they were afraid of having to touch dead things and skulls. The participants also described scientists as white, old, male, and middle class. During one focus group, the boys mentioned that girls would not be good scientists because girls like fashion only and while doing science, girls would just break their nails. The male participants were unable to name any female scientists.

Girls’ STEM Self-Efficacy

Bandura, Bararanelli, Caprara, and Pastorelli (2001) conducted a study on self-efficacy. They found that career choices were highly influenced by a students’ self-efficacy. They also found that individuals do not choose certain careers if they feel that they are not going to be successful in them. Bandura et al. (2001) also stated that self-efficacy in certain subjects was the predictor of whether or not women pursued particular jobs. Their study also showed that college men had a higher self-efficacy for careers that were typically deemed as female jobs, as well as male jobs. Whereas, women tended to doubt their abilities and have a lower self-efficacy in careers that were typically perceived as male dominant.

Girls’ Mathematics Self-Efficacy

As previously stated, Bandura et al. (2001) conducted a study regarding children’s self-efficacy in mathematics. They found that there was no significant difference between boys’ and girls’ mathematics abilities. However, they noticed that girls lost confidence in their abilities to perform mathematical problems and tasks as they entered high school, whereas boys continued to be confident. Males in high school typically had a higher mathematics self-efficacy, while their female counterparts’ mathematics self-efficacy was lowered.

Hizieak-Clark, van Staaden, Bullerjahn, Sondergeld, Knaggs (2015) conducted a study to determine the influence of a STEM program on students' self-efficacy. This STEM program was a partnership between a two year college and a four-year university. The Science, Engineering, and Technology Gateway of Ohio (SETGO) program was evaluated for five consecutive years. The priority of the program was to provide mentorship, instruction that was engaging, and a cohort learning environment where students would be rigorously challenged and encouraged to graduate with a STEM degree. For the survey aspect of the study, they focused on the students' STEM confidence and self-efficacy. They found that students demonstrated an increase in STEM self-efficacy and confidence because of the program. However, within genders, no statistical significance was found. Boys and girls both had similar increases in STEM confidence and self-efficacy. However, boys were more verbal about their abilities, stating that they already were aware of their intelligence and how good they were in STEM. The girls, on the other hand, verbalized the positive changes they experienced because of the mentorship and/or engaging lessons stating that they had learned new STEM skills and amassed additional STEM knowledge.

In a related study, Frost and Wiest (2007) examined the impact that a previously attended Math Camp (intervention summer program) had on building confidence in mathematics for girls. Nineteen seventh and eighth grade female mathematics camp attendees were chosen to participate in in this study. Each girl was interviewed two times for an hour using open ended questions, one month and six months after the camp was completed. During the first interview, one month after the Math Camp ended, 16 of the 19 girls said that the camp had helped build their confidence in mathematics. In the second interview, six months after the camp ended, all 19 girls said that their confidence had improved because of the Math Camp. Cooperative group work had helped 43% of these girls have a more positive outlook toward mathematics.

Females' Science Self-Efficacy

Wallace and Hattingh (2014) conducted a study related to the attitudes that girls had regarding science. They believed that if students were engaged in learning and in a safe environment where they could take risks, then students would be more apt to experience positive gains in their self-efficacy and attitudes toward science. Girls were given an open ended survey that sought to find out what they struggled with in science, their attitudes toward science, and what career they foresaw themselves pursuing. Wallace and Hattingh found that though girls were interested in and had positive attitudes toward science, many were not interested in pursuing it as a career. The girls stated they were not motivated enough to choose one of the sciences as a career pathway.

Females' Engineering and Technology Self-Efficacy

Bystydzienski, Eisenhart, and Bruning (2015) conducted a study on an afterschool intervention program with tenth grade girls. The goal of the program was to help participating girls become interested in engineering and possibly consider it as a career choice. During their tenth grade year, students participated in various hands-on explorations. When they went to eleventh grade, the students developed and completed independent projects related to engineering. In their final year of high school, these girls were matched with college aged women as mentors. After graduation, the girls were tracked for four years. They shared their experiences with the researchers and completed surveys through a secure wiki-type website. Participants were given a Blackberry phone to collaborate and communicate with other participants, complete various tasks, and share their own thinking and learning processes. After graduation, a private group on

Facebook was set up for the girls to communicate with one another and complete surveys about their college coursework.

Bystydzienski et al. (2015) found that at the start of the study, only 18% of the girls had an interest in engineering. By the end of their second year in the program, 57% of participants demonstrated an interest in engineering, an increase in students' interest in engineering just after two years of the program. However, when they selected majors in college, only 33% of participants chose a STEM related major. In addition, a significant number of the women did not enter engineering majors or they changed their major from engineering to a non-STEM major. This was because of their lack of self-confidence or the self-doubt that they possessed regarding their abilities to perform in engineering classes. Many of the participants believed they were not good enough to remain in the engineering major so they dropped out.

In a related study, Chukwurah and Klein-Gardner (2014) examined how a two week STEM summer program affected girls' engineering self-efficacy. Participants consisted of 16 incoming ninth and tenth grade females. Students were administered the Longitudinal Assessment of Engineering Self-Efficacy (LAESE) Pre-College Self-Efficacy Survey at the beginning and end of the summer program to determine changes in self-efficacy of students learning engineering. Students also completed a STEM Summer Institute (SSI) satisfaction survey on the last day of the program. The results showed that the girls' engineering self-efficacy significantly improved through the course of the program. The participants felt more confident in completing engineering tasks due to the SSI. The researchers found that participating in the SSI was critical in increasing girls' engineering self-efficacy and believed they would have a greater success in STEM because of the program.

Master, Cheryan, Moscatelli, and Meltzoff (2017) examined whether or not six year olds possessed gender stereotypes related to computer science and engineering. They found that even at six years, both genders believed that boys were better at computer science than girls. Girls felt that they would not be as successful as the boys in computer science and the boys believed the same thing. Next, they examined if those girls, who stated that boys could perform better in computer science tasks, were less motivated to participate and complete compute science activities than boys. They found that the boys were more motivated to learn about technology and computer science than the girls. The girls had a lower self-efficacy where they did not believe they were as good as the boys in completing computer science activities.

Finally, they observed whether or not the girls in a treatment group that participated in a kid-friendly robotic program experienced an increase in motivation to learn programming as compared to those not part of the kid-friendly robotic program. The researchers found that the group of girls who had the opportunity to program the robot was more motivated to learn and use technology than those who did not have this opportunity. They also found that the girls who had the opportunity to program the robot had a higher self-efficacy in engineering and technology than the girls who did not receive the same opportunity. Within this group, there was no significant difference in the level of motivation between the boys and girls. Both had a higher self-efficacy in their abilities to complete computer programming tasks.

Girls' Perceptions of STEM Self-Efficacy

As previously stated, Bandura et al. (2001) conducted a study in self-efficacy. They found that girls' perceptions of their self-efficacy in certain subjects played an important role in how they felt they would perform in or be successful in these subjects. They also stated that their perceptions of their self-efficacy were the true indicators of the type of job they selected based on whether or not they believed they would be successful. The male participants had a higher perception of their self-efficacy in science and technology, while the female participants' perceptions of their self-efficacy were higher in education and health related fields. They also found that girls and boys have similar abilities in mathematics and science but girls are less likely to choose a career in mathematics or science because they believe they will not be successful.

Brown, Ernst, Clark, DeLuca, and Kelly (2017) also conducted a study on STEM self-efficacy. They found that boys and girls had similar abilities in STEM. But, they noticed that it was not their abilities that set them apart, rather, it was their perceptions of their abilities. Boys perceived their abilities more positively than girls. The girls' perceptions of their self-efficacy were that they were not as capable as the boys. They also found that self-perceptions influenced their career choices, not their true abilities. They stated that by the seventh grade, girls were less likely to participate in STEM subjects because they did not believe they could keep up with the boys and be successful in their coursework.

Inspiring Girls in STEM

Female Role Models

Buck, Plano Clark, Leslie-Pelecky, Lu, and Cerda-Lizarraga (2007) conducted a study that examined the relationship between girls and female scientists who served as role models and the impact this relationship had on the girls' potential pursuit of science and mathematics interest. The girls and their female scientist role models were interviewed three times over a six month time period. The findings from this study indicated that girls have a higher probability of remaining interested in the sciences and are more likely to choose the sciences as careers if they have positive relationships with women in STEM who serve as role models. The girls who participated could picture themselves as scientists because of the part their female STEM role models played in their lives. When asked what a scientist looked like, many of the participants described their visual of a scientist similarly to their female role models.

In addition, Wolverton et al. (2015) conducted a qualitative case study of women with STEM careers. They interviewed a variety of women holding a vast range of STEM degrees and employed in STEM related jobs. In an interview with Dr. Linda S. Birnbaum (Toxicologist), Birnbaum stated that young women should have a female role model with a STEM career because women in STEM can positively influence younger women's views of certain STEM positions. Dr. Birnbaum had been a role model to several girls because she believed it would help them stay in STEM fields, rather than leaving for other jobs. She observed that girls with female mentors or role models in STEM careers were more likely to persevere in male dominated careers.

Furthermore, Trotman Reid and Roberts (2006) conducted a similar study to determine the impact that a Saturday mathematics and science program had on girls' confidence in mathematics and science. Faculty from two research universities established GO-GIRL, Gaining Options: Girls Investigate Real Life for seventh grade girls. The program occurred over the time frame of 10 consecutive Saturdays. Of the 74 girls that participated in the program, 71 completed the program. Participants explored mathematics and scientific reasoning skills, statistical concepts, data literacy and analysis, and mathematics related careers. The program consisted of mentors enrolled in a teacher preparation program (2 males and 18 females) to help guide and support the girls participating in the program. The university selected these individuals because of their interest in being mentors, even though none were mentors in a STEM related course or degree program. Trotman Reid and Roberts (2006) stated that this opportunity could promote a desire to participate in community service learning among the pre-service teacher mentors, which could prompt them to participate in the program, which in turn, could be encouraging to the girls. Prior to entering the program, mentors created the curriculum and lessons that would be taught to the girls based on their pre-test findings. Girls were asked to write journal entries, which included responses to open ended questions pertaining to mentorship in general and their experience in the program. Results showed that mentoring increased the girls' mathematics confidence and competence. The girls unanimously stated that their mentors provided a positive impact on their mathematics learning during the study. Participants saw their mentors more as friends than teachers. An analysis of their journals also reflected that 95.9% of participants indicated their mentors provided academic assistance, 41.9% reported receiving social support, and 9.5% of participants reported receiving emotional support.

Even though role models may be instrumental to inspiring girls in STEM, it is imperative to consider the role models selected. Sammet and Kekelis (2016) mention that it is not the female role models who inspire girls in STEM, it is the quality and effectiveness of the female role model that can inspire them. They suggest that just because a girl has a female role model does not mean that the student will be inspired to follow in the role model's footsteps in a STEM career. It is crucial to ensure that the female role models are similar in demographics to the girls and know how to talk, support, model, coach, and listen effectively (Sammet & Kekelis, 2016) for these girls to be inspired. Sammet and Kekelis (2016) state that Out of School Time (OST) role models should be first trained in how to effectively serve as role models before any change in girls' STEM interests or perceptions of their own STEM related abilities might be realized.

Similarly, Bamberger (2014) conducted a study concerning the influence female role models had on students' interests in pursuing STEM as a career. This study took place at a large technology company in Israel where 60 girls in the ninth grade were invited to participate in a program designed specifically for females. During the course of the program, the girls visited the company, listened to lectures by female scientists and engineers, and engaged in discussions with the female employees. During these meetings, female scientists and engineers spoke about their careers, work challenges they faced because of their gender, and balancing their family and work schedules. Students were given a questionnaire before the program began and upon completing the program.

In one part of the questionnaire, participants were asked to describe the appearance of a female scientist or engineer. There were a variety of responses such as ‘smart’, ‘nicely dressed’, ‘serious’, or ‘responsible’ (Bamberger, 2014). By the end of the study, more often the female scientist and engineer were not being described in a positive light. In another part of the questionnaire, participants were asked if they thought women could handle science and technology. Ninety percent of the young women said that women could handle science and technology “exactly like a man” (2014). The female participants went further to say that the problem involved balancing job and family and those family responsibilities could get in the way of effectively managing a career in science and technology (2014). One student in particular stated that a woman could do the job just as well as a man; however, she may not be able to because of the long hours and the hard work it required, which could interfere with family responsibilities.

Bamberger (2014) also found that at the beginning of the program, 80% of the participants were interested in studying science or technology in the future. However, after the program, 40% of participants stated they were interested in a STEM career. Bamberger states that after the program, fewer girls were interested in STEM careers because of the female role models who were a part of the program. Some participants viewed female scientists and engineers in a less positive manner and said they could not do the job that the female scientist or engineer did. They conveyed their respect for female scientists and engineers (Bamberger, 2014) but many were no longer interested in pursuing STEM related courses. It was suggested that female STEM role models be similar to female students so a relationship can be established and developed (2014). Bamberger also mentioned the need for opportunities for girls to engage with and build a relationship with one female role model, not several who may change on a daily basis. By being intentional about the female role model, more girls may see the value and importance of pursuing a STEM career, instead of choosing to opt out.

Furthermore, one study involved the impact female electronic STEM role models had on females' STEM interest and action plans. Stoeger, Hopp, and Ziegler's (2017) study examined whether or not the type of online mentoring (one-on-one verses group mentoring) made a difference in girls' interest in STEM. They stated that there were four crucial parts of an effective STEM mentoring program with girls. First, girls benefit from not just a role model, but a female role model who is similar to them (2017). Next, interventions, like mentoring, should be in place for girls before they reach high school when their interest in STEM significantly decreases (2017). Then, the mentoring program needs to be an established one where the mentor and mentee are able to meet on a consistently regular basis to be deemed successful (2017). Finally, girls need to be given the opportunity to meet and have a mentoring relationship with role models of their same age (2017). These four aspects, Stoeger, Hopp and Ziegler (2017), state are very important to inspiring more girls in STEM.

Stoeger, Hopp, and Ziegler (2017), next, conducted a study to determine if the type of online mentoring influenced these girls to pursue STEM related careers or majors. They stated that online mentoring has proven to be an effective method of inspiring and increasing STEM interest in girls (2017), however, is one-on-one online mentoring more effective than group online mentoring? First, they examined the frequency of STEM communication in a group mentoring setting verses a one-on-one setting. Next, they examined which setting (group or one-on-one) allowed for more networking. Then, they examined which type of mentoring program, one-on-one or group, influenced girls' course selections in STEM. Finally, they examined if the girls' networking statuses affected their interest in STEM courses.

For the study, Stoeger et al. (2017) used a pre-existing online mentoring program called CyberMentor. For the first six years of the program, participants were mentored on a one-on-one basis, but then it shifted to a group mentoring focus. The researchers wanted to determine if the shift from one-on-one to group mentoring made a difference in the STEM interests of girls. They collected archived data comparing the girls who were being mentored from one year participating in the old one-on-one program to girls participating in the new group mentoring program (2017). Girls from the ages of 11-18, who would be participating in the CyberMentor program had been asked to complete an online questionnaire prior to the start of the program and then six months after the start of the program (2017). Stoeger et al. (2017) pulled data from the participants, in both the one-on-one and group mentoring settings, who wrote a minimum of three STEM related emails during the time of the study. Data were collected from 140 girls in the one-on-one mentoring program and 173 girls in the group mentoring program (2017).

Stoeger et al. (2017) results indicated group online mentoring was more effective than one-on-one mentoring. In all four aspects being examined, STEM communication, networking, course selection, and STEM interest, group mentoring reflected the greatest effectiveness (2017). First, the participants in the group mentoring program had significantly more STEM-related communication than the one-on-one mentoring group

(2017). Next, the study showed an increase in the STEM-related networking with the participants in the group mentoring program compared to the one-on-one mentoring program (2017). Then, after six months of being in the CyberMentor program, participants in group mentoring showed more interest in STEM electives than those in the one-on-one mentoring (2017). Finally, the more central or immersed in their networking groups the participating girls were the more positive influence the experience had on their STEM interests. The participants in the group mentoring program were more immersed in networking than those in the one-on-one group (2017). As a result of the study, Stoeger et al. (2017) concluded that group mentoring fostered and encouraged more girls in STEM than did one-on-one mentoring. Therefore, online group mentoring should be considered an option for schools and programs seeking to increase girls' STEM interest.

STEM Education

Craig (2014) conducted a study to show the impact that participating in robotics has on girls' self-confidence and abilities in STEM. He found that spatial abilities, critical thinking skills, and problem solving skills, which are skills needed by engineers and scientists, are fostered and developed through robotics. He suggested that these skills will help inspire girls to pursue STEM careers. His study also showed that negative stereotypes could be diminished when girls have safe environments within which to explore STEM. Additionally, he stated that girls who are given the opportunity to participate in such programs can become more interested and skilled in STEM education.

Moreover, Gomoll, Hmelo-Silver, Sabanovic, and Francisco (2016) conducted a case study with 13 to 18 year olds to determine if a robotics program impacted students' interests in STEM. They introduced a human centered robotics program to a boys and girls' club. There were 20 males and 26 females who were interested in participating in the 11 weeks robotics program. Participants were asked to "design and build a telepresence robot that could be used to communicate with a distant group of students" in another state (p. 901). Participants had the opportunity to brainstorm, design and build this robot while collaborating with others on a real world scenario (Gomoll et al., 2016). The researchers provided the facilitators with lessons to be implemented with the participants to foster creativity, collaboration, critical thinking, and engineering skills (Gomoll et al., 2016). Facilitators included college researchers and college students from the Informatics and Science department in the local university. Participants were interviewed before and after the robotics program with the goal to examine any changes in their STEM perceptions or abilities (Gomoll et al., 2016).

During the robotics program, the researchers set up cameras and microphones to record three groups of students as they worked on their task. Gomoll et al. (2016) primarily focused on four specific female participants who attended the program on a regular basis. These four females were in the seventh and eighth grades. The researchers transcribed the four females' communication with their group members and looked for behaviors that represented engagement and interest (2016). They viewed the recordings and the participants' interview responses to gather more insight into their STEM interests (2016). Results showed that all four girls were engaged in building and designing the robot to fulfill a task. The participants learned how to brainstorm, communicate, collaborate, and build a robot to solve a real world problem (Gomoll et al., 2016). One of the girls participating in the study shared in her interview that what she knew about robots was from television shows and cartoons, for she had no prior experience with them (2016). Gomoll et al., (2016) found that through this program, female students increased their interest in and engagement levels with STEM by designing and building robots. They stated that because the girls were given the opportunity to build and design robots, they were more likely to continue pursuing additional STEM courses and STEM opportunities and thus more likely to consider pursuing a STEM related career, particularly engineering (2016).

In order to attract more women to STEM careers, service and global learning should be incorporated within STEM (Clewell & Campbell, 2002). Using real world situations to teach problem solving to girls can help engage them in STEM learning (Halpem et al. 2007). Gurian and Stevens (2004) found that if girls were provided learning opportunities in real world situations and science problem solving opportunities, their attitudes and perceptions of science might improve. According to the National Academy of Engineering (NAE) (2008), women relate to the social value or purpose of what they study, so selecting engineering lessons that demonstrate real-world connections may help them be more successful in their learning.

Wolverton et al. (2015) conducted a qualitative case study of women with STEM careers. They interviewed a variety of women holding a vast range of STEM degrees. In an interview with Dr. Sharon Hays, she stated that girls need to be encouraged in STEM at an early age if the number of women in STEM fields is to increase. She believed this to be important because science is a field where a stable foundation in science education is critical to be successful. She emphasized the significance of engaging students in STEM education in elementary school since this is where students begin to form their foundational learning. She added that if schools wait to introduce STEM to girls later in their educational careers, she feared that it would be too late to spark and maintain interest.

Similarly, Yanyan, Huang, Jiang, and Chang (2016) conducted a study to determine if fourth graders' science and problem solving skills increased when an engineering design-based approach was utilized. The study included 30 participants (10 females and 20 males) who were divided into control and experimental groups. The control group utilized a common pedagogical approach with Lego bricks, while the experimental group used an engineering design-based approach with the same Lego bricks. Within each group, smaller working groups were created, allowing for two males and one female per small group. Students were given a pre-test and post-test where their performance was examined. An analysis of participants' performance and problem solving abilities was conducted based on the two assessments. The results demonstrated growth in both the control and experimental groups regarding performance in science. No significance was found in the experimental group compared to the control group in relation to their science performance. However, Yanyan et al. (2016) found that participants who used the engineering design-based approach demonstrated a higher level of problem solving skills and abilities. They also found that the male participants in the experimental group had a higher problem solving ability and science performance than the females in the group (2016). Classroom observations revealed that females were less engaged in the engineering design-based lessons and were less willing to participate in discussions than males. They found that the female participants' lack of engagement and participation resulted in lower science performance and problem-solving ability on the assessments (2016).

Out-of-school Time Programs

Out-of-school time (OST) programs can be beneficial in bridging the STEM achievement gender gap. OST's give girls opportunities to engage in STEM related learning that they may not receive during the school day (Sammet & Kekelis, 2016). Moreover, these additional opportunities can spur interest in STEM and in those programs that initial STEM interest can be fostered and nurtured. Sammet and Kekelis (2016) discussed two strategies that can "recruit and retain girls in STEM, and strengthen the STEM ecosystem" (p. 5). The first strategy focused on the audience and knowing girls' needs. It is critical to truly understand who will be targeted. Sammet and Kekelis (2016) mentioned that no STEM program will fit all female students so it is important to identify what interests them, as individuals. The authors suggested that this be done early in the child's education, as elementary students. Sammet and Kekelis (2016) also stated that STEM OST programs should focus on real world problems that either relate to the students themselves or the community in which they live. They suggested that girls thrive on participating in opportunities where they can help solve problems and see the worth in their solutions. Creating a safe environment where girls can take risks in learning and creating possible solutions for real world problems is also critical in increasing their STEM interest (Sammet & Kekelis, 2016).

The second strategy that Sammet and Kekelis (2016) identified involved strengthening and increasing the "girl-centric ecosystem" (p. 12). According to Sammet and Kekelis (2016), the word ecosystem in this context refers to the always changing interactions between female students, their families, the community, and their culture. Because these interactions can fluctuate, they stressed the importance of building strong relationships. One component of this ecosystem, parental support, is very critical because female students look to their parents as role models (Sammet & Kekelis, 2016). To maintain a positive influence, OST programs need to embrace students' home lives and engage their families in a partnership (Sammet & Kekelis, 2016). They (2016) suggested that OST programs include parents in their daughters' STEM learning since girls view their parents as role models. The interaction between the girl and the community is just as important as the one between the daughter and the parent. Sammet and Kekelis (2016) stressed the importance of OST programs creating stable and positive partnerships with community members so female students can meet female STEM role models who might acquaint them with their various job roles in STEM that may possibly interest them in the future.

Summary of Findings

Much research has focused on gender inequality in STEM (Hughes, 2014) and on the self-efficacy of girls (Wallace & Hattingh, 2014; Chukwurah & Klein-Gardner, 2014). Inspiring girls in STEM has also been a prevalent topic in the literature (Bystydzienski, Eisenhart, & Bruning, 2015). Archer et al. (2010) found that both boys and girls considered science related activities to be masculine and that girls did not pursue science careers because they considered them to be risky and dangerous. It was also found that many perceived scientists to be white, old, middle class men (Mead & Metraux, 1957). These inaccurate and negative perceptions contribute to gender inequality in science. However, there are also many promising strategies and initiatives in the literature related to improving STEM education for girls, motivating girls to consider pursuing STEM courses and STEM careers, and persisting in those careers including mathematics camps (Frost & Wiest, 2007), opportunities to explore robotics (Craig, 2014), pairing young girls with female role models in STEM (Betx, 1994; Buck, Plano Clark, Leslie-Pelecky, Lu, and Cerda-Lizarraga, 2007) and more.

Conclusion

Froschl and Sprung (2014) stated that the U.S. cannot afford to increase the current gender gap compared to the rest of the world in STEM education. They argued that the perspective of women is greatly needed in all STEM fields. In addition, women are grossly underrepresented in engineering fields in the United States (Cunningham, 2016). According to the United States Congress Joint Economic Committee (2012), by 2018, 63% of jobs will require a skillset in STEM. To meet that requirement and to make sure innovation and productivity continues to improve, more individuals will need the skills associated with STEM disciplines (Klobuchar, 2014). But, will women be the targeted population since they are considered the minority in STEM careers, or will men continue to be the gender to take advantage of STEM experiences and opportunities? Plato (1922) argued that if we expect women and men to do the same things, then they need to be taught the same things. If we want girls to be successful in science, it is our responsibility to make sure we are supporting them as they develop their skillsets in STEM (Chatman et al., 2008). We need to help them perceive STEM more positively, build their confidence, and squelch the gender stereotypes that may be associated with STEM careers.

A famous African proverb states, "If you educate a boy, you educate one person. If you educate a girl, you educate a family- and a whole nation." Throughout history, women have been the caregivers and have passed on their beliefs, perceptions and cultural beliefs to their daughters to help them be successful (Lyon, 2014). By educating girls in STEM, mothers will be better equipped and more readily aware of passing positive perceptions, self-efficacy and STEM interests to their daughters (2014), thus encouraging more girls to get involved in STEM education. Girls can play a critical role in increasing the number of innovators, engineers, researchers, and developers to ensure the growth of the United States' economy (Wallace & Hattingh, 2014). This chapter included a literature review of the ideas involved in this study related to STEM self-efficacy and females. Chapter 3 includes an overview of the research problem, research purpose and questions, research design, population and sample, instrumentation, data collection procedures, data analysis, and research design limitations for this study.

CHAPTER III:

METHODOLOGY

The purpose of this sequential mixed-methods study was to examine the influence of participating in a STEM Academy on girls' STEM self-efficacy. Girls in a sixth grade STEM Academy were individually matched to sixth grade girls not participating in the STEM Academy located in an urban school district in southeast Texas. Participants were administered the *Student Attitudes toward STEM* (S-STEM) *–Middle and High School Students (6-12th grades) Survey*. During two specified times during the semester, 10 girls in the STEM Academy participated in one semi-structured focus group. Quantitative data were analyzed using independent t-tests to establish the baseline equivalence, while qualitative data were analyzed using a blend of priori and inductive thematic coding process. This chapter presents an overview of the research problem, operational definitions of the theoretical constructs, the purpose of the research and corresponding research questions, research design, population and sampling of the participants, instrumentation, data collection and analysis, ethical considerations, and the limitations of this study.

Overview of the Research Problem

Typically, boys tend to be more confident in their mathematics and science abilities compared to girls (Libarkin & Kurdziel, 2003). In many K-12 STEM classes, boys are more likely than girls to be given the opportunity to engage with materials, problem solve, and communicate their findings (Chatman et al., 2008). Without these opportunities or experiences, girls may lose interest in science, technology, engineering, and mathematics by the time they reach fifth grade (Chen & Zimmerman, 2007). If this occurs, the gender gap may not decrease, but may in fact continue to increase. Fenema (2000) found that boys were more confident and assertive than girls in mathematics and science classrooms. This lack of confidence in girls in STEM is evident at an early age (Steinke, 1999). Building girls' STEM self-esteem and STEM confidence will improve their STEM performance and they will be more likely to realize that science, engineering, and mathematics may, in fact, be viable career choices (Frize et al., 2009). For if girls are expected to be successful in science then they need to be offered experiences that are designed to develop STEM related skills (Chatman et al., 2008). To ensure this happens educators should provide a learning environment that builds girls' interests and skills in science (Chatman et al., 2008).

Operationalization of Theoretical Constructs

This study includes five constructs: (a) mathematics self-efficacy, (b) science self-efficacy, (c) engineering self-efficacy, (d) technology self-efficacy, and (e) attitude towards STEM. Self-efficacy is defined as beliefs that individuals have related to their abilities to complete a given task (Bandura, 1994). Science, Technology, Engineering, and Mathematics (STEM) self-efficacy is an umbrella for the four constructs: (a) science self-efficacy, (b) technology self-efficacy, (c) engineering self-efficacy, and (d) mathematics self-efficacy. Mathematics self-efficacy will be defined as an individuals' belief on how well they perform a mathematical task and assess their abilities to perform that task. Science self-efficacy will be defined as individuals' beliefs related to performing scientific tasks and assessing how well it is performed. Engineering self-efficacy will be defined as an individual's belief in how well he or she can perform an engineering task and assess their performance. Technology self-efficacy will be defined as individuals' beliefs related to their abilities to integrate and use technology. Attitude is defined as an individual's feeling about carrying out specific behaviors (Ajzen, 1991). These five constructs were measured using the *Student Attitudes toward STEM* (S-STEM) –*Middle and High School Students (6-12th grades) Survey*.

Research Purpose, Questions, and Hypotheses

The purpose of this sequential mixed-methods study was to examine the influence of participating in a STEM Academy on girls' STEM self-efficacy. This study addressed the following research questions:

1. Does participation in a sixth grade STEM Academy influence girls' self-efficacy in mathematics?

   H_a: Participation in a sixth grade STEM Academy does influence girls' self-efficacy in mathematics.

2. Does participation in a sixth grade STEM Academy influence girls' self-efficacy in science?

   H_a: Participation in a sixth grade STEM Academy does influence girls' self-efficacy in science.

3. Does participation in a sixth grade STEM Academy influence girls' self-efficacy in engineering and technology?

   H_0: Participation in a sixth grade STEM Academy does not influence girls' self-efficacy in engineering and technology.

4. Is there a statistically significant mean difference in girls' STEM self-efficacy between pre and post survey data in the STEM Academy?

   H_0: There is not a statistically significant mean difference in girls' STEM self-efficacy between pre and post survey data in the STEM Academy.

5. How does participation in a sixth grade STEM Academy affect girls' perceptions of STEM self-efficacy?

Research Design

For this study, a sequential mixed methods approach (QUAN→qual) was used to examine whether participation in a sixth grade STEM Academy influences girls' STEM self-efficacy. The design included a quantitative component and a qualitative component. An advantage to utilizing this design was to allow for a more complete and comprehensive analysis of the quantitative results by following up with a qualitative phase. Sixth grade girls in the STEM Academy were individually matched with sixth grade girls not participating in the STEM Academy located in a large urban school district in southeast Texas. Participants were administered the *Student Attitudes toward STEM* (S-STEM) *–Middle and High School Students (6-12th grades) Survey*. The qualitative component included a focus group consisting of 10 STEM Academy girls to gather further information on their STEM self-efficacy. The quantitative data were analyzed using independent t-tests, while qualitative data were analyzed using a priori and inductive thematic coding process to determine any emerging themes.

Population and Sample

The population of the study consisted of students from a large urban school district in southeast Texas. According to the Texas Education Agency (TEA, 2016), this school district was designated as an Industry Cluster Innovative Academy (ICIA). The school district consisted of 45 schools (24 elementary schools, six intermediate schools, six middle schools, and nine high schools) and had a student population of approximately 46,223 students. Table 3.1 provides the demographics of the student district data according to the 2017-2018 Texas Academic Performance Report (TAPR, 2018). The school district's student population included 52.0% were males, 48.0% females, 29.0% African American, 53.1% Hispanic, 4.0% White, 1.1% American Indian, 12.0% Asian, 0.1% Pacific Islander, and 0.6% two or more races. The district's population also included 79.7% Economically Disadvantaged, 77.8% At-Risk, 43.6% English Language Learners, 4.4% Gifted & Talented and 7.3% Special Education.

Table 3.1

Student Demographics of the District

	Frequency (n)	Percentage (%)
1. Gender		
Male	24,036	52.0
Female	22,187	48.0
2. Race/Ethnicity		
African American	13,393	29.0
American Indian	509	1.1
Asian	5,525	12.0
Hispanic	24,566	53.1
Pacific Islander	63	0.1
White	1,872	4.0
Two or more races	295	0.6
3. Socioeconomic Status		
Economically Disadvantaged (Eco-Dis)	38,273	82.6
At-Risk	34,782	75.1
4. Special Populations		
English Language Learners	19,784	42.7
Gifted & Talented	2,048	4.4
Special Education	3,364	7.3
Student Total (N)	46,223	

Of the 45 schools in the district, there was one high school designated as an Industry Cluster Innovative Academy (ICIA) and eight schools with a STEM Academy on their campus (two middle schools, two intermediate schools, and four elementary schools). For this study, only one of the eight schools having a STEM Academy on campus was selected to participate. The other seven schools were not selected because they did not meet the following criteria: (a) administrative and teacher support, (b) proximity to the researcher's office, (c) availability of the students to participate in the study, (d) meeting state standards on the state assessments, and (e) larger population of girls enrolled in the STEM Academy. Due to these reasons, School A was the sole school with a STEM Academy to participate in the study. Table 3.2 provides student demographics for School A, as reported by the 2017-2018 Texas Academic Performance Report (TAPR, 2018). School A had a population of 1,044 students enrolled consisting of 51.0% males, 49.0% females, 26.1% African American, 44.4% Hispanic, 21.5% Asian, 5.6% White, 0.6% American Indian and 0.5% Pacific Islander, and 1.3% Two or More Races. School A's population also included 78.0% Economically Disadvantaged, 80.8% At-Risk, 35.2% English Language Learners, 10.0% Gifted & Talented, and 11.3% Special Education.

Table 3.2

Student Demographics of School A

	Frequency (n)	Percentage (%)
1. Gender		
Male	532	51.0
Female	512	49.0
2. Race/Ethnicity		
African American	273	26.1
American Indian	58	5.6
Asian	224	21.5
Hispanic	464	44.4
Pacific Islander	5	0.5
White	58	5.6
Two or more races	14	1.3
3. Socioeconomic Status		
Economically Disadvantaged (Eco-Dis)	814	78.0
At-Risk	844	80.8
4. Special Populations		
English Language Learners	399	36.0
Gifted & Talented	104	10.0
Special Education	118	11.3
Student Total (N)	1,044	

The sixth grade STEM Academy in School A had a population of 120 female students. Of this population, 19.2% were African American, 36.7% Hispanic, 33.3% Asian, 3.3% White, 1.7% American Indian, 2.5% Pacific Islander, and 3.3% Two or More Races. The STEM Academy's population also included 78.0% Economically Disadvantaged, 74.2% At-Risk, 44.2% English Language Learners, 21.7% Gifted & Talented and 2.5% Special Education. There were 133 female students not enrolled in the sixth grade STEM Academy program. This population also included 24.1% African American, 57.9% Hispanic, 14.3% Asian, 2.3% White, 0.8% American Indian, 0.0% Pacific Islander, and 0.0% Two or More Races. Additionally, this population consisted of 88.0% Economically Disadvantaged, 91.8% At-Risk, 63.2% English Language Learners, 3.8% Gifted & Talented and 12.0% Special Education. From School A, sixth grade girls participating in the STEM Academy were individually matched with sixth grade girls not participating in the STEM Academy. Participants were matched according to the following criteria: Race/Ethnicity, Economically Disadvantaged, At-Risk, English Language Learners, and a passing grade of 70 or more in all subjects (Reading, Writing, Mathematics, Science, and Social Studies) in the previous school year in fifth grade. Table 3.3 represents the demographics of the female students in the sixth grade STEM Academy program and female students not in the STEM Academy program at School A.

Table 3.3

Demographics of the Female Sixth Grade Students in School A

	STEM Academy (n)	STEM Academy (%)	Non-STEM Academy (n)	Non-STEM Academy (%)
1. Race/Ethnicity				
African American	23.0	19.2	32.0	24.1
American Indian	2.0	1.7	1.0	0.8
Asian	40.0	33.3	19.0	14.3
Hispanic	44.0	36.7	77.0	57.9
Pacific Islander	3.0	2.5	0.0	0.0
White	4.0	3.3	3.0	2.3
Two or More Races	4.0	3.3	0.0	0.0
2. Socioeconomic Status				
Economically Disadvantaged (Eco-Dis)	85.0	70.8	117.0	88.0
At-Risk	89.0	74.2	122.0	91.8
3. Special Populations				
English Language Learners	53.0	44.2	84.0	63.2
Gifted & Talented	26.0	21.7	5.0	3.8
Special Education	3.0	2.5	16.0	12.0
Student Total (N)	120		133	

Participant Selection

Sixth grade girls enrolled in School A of a large urban school district in southeast Texas were invited to participate in this study. Two participant sample groups were utilized in this study, sixth grade girls enrolled in the STEM Academy program and those not enrolled in the STEM Academy program. All sixth grade girls enrolled in School A were given Parent Consent/Student Assent forms. Students in the STEM Academy program who returned the Parent Consent/Student Assent forms were individually matched with a student not participating in the STEM Academy program who also returned the Parent Consent/Student Assent form. These students were invited to participate in the *Student Attitudes toward STEM* (S-STEM) *–Middle and High School Students (6-12th grades)*survey. There were an equal number of girls enrolled in the STEM Academy program and girls not enrolled in the STEM Academy program who participated in the *S-STEM* survey. Only girls in the STEM Academy were purposefully selected for the focus groups to gather more insight on their STEM self-efficacy while participating in the STEM Academy. Students were selected to match the district's demographics of race/ethnicity.

Instrumentation

The *Student Attitudes toward STEM* (S-STEM) *–Middle and High School Students (6-12th grades) Survey* was used to examine if participating in a STEM Academy effects girls' self-efficacy in STEM. This survey was designed by the Friday Institute for Educational Innovation at North Caroline State University to determine students' attitudes and self-efficacy regarding STEM, mathematics, science, engineering and technology, and 21st century skills (2012). The survey instrument was piloted to 109 students from sixth to 12th grade who were already participating in a program within the National Science Foundation (NSF) outreach project and revisions were made to the survey based on responses and data collection. It was administered again to 9,081 students in the 6^{th}-12^{th} grades and revisions were made according to teacher and student feedback regarding appropriateness of the item and its' function.

The survey consisted of three validated constructs: (a) mathematics, (b) science, and (c) engineering and technology. The mathematics construct contained 8-items, science construct contained 9-items, and the engineering and technology construct contained 9-items (see Table 3.4). Participants were asked to use Likert's 5-point scale (1 = *Strongly Disagree* to 5 = *Strongly Agree*). The researcher calculated Cronbach's Alpha for each individual construct. The Cronbach's Alpha's reliability coefficients for the mathematics construct was 0.90, science was 0.86, and engineering and technology was 0.82. The overall Cronbach's Alpha's reliability coefficient for the instrument (mathematics, science, and engineering and technology) was 0.86.

Table 3.4

Construct Descriptions for the S-STEM Survey

Subscales	Description
1. Mathematics	1. Math has been my worst subject. 2. I would consider choosing a career that uses math. 3. Math is hard for me. 4. I am the type of student to do well in math. 5. I can handle most subjects well, but I cannot do a good job with math. 6. I am sure I could do advanced work in math. 7. I can get good grades in math. 8. I am good in math.
2. Science	9. I am sure of myself when I do science. 10. I would consider a career in science. 11. I expect to use science when I get out of school. 12. Knowing science will help me earn a living. 13. I will need science for my future. 14. I know I can do well in science. 15. Science will be important to me in my life's work. 16. I can handle most subjects well, but I cannot do a good job with science. 17. I am sure I could do advanced work in science.
3. Engineering & Technology	18. I like to imagine creating new products. 19. If I learn engineering, then I can improve things that people use every day. 20. I am good at building and fixing things. 21. I am interested in what makes machines work. 22. Designing products or structures will be important for my future work. 23. I am curious about how electronics work. 24. I would like to use creativity and innovation in my future work. 25. Knowing how to use math and science together will allow me to invent useful things. 26. I believe I can be successful in a career in engineering.

Data Collection

Quantitative

Approval from University of Houston-Clear Lake's (UHCL) Committee for the Protection of Human Subjects (CPHS), as well as the school district's Institutional Review Board (IRB) was obtained prior to collecting data. After permission was granted, the researcher distributed Parent Permission/Student Assent forms to the parents via the students' take home folders. All girls in the sixth grade received a Parent Consent/Student Assent form asking permission to administer the *Student Attitudes toward STEM* (S-STEM) *–Middle and High School Students (6-12th grades) Survey* at two different points of the semester, August and December. All Parent Permission/Student Assent forms were stored in a secured file cabinet for five years. After the five-year time period expired, all forms will be destroyed. Students in the STEM Academy, with consent, were individually matched with students not participating in the STEM Academy, with consent to be administered the survey.

Sixth grade girls with parent permission were given the *Student Attitudes toward STEM* (S-STEM) *–Middle and High School Students (6-12th grades) Survey*. The survey was converted into a Google Form and participants completed the survey using a given iPad. The researcher selected two times (August and December) during the semester to administer the survey in School A's science lab to the girls whom returned signed assents. Participating students completed the survey on a Google Form where results were automatically tabulated and collected on Google Sheets. The researcher set up the Google Form to permit only one response to the survey by each student. Students entered their school identification number to ensure consistent individual matching across the two times that the survey was administered. Upon completion of the survey, the researcher closed the survey preventing any more responses from being entered. A schedule was set up for students to come to the science lab to complete the survey using iPads the researcher had available. The researcher explained the purpose of the study to participants and they were notified that they may stop the survey at any time or opt out of taking it. Participants also were notified that the study was voluntary and their responses would remain anonymous and confidential. The results of the survey were printed out and stored in a secure file cabinet for five years until it will be destroyed by the researcher. The survey link was stored on a password protected Google Drive. The response tab on the Google Form survey was turned off preventing future responses. Responses to the Google Form were placed in a password protected folder on the researcher's computer and in the researcher's office within a locked file cabinet for five years when it will be destroyed.

Qualitative

The qualitative component of the study included one focus group with 10 girls in the STEM Academy program. A purposeful sample of girls in the STEM Academy was selected based on the district's race/ethnicity demographics. Each focus group occurred in the Science lab of the school on dates established by the researcher and the schools' campus leaders. Girls in the STEM Academy were invited to participate in a focus group which lasted approximately one hour. For this study, students participated in the interview twice during the school year, prior to participating in the STEM Academy and at the end of the fall semester. This was to examine if students' STEM self-efficacy changed during the semester after participating in the program. Students were notified that they may stop the interview at any time or opt out of participating in it. Participants were also notified that the study was voluntary and their responses would remain confidential. A digital recording device was utilized during the focus group and the recording was transcribed later onto a Microsoft Word document. Participants were asked open ended questions about their attitudes and self-efficacy related to STEM. These questions were designed to provide additional information on girls' STEM self-efficacy. To keep their confidentiality and to ensure the same participants were interviewed during both times of the study, participants gave the researcher their student identification number. During the interviews, the researcher made every attempt to be objective. The names of the school district, schools, and participants selected for this study were given pseudonyms as a means of protecting their identities.

Data Analysis

Quantitative

All quantitative data from each of the administrations were converted from the Google Sheets to a Microsoft Excel spreadsheet. The Excel spreadsheet was then imported into IBM Statistical Package for the Social Sciences (IBM SPSS) where the data were analyzed. To answer research question one, ANCOVA was used to determine if participation in a sixth grade STEM Academy influenced girls' self-efficacy in mathematics. The independent variable was a categorical variable representing participating or not participating in the STEM Academy program. The dependent variable, self-efficacy in mathematics, was a continuous variable. For research question two, the data were further examined using independent samples t-tests to determine if participation in a sixth grade STEM Academy influenced girls' self-efficacy in science. The independent variable was a categorical variable representing participating or not participating in the STEM Academy program. The dependent variable, self-efficacy in science, was a continuous variable.

To further analyze research question three, independent samples t-tests were used to determine if participation in a sixth grade STEM Academy influenced girls' self-efficacy in engineering and technology. The independent variable was a categorical variable representing participating or not participating in the STEM Academy program. The dependent variable, self-efficacy in engineering and technology, was a continuous variable. For research question four, a paired t-test was used to determine if a statistically significant mean difference existed in STEM Academy girls' STEM self-efficacy comparing pre- and post-survey data. The independent variable was a categorical variable: (a) participating in the STEM Academy and (b) not participating in the STEM Academy. The dependent variable, self-efficacy in mathematics, science, and engineering and technology was a continuous variable. Statistical significance was measured using a p-value of 0.05 and Cohen's d and r^2 were used to calculate effect sizes.

Qualitative

After quantitative data were analyzed, the findings were utilized to form a focus group of 10 students to gain a more complete and comprehensive understanding of whether or not participation in a sixth grade STEM Academy influenced their perceptions of STEM self-efficacy. For research question five, data were obtained from the focus groups and analyzed using a thematic analysis approach. After the interviews were transcribed, each student's responses were copied and pasted onto an individual Microsoft Word document using pseudonyms. Each Microsoft Word document was uploaded to NVivo and a blend of priori and inductive codes were used to analyze the qualitative data. The researcher looked for trends and patterns in each of the participant's responses such as career interests, course selection, STEM pathway, favorite subject, feelings about mathematics and science, feelings about STEM learning, feelings changed about STEM, majoring in STEM, and participating in the STEM Academy. From there, participants' responses were grouped according to these themes. Within these themes, responses were coded into subcategories. Results were organized, categorized, and subcategorized based on the themes that emerge.

Qualitative Validity

The qualitative analysis process included validation by utilizing triangulation of students' survey responses to the responses in the focus group. Responses to the survey and focus group questions were matched using student identification numbers. The interview questions were peer reviewed by experienced educators including district level administrators to guarantee the questions asked in the interview would permit the researcher to collect the data needed to answer the research questions. The peer reviews served the purpose of obtaining feedback related to questions posed to students about their attitudes and self-efficacy in STEM, science, mathematics, and engineering and technology. During the qualitative coding phase, the researcher constantly safeguarded against subjective interpretations as themes emerge.

Privacy and Ethical Considerations

Permission was obtained from University of Houston Clear Lake's CPHS and the participating school district's IRB prior to collecting data. Parent permission was obtained using a Parent Consent/Student Assent form since participants were under the age of 18. Signed consent and assent forms were stored in a locked file cabinet in the researcher's office for five years after which they will be destroyed. Participants were notified that survey and focus group responses would remain confidential. It was also made clear that participants could stop the survey and/or focus group at any time, if they chose to do so. The results of the survey were printed out and stored in a secure file cabinet for five years until it will be destroyed by the researcher. The survey link was stored on a password protected Google Drive. After data concluded, the response tab on the Google Form survey was turned off, preventing any future responses. Responses to the Google Form were placed in a password protected folder on the researcher's computer and in the researcher's office within a locked file cabinet for five years, after which it will be destroyed.

Participants were informed that their responses during the focus group interviews and their identities would remain confidential. During the interviews, the researcher made every attempt to be objective. The names of the school district, schools, and participants selected for this study were given pseudonyms as a means of protecting their identities. Data collected from the participants, transcriptions of interviews, and the digital recording device were stored on a flash drive that was stored in a locked file cabinet in the researcher's office for five years before being destroyed.

Limitations of the Study

In this study, there were a number of limitations. First, the study may not be able to be replicated because other districts may not have a STEM Academy on their campuses. Thus, caution should be taken when considering implementing this study in other school districts as the results may not be generalizable to other school districts. Second, prior to enrolling in the STEM Academy, students in this study may have participated in a STEM program, during school, after school, on weekends, or in the summer. This could potentially impact the validity of the responses to the survey and interviews because students' self-efficacy may have been influenced by one of these programs, not the STEM Academy program. Therefore, future studies should be made aware of students' prior engagement in STEM opportunities as a reason to enroll in a STEM Academy. Third, some STEM Academy teachers may be new to teaching or new to STEM which could impact girls' self-efficacy. This could result in students not receiving as much STEM-related instruction as other STEM Academy classrooms. As a result, generalizability may be questionable.

Fourth, another limitation is the sole selection of School A. For this study, only one of the eight schools that had a STEM Academy on campus was selected to participate. The other seven schools were not selected because they did not meet the following criteria: (a) administrative and teacher support, (b) proximity to the researcher's office, (c) availability of the students to participate in the study, (d) meeting state standards on the state assessments, and (e) larger population of girls enrolled in the STEM Academy. Due to these reasons, School A was the only school with a STEM Academy to participate in the study.

Fifth, the participants may come to the STEM Academy program already with a high self-efficacy in mathematics, science, engineering, technology, and STEM. This could invalidate findings because they already had a high self-efficacy. Sixth, the increase in self-efficacy could be a result of a variety of reasons. The teacher's instruction, teacher experience, participation in other STEM programs, parent and teacher influence, out of school time programs or events, and family engagement events may all play a role in students' self-efficacy, not necessarily the STEM Program. Those not participating in the STEM Academy may have a higher self-efficacy due to these reasons, as well. It is important to take note of any outside factors or influences that may contribute to a change in self-efficacy, for participants in the STEM Academy as well as those not participating in the program.

A seventh limitation occurred between the first and second administration of the survey. One student participating in the STEM Academy program moved to another school district, thus the researcher had to identify another student to replace her. Eighth, during the focus groups, participants had a difficult time trying to express their feelings and thoughts. Many of the participants struggled with verbalizing what they wanted to say, limiting what the participants said during the focus groups. A ninth limitation is that the students applied to be in the STEM Academy program, they were not randomly selected. As such, participants would already have an interest in STEM thus driving them to apply. This could invalidate results because they already had a high self-efficacy in STEM or an interest which contributed to their participation. A tenth limitation was that the sample size of matched participants was small, consisting of 28 students which prevented from the researcher analyzing a larger data collection. A larger sample size may result in different findings. Finally, the last limitation was that the survey was not given in Spanish. Some students struggled with understanding what the questions were asking and sought clarification from the researcher. This lack of comprehension of English may result in invalid data that was collected.

Conclusion

The purpose of this sequential mixed methods study was to examine the influence of participating in a sixth grade STEM Academy on girls' STEM self-efficacy. This chapter provided an overview of the research problem, operationalization of theoretical constructs, research purpose, questions, research design, population and sampling selection, instrumentation, data collection procedures, data analysis, privacy and ethical considerations, and the limitations of the study. Chapter 4 will include a detailed description of the demographic characteristics of the participants, followed by the findings for each of the research questions.

CHAPTER IV:

RESULTS

The purpose of this sequential mixed-methods study was to examine the influence of participating in a STEM Academy on girls' STEM self-efficacy. Participants were administered the *Student Attitudes toward STEM* (S-STEM) *–Middle and High School Students (6-12th grades) Survey* twice during the fall semester, August and December, to observe any possible any changes in their self-efficacy. This chapter includes a detailed description of the demographic characteristics of the participants in this study. It also includes a thorough analysis of the quantitative and qualitative data that were obtained.

Participant Demographics

The quantitative part of the research study included a total of 56 individually matched participants, 28 students enrolled in the STEM Academy program and 28 students not enrolled in the STEM Academy program. Prior to the start of the school year, sixth grade girls intending to participate in the STEM Academy were individually matched to sixth grade girls not intending to participate in the STEM Academy. Participants were matched according to the following criteria: Race/Ethnicity, Economically Disadvantaged, At-Risk, English Language Learners, and a passing grade of 70 or more in all subjects (Reading, Writing, Mathematics, Science, and Social Studies) the previous school year.

The demographics of the participants in the STEM Academy program were as follows: 28.6% African American, 50.0% Hispanic, 3.6% White, 14.3% Asian, and 3.6% American Indian. Of the 28 participants in the STEM Academy program, 92.9% were Economically Disadvantaged, 89.3% At-Risk and 14.3% English Language Learners. Students were also required to receive a passing grade of 70 or more the previous school year when they were in fifth grade to apply for the STEM Academy and 100% of participants met this criterion. The demographics of the participants not enrolled in the STEM Academy program were as follows: 28.6% African American, 50.0% Hispanic, 3.6% White, 14.3% Asian, and 3.6% American Indian. Of the 28 participants in the non-STEM Academy program, 92.9% were Economically Disadvantaged, 89.3% At-Risk and 14.3% English Language Learners. Students were required to receive a passing grade of 70 or more the previous school year when they were in fifth grade and 100% of participants met this criterion. Table 4.1 shows the demographics of the participants matched for this study.

Table 4.1

Surveys: Matched Participant Demographics

	STEM Academy (n)	STEM Academy (%)	Non-STEM Academy (n)	Non-STEM Academy (%)
1. Race/Ethnicity				
African American	8	28.6	8	28.6
American Indian	1	3.6	1	3.6
Asian	4	14.3	4	14.3
Hispanic	14	50.0	14	50.0
White	1	3.6	1	3.6
2. Socioeconomic Status				
Economically Disadvantaged (Eco-Dis)	26	92.9	26	92.9
At-Risk	25	89.3	25	89.3
3. Special Populations				
English Language Learners (ELL)	4	14.3	4	14.3
4. Passing Grade of 70 or more				
Mathematics	28	100	28	100
Reading	28	100	28	100
Science	28	100	28	100
Social Studies	28	100	28	100
Writing	28	100	28	100
Student Total (N)	28		28	

Female students in the STEM Academy were invited to participate in a focus group. Ten students were selected based on their race/ethnicity demographics, which reflected the demographics of the school district as closely as possible. The demographics included 30.0% African Americans, 50.0% Hispanics, and 20.0% Asians. It also included 90.0% of students that are Economically Disadvantaged, 100.0% At-Risk, and 40.0% English Language Learners. Table 4.2 represents the demographics for the participants in the focus group sessions.

Table 4.2

Focus Groups: Participant Demographics

	STEM Academy (n)	STEM Academy (%)
1. Race/Ethnicity		
African American	3	30.0
Asian	2	20.0
Hispanic	5	50.0
2. Socioeconomic Status		
Economically Disadvantaged (Eco-Dis)	9	90.0
At-Risk	10	100.0
3. Special Populations		
English Language Learners (ELL)	4	40.0
Student Total (N)	10	

Instrument Reliability

Cronbach's alphas were calculated by the researcher to determine the reliability of each of the three constructs, mathematics, science, and engineering and technology. The researcher calculated Cronbach's Alpha for each individual construct. The Cronbach's Alpha's reliability coefficients for the mathematics construct was 0.90, science was 0.86, and engineering and technology was 0.82. The overall Cronbach's Alpha's reliability coefficient for the three constructs (mathematics, science, and engineering and technology) was 0.86 calculated by The Friday Institute for Educational Innovation (2012). According to Santos (1999), for an instrument to be considered acceptable, the reliability coefficients should be greater than 0.7. Table 4.3 shows the Cronbach's alpha for the S-STEM survey.

Table 4.3

Cronbach's Alpha for S-STEM

	Friday Institute for Educational Innovation (2012)	George (2018)
Entire S-STEM Survey	.860	.870
1. Mathematics	Not reported	.900
2. Science	Not reported	.860
3. Engineering and Technology	Not reported	.821

Research Question One

Research question one, *Does participation in a sixth grade STEM Academy influence girls' self-efficacy in mathematics?*, was answered using the eight items related to the mathematics construct of the S-STEM survey. The mathematics construct of the survey measured participants' attitudes and self-confidence in mathematics. Participants responded to a 5-point Likert Scale (1 = *Strongly Disagree*, 2 = *Disagree*, 3 = *Neutral*, 4 = *Agree*, 5 = *Strongly Agree*). At the beginning of the fall semester prior to the school year starting, a baseline equivalence of mathematics self-efficacy was established with participants intending to participate in the STEM Academy program and participants not intending to participate in the STEM Academy program. Table 4.4 shows the data from the baseline equivalence. Results of the independent t-test indicated that girls who were intending to participate in the STEM Academy program had a higher mathematics self-efficacy than the girls not intending to participate in the STEM Academy program, $t(54) = 2.935$, $p = 0.005$. On average, females who intended to enroll in the STEM Academy program (M = 28.36) reported a higher mathematics' self-efficacy than females who did not intend to enroll in the STEM Academy program (M = 23.00). This suggested that students in the STEM Academy program already had a high mathematics self-efficacy prior to the start of the program in the beginning of the school year.

Table 4.4

Baseline Equivalence: Mathematics Self-efficacy

Type of Program	N	M	SD	*t*-value	df	*p*-value	d
1.STEM Academy Program	28	28.36	5.91	2.94	54	.005*	.51
2.Non-STEM Academy Program	28	23.00	7.64				

*Statistically significant (p < .05)

At the end of the fall semester, the students participating in the STEM Academy program and students not participating in the STEM Academy program were administered the same survey as administered in the beginning of the fall semester to determine if participating in a sixth grade STEM Academy program influenced mathematics self-efficacy in girls. An ANCOVA test was conducted to determine if a statistically significant mean difference existed between program participation on mathematics self-efficacy controlling for self-efficacy prior to participation. Table 4.5 shows results from the ANCOVA test. Results indicated a statistically significant mean difference between groups in terms of mathematics self-efficacy when controlling for prior mathematics self-efficacy, $F(1, 53) = 8.41$, $p = 0.005$, $\eta^2 = 0.12$. Approximately 12.0% of the variance in mathematics self-efficacy after participation is attributable to the type of program enrolled in after controlling for prior mathematics self-efficacy. When prior mathematics self-efficacy was controlled, there was an increase in mathematics self-efficacy on pre- and post-survey data with comparing Group 1 and Group 2. Students in the STEM Academy program (M = 28.93) had a higher mathematics self-efficacy compared to the students not in the STEM Academy program (M = 24.21).

Table 4.5

Analysis of Covariance: Type of Program's Influence on Mathematics Self-Efficacy

Type of Program	N	M	SD	F-value	df	*p*-value	η^2
1. STEM Academy	28	28.93	6.92	8.41	1	.005*	.12
2. Non-STEM Academy	28	24.21	6.04				

*Statistically significant (p < .05)

A paired t-test was also conducted to determine if a statistically significant mean difference existed in the STEM Academy's girls' mathematics self-efficacy between their pre- and post- survey data. Results of the paired t-test indicated there was not a statistically significant mean difference between pre- and post-mathematics self-efficacy, $t(27) = -0.313$, $p = 0.757$. On average, girls' pre-survey data (M = 28.36) did not report a higher mathematics self-efficacy than on the post-survey data (M = 28.93). This suggested that there was not a difference between mathematics self-efficacy prior to the start of the program and at the end of the fall semester with girls in the STEM Academy. Table 4.6 shows the results of the paired t-test.

Table 4.6

Paired t-test: Mathematics Self-Efficacy of STEM Academy Participants

Type of Survey	N	M	SD	*t*-value	df	*p*-value
1. Pre-survey	28	28.36	5.91	-0.31	27	.757
2. Post-survey	28	28.93	6.92			

*Statistically insignificant ($p < .05$)

Differences were evident when comparing those participating in the STEM Academy to those not participating in the STEM Academy. For example, 21.4% participants in the STEM Academy program agreed/strongly agreed that mathematics is their worst subject, while more than twice (49.9%) the participants not in the STEM Academy program agreed/strongly agreed with this statement. Approximately 57.0% participants in the STEM Academy program responded that they agreed/strongly agreed to consider a career that uses mathematics, while only 25.0% participants not in the STEM Academy program said they would consider it. While 50.0% participants in the STEM Academy program agreed/strongly agreed that they do well in mathematics, only 32.1% participants not in the STEM Academy agreed/strongly agreed. Finally, 60.7% participants in the STEM Academy program agreed/strongly agreed that they felt they could do advanced work in mathematics, while 39.3% participants not in the STEM Academy program agreed/strongly agreed. Table 4.7 shows the expanded responses and Table 4.8 shows the collapsed responses.

Table 4.7

Expanded Responses to Mathematics Self-Efficacy for All Participants (%)

Survey Item	Type of Program	Type of Survey	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. Math has been my worst subject.	STEM Academy	Pre-Survey	17.9 (n = 5)	17.9 (n = 5)	46.4 (n = 13)	10.7 (n = 3)	7.1 (n = 2)
		Post-Survey	21.4 (n = 6)	42.9 (n = 12)	14.3 (n = 4)	17.9 (n = 5)	3.6 (n = 1)
	non-STEM Academy	Pre-Survey	17.9 (n = 5)	10.7 (n = 3)	21.4 (n = 6)	17.9 (n = 5)	32.1 (n = 9)
		Post-Survey	10.7 (n = 3)	21.4 (n = 6)	25.0 (n = 7)	17.9 (n = 5)	25.0 (n = 7)
2. I would consider choosing a career that uses math.	STEM Academy	Pre-Survey	0.0 (n = 0)	17.9 (n = 5)	32.1 (n = 9)	35.7 (n = 10)	14.3 (n = 4)
		Post-Survey	3.6 (n = 1)	17.9 (n = 5)	21.4 (n = 6)	28.6 (n = 8)	28.6 (n = 8)
	non-STEM Academy	Pre-Survey	10.7 (n = 3)	25.0 (n = 7)	39.3 (n = 11)	21.4 (n = 6)	3.6 (n = 1)
		Post-Survey	10.7 (n = 3)	17.9 (n = 5)	46.4 (n = 13)	21.4 (n = 6)	3.6 (n = 1)

(continued)

Table 4.7

Expanded Responses to Mathematics Self-Efficacy for All Participants (%) (cont.)

Survey Item	Type of Program	Type of Survey	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
3. Math is hard for me.	STEM Academy	Pre-Survey	17.9 (n = 5)	32.1 (n = 9)	17.9 (n = 5)	28.6 (n = 8)	3.6 (n = 1)
		Post-Survey	28.6 (n = 8)	21.4 (n = 6)	25.0 (n = 7)	17.9 (n = 5)	7.1 (n = 2)
	non-STEM Academy	Pre-Survey	0.0 (n = 0)	35.7 (n = 10)	17.9 (n = 5)	21.4 (n = 6)	25.0 (n = 7)
		Post-Survey	7.1 (n = 2)	21.4 (n = 6)	25.0 (n = 7)	25.0 (n = 7)	21.4 (n = 6)
4. I am the type of student to do well in math.	STEM Academy	Pre-Survey	0.0 (n = 0)	14.3 (n = 4)	39.3 (n = 11)	32.1 (n = 9)	14.3 (n = 4)
		Post-Survey	3.6 (n = 1)	10.7 (n = 3)	35.7 (n = 10)	35.7 (n = 10)	14.3 (n = 4)
	non-STEM Academy	Pre-Survey	28.6 (n = 8)	3.6 (n = 1)	35.7 (n = 10)	21.4 (n = 6)	10.7 (n = 3)
		Post-Survey	10.7 (n = 3)	25.0 (n = 7)	32.1 (n = 9)	25.0 (n = 7)	7.1 (n = 2)

(continued)

Table 4.7

Expanded Responses to Mathematics Self-Efficacy for All Participants (%) (cont.)

Survey Item	Type of Program	Type of Survey	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
5. I can handle most subjects, but I cannot do a good job with math.	STEM Academy	Pre-Survey	25.0 (n = 7)	35.7 (n = 10)	10.7 (n = 3)	28.6 (n = 8)	0.0 (n = 0)
		Post-Survey	28.6 (n = 8)	39.3 (n = 11)	10.7 (n = 3)	17.9 (n = 5)	3.6 (n = 1)
	non-STEM Academy	Pre-Survey	14.3 (n = 4)	28.6 (n = 8)	28.6 (n = 8)	3.6 (n = 1)	25.0 (n = 7)
		Post-Survey	14.3 (n = 4)	10.7 (n = 3)	39.3 (n = 11)	32.1 (n = 9)	3.6 (n = 1)
6. I am sure I could do advanced work in math	STEM Academy	Pre-Survey	3.6 (n = 1)	10.7 (n = 3)	17.9 (n = 5)	50.0 (n = 14)	17.9 (n = 5)
		Post-Survey	3.6 (n = 1)	14.3 (n = 4)	21.4 (n = 6)	28.6 (n = 8)	32.1 (n = 9)
	non-STEM Academy	Pre-Survey	21.4 (n = 6)	25.0 (n = 7)	28.6 (n = 8)	17.9 (n = 5)	7.1 (n = 2)
		Post-Survey	7.1 (n = 2)	14.3 (n = 4)	39.3 (n = 11)	25.0 (n = 7)	14.3 (n = 4)

(continued)

Table 4.7

Expanded Responses to Mathematics Self-Efficacy for All Participants (%) (cont.)

Survey Item	Type of Program	Type of Survey	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
7. I can get good grades in math.	STEM Academy	Pre-Survey	0.0 (n = 0)	3.6 (n = 1)	7.1 (n = 2)	67.9 (n = 19)	21.4 (n = 6)
		Post-Survey	0.0 (n = 0)	7.1 (n = 2)	28.6 (n = 8)	35.7 (n = 10)	28.6 (n = 8)
	non-STEM Academy	Pre-Survey	7.1 (n = 2)	10.7 (n = 3)	32.1 (n = 9)	35.7 (n = 10)	14.3 (n = 4)
		Post-Survey	0.0 (n = 0)	7.1 (n = 2)	42.9 (n = 12)	28.6 (n = 8)	21.4 (n = 6)
8. I am good at math.	STEM Academy	Pre-Survey	0.0 (n = 0)	17.9 (n = 5)	28.6 (n = 8)	39.3 (n = 11)	14.3 (n = 4)
		Post-Survey	0.0 (n = 0)	7.1 (n = 2)	35.7 (n = 10)	46.4 (n = 13)	10.7 (n = 3)
	non-STEM Academy	Pre-Survey	21.4 (n = 6)	3.6 (n = 1)	35.7 (n = 10)	32.1 (n = 9)	7.1 (n = 2)
		Post-Survey	10.7 (n = 3)	14.3 (n = 4)	39.3 (n = 11)	28.6 (n = 8)	7.1 (n = 2)

Table 4.8

Collapsed Responses to Mathematics Self-Efficacy for All Participants (%)

Survey Item	Type of Program	Type of Survey	Strongly Disagree/Disagree	Agree/Strongly Agree
1. Math has been my worst subject.	STEM Academy	Pre-Survey	35.7 (n = 10)	17.9 (n = 5)
		Post-Survey	64.3 (n = 18)	21.4 (n =6)
	non-STEM Academy	Pre-Survey	28.6 (n = 8)	50.0 (n = 14)
		Post-Survey	32.1 (n = 9)	42.9 (n = 12)
2. I would consider choosing a career that uses math.	STEM Academy	Pre-Survey	17.9 (n = 5)	50.0 (n = 14)
		Post-Survey	21.4 (n =6)	57.1 (n = 16)
	non-STEM Academy	Pre-Survey	35.7 (n = 10)	25.0 (n = 7)
		Post-Survey	28.6 (n = 8)	25.0 (n = 7)

(continued)

Table 4.8

Collapsed Responses to Mathematics Self-Efficacy for All Participants (%) (cont.)

Survey Item	Type of Program	Type of Survey	Strongly Disagree/Disagree	Agree/Strongly Agree
3. Math is hard for me.	STEM Academy	Pre-Survey	50.0 (n = 14)	32.1 (n = 9)
		Post-Survey	50.0 (n = 14)	25.0 (n = 7)
	non-STEM Academy	Pre-Survey	35.7 (n = 10)	46.4 (n = 13)
		Post-Survey	28.6 (n = 8)	46.4 (n = 13)
4. I am the type of student to do well in math.	STEM Academy	Pre-Survey	14.3 (n = 4)	46.4 (n = 13)
		Post-Survey	14.3 (n = 4)	50.0 (n = 14)
	non-STEM Academy	Pre-Survey	32.1 (n = 9)	32.1 (n = 9)
		Post-Survey	35.7 (n = 10)	32.1 (n = 9)

(continued)

Table 4.8

Collapsed Responses to Mathematics Self-Efficacy for All Participants (%) (cont.)

Survey Item	Type of Program	Type of Survey	Strongly Disagree/Disagree	Agree/Strongly Agree
5. I can handle most subjects, but I cannot do a good job with math.	STEM Academy	Pre-Survey	60.7 (n = 17)	28.6 (n = 8)
		Post-Survey	67.9 (n = 19)	21.4 (n = 6)
	non-STEM Academy	Pre-Survey	42.9 (n = 12)	28.6 (n = 8)
		Post-Survey	25.0 (n = 7)	35.7 (n = 10)
6. I am sure I could do advanced work in math.	STEM Academy	Pre-Survey	14.3 (n = 4)	67.9 (n = 19)
		Post-Survey	17.9 (n = 5)	60.7 (n = 17)
	non-STEM Academy	Pre-Survey	46.4 (n = 13)	25.0 (n = 7)
		Post-Survey	21.4 (n = 6)	39.3 (n = 11)

(continued)

Table 4.8

Collapsed Responses to Mathematics Self-Efficacy for All Participants (%) (cont.)

Survey Item	Type of Program	Type of Survey	Strongly Disagree/Disagree	Agree/Strongly Agree
7. I can get good grades in math.	STEM Academy	Pre-Survey	3.6 (n = 1)	89.3 (n = 25)
		Post-Survey	7.1 (n = 2)	64.3 (n = 18)
	non-STEM Academy	Pre-Survey	17.9 (n = 5)	40.0 (n = 14)
		Post-Survey	7.1 (n = 2)	40.0 (n = 14)
8. I am good at math.	STEM Academy	Pre-Survey	17.9 (n = 5)	53.6 (n = 15)
		Post-Survey	7.1 (n = 2)	57.1 (n = 16)
	non-STEM Academy	Pre-Survey	25.0 (n = 7)	39.3 (n = 11)
		Post-Survey	25.0 (n = 7)	35.7 (n = 10)

Differences were also seen in the STEM Academy girls' mathematics self-efficacy between their pre- and post-survey data. On the pre-survey, 35.7% disagreed/strongly disagreed that mathematics was their worst subject, while on the post-survey, 64.3% disagreed/strongly disagreed. On the pre-survey, 50.0% participants agreed/strongly agreed that they would consider a career that uses mathematics, while on the post-survey, 57.1% participants agreed/strongly to this statement. On the pre-survey, 89.3% participants felt they get good grades in mathematics, while on the post-survey, 64.3% participants felt they get good grades in mathematics. On the pre-survey, 67.9% participants believed they could do advanced work in mathematics while on the post-survey, 60.7% participants felt they could do advanced work in mathematics.

Research Question Two

Research question two, *Does participation in a sixth grade STEM Academy influence girls' self-efficacy in science?*, was answered using the nine items related to the science construct of the survey. The science construct of the survey measured participants' attitudes and self-confidence in science. Participants responded to a 5-point Likert Scale (1 = *Strongly Disagree*, 2 = *Disagree*, 3 = *Neutral*, 4 = *Agree*, 5 = *Strongly Agree*).

At the beginning of the fall semester prior to the school year starting, a baseline equivalence of the science self-efficacy was established with participants intending to participate in the STEM Academy program and participants not intending to participate in the STEM Academy. Table 4.9 shows the data from the baseline equivalence. Results of the independent t-test indicated that girls who were intending to participate in the STEM Academy did not have a higher science self-efficacy than the girls not intending to participate in the STEM Academy program, $t(54) = 1.87$, $p = 0.066$. On average, girls who intended to enroll in the STEM Academy (M = 36.50) did not report a higher science self-efficacy than females who did not intend to enroll in the STEM Academy (M = 33.46). This suggested that students would begin the school year enrolled in the STEM Academy or not enrolled in the STEM Academy having no difference in their science self-efficacy.

Table 4.9

Baseline Equivalence: Science Self-efficacy

Type of Program	N	M	SD	*t*-value	df	*p*-value
1. STEM Academy Program	28	36.50	5.80	1.87	54	.066
2. Non-STEM Academy Program	28	33.46	6.32			

*Statistically insignificant (p < .05)

At the end of the fall semester, students participating in the STEM Academy and students not participating in the STEM Academy were administered the same survey as administered in the beginning of the fall semester to determine if participating in a sixth grade STEM Academy influenced science self-efficacy in girls. Table 4.10 shows the results from the independent t-test. Results of the independent t-test indicated that participating in a STEM Academy did influence science self-efficacy, $t(54) = 2.42$, $p = .019$, Cohen's d = 0.67 (large effect size), $r^2 = 0.102$. On average, girls participating in the STEM Academy (M = 36.07) did report a higher science self-efficacy than girls not participating in the STEM Academy (M = 32.00). As a result of participating in the STEM Academy program, 10% of the variance in science self-efficacy was seen. This suggested that students had a higher science self-efficacy due to their participation in the STEM Academy program.

Table 4.10

Type of Program's Influence on Science Efficacy

Type of Program	N	M	SD	*t*-value	df	*p*-value	d
1. STEM Academy Program	28	36.07	6.51	2.42	54	0.019*	0.67
2. Non-STEM Academy Program	28	32.00	6.07				

*Statistically significant (p < .05)

A paired t-test was also conducted to determine if a statistically significant mean difference existed in STEM Academy's girls' science self-efficacy when comparing pre- and post- science survey data. Results of the paired t-test indicated there was not a statistically significant mean difference between pre and post-science self-efficacy, $t(27) = 0.234$, $p = 0.82$. On average, girls' pre-survey data (M = 36.50) did not report a higher science self-efficacy than on the post-survey data (M = 36.07). This suggested that there was not a difference between science self-efficacy prior to the start of the program and at the end of the fall semester with the girls in the STEM Academy. Table 4.11 shows the results of the paired t-test.

Table 4.11

Paired t-test: Science Self-Efficacy of STEM Academy Participants

Type of Survey	N	M	SD	*t*-value	df	*p*-value
1. Pre-Survey	28	36.50	5.80	0.23	27	0.82
2. Post-Survey	28	36.07	6.51			

*Statistically insignificant ($p < .05$)

Differences were seen comparing girls participating in the STEM Academy versus girls not participating in the STEM Academy. For example, 85.7% participants in the STEM Academy program felt confident in science, while 53.6% participants not in the STEM Academy program agreed/strongly agreed with this statement. Participants in the STEM Academy and not in the STEM Academy program did not feel confident in science 3.6% of the time. While 60.7% participants in the STEM Academy program responded that they would consider choosing a career in science, 42.9% participants not in the STEM Academy program agreed/strongly agreed. Also, only 17.9% participants in the STEM Academy program and 10.7% participants not in the STEM Academy said they would not consider a career in science.

Only 71.4% participants in the STEM Academy program and 53.6% participants not in the STEM Academy program believed that knowing science will help them earn a living. Additionally, 7.1% participants in the STEM Academy program and 14.3% not in the STEM Academy program did not agree that knowing science will help them earn a living. When asked if they felt they do well in science, 89.3% of participants in the STEM Academy program and 60.7% not in the STEM Academy program agreed/strongly agreed with that statement. Only 60.7% participants in the STEM

Academy program and 39.3% not in the STEM Academy program felt they could do advanced work in science. Then, 14.3% participants in the STEM Academy program and 10.7% participants not in the STEM Academy program did not feel confident in doing advanced work in science. Table 4.12 shows the expanded responses and Table 4.13 shows the collapsed responses.

Table 4.12

Expanded Responses to Science Self-Efficacy for All Participants (%)

Survey Item	Type of Program	Type of Survey	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I am sure of myself when I do science.	STEM Academy	Pre- Survey	0.0 (n = 0)	0.0 (n = 0)	10.7 (n = 3)	39.3 (n = 11)	50.0 (n = 14)
		Post- Survey	0.0 (n = 0)	3.6 (n = 1)	10.7 (n = 3)	46.4 (n = 13)	39.3 (n = 11)
	non-STEM Academy	Pre- Survey	0.0 (n = 0)	7.1 (n = 2)	32.1 (n = 9)	32.1 (n = 9)	28.6 (n = 8)
		Post- Survey	3.6 (n = 1)	0.0 (n = 0)	46.4 (n = 13)	35.7 (n = 10)	17.9 (n = 5)
2. I would consider a career in science.	STEM Academy	Pre- Survey	7.1 (n = 2)	7.1 (n = 2)	21.4 (n = 6)	32.1 (n = 9)	21.4 (n = 6)
		Post- Survey	0.0 (n = 0)	17.9 (n = 5)	21.4 (n = 6)	25.0 (n = 7)	35.7 (n = 10)
	non-STEM Academy	Pre- Survey	3.6 (n = 1)	7.1 (n = 2)	32.1 (n = 9)	32.1 (n = 9)	25.0 (n = 7)
		Post- Survey	0.0 (n = 0)	10.7 (n = 3)	46.4 (n = 13)	21.4 (n = 6)	21.4 (n = 6)

(continued)

Table 4.12

Expanded Responses to Science Self-Efficacy for All Participants (%) (cont.)

Survey Item	Type of Program	Type of Survey	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
3. I expect to use science when I get out of school.	STEM Academy	Pre- Survey	0.0 (n = 0)	7.1 (n = 2)	17.9 (n = 5)	28.6 (n = 8)	35.7 (n = 10)
		Post- Survey	0.0 (n = 0)	10.7 (n = 3)	17.9 (n = 5)	50.0 (n = 14)	21.4 (n = 6)
	non-STEM Academy	Pre- Survey	7.1 (n = 2)	0.0 (n = 0)	39.3 (n = 11)	28.6 (n = 8)	28.6 (n = 8)
		Post- Survey	0.0 (n = 0)	7.1 (n = 2)	39.3 (n = 11)	32.1 (n = 9)	21.4 (n = 6)
4. Knowing science will help me earn a living.	STEM Academy	Pre- Survey	3.6 (n = 1)	3.6 (n = 1)	21.4 (n = 6)	35.7 (n = 10)	35.7 (n = 10)
		Post- Survey	0.0 (n = 0)	7.1 (n = 2)	21.4 (n = 6)	35.7 (n = 10)	35.7 (n = 10)
	non-STEM Academy	Pre- Survey	3.6 (n = 1)	7.1 (n = 2)	35.7 (n = 10)	32.1 (n = 9)	21.4 (n = 6)
		Post- Survey	0.0 (n = 0)	14.3 (n = 4)	32.1 (n = 9)	39.3 (n = 11)	14.3 (n = 4)

(continued)

Table 4.12

Expanded Responses to Science Self-Efficacy for All Participants (%) (cont.)

Survey Item	Type of Program	Type of Survey	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
5. I will need science for my future.	STEM Academy	Pre- Survey	0.0 (n = 0)	7.1 (n = 2)	10.7 (n = 3)	42.9 (n = 12)	39.3 (n = 11)
		Post- Survey	0.0 (n = 0)	10.7 (n = 3)	17.9 (n = 5)	35.7 (n = 10)	35.7 (n = 10)
	non-STEM Academy	Pre- Survey	7.1 (n = 2)	3.6 (n = 1)	17.9 (n = 5)	46.4 (n = 13)	25.0 (n = 7)
		Post- Survey	0.0 (n = 0)	10.7 (n = 3)	28.6 (n = 8)	46.4 (n = 13)	14.3 (n = 4)
6. I know I can do well in science.	STEM Academy	Pre- Survey	0.0 (n = 0)	0.0 (n = 0)	14.3 (n = 4)	35.7 (n = 10)	50.0 (n = 14)
		Post- Survey	0.0 (n = 0)	0.0 (n = 0)	10.7 (n = 3)	35.7 (n = 10)	53.6 (n = 15)
	non-STEM Academy	Pre- Survey	0.0 (n = 0)	3.6 (n = 1)	28.6 (n = 8)	32.1 (n = 9)	35.7 (n = 10)
		Post- Survey	0.0 (n = 0)	3.6 (n = 1)	35.7 (n = 10)	46.4 (n = 13)	14.3 (n = 4)

(continued)

Table 4.12

Expanded Responses to Science Self-Efficacy for All Participants (%) (cont.)

Survey Item	Type of Program	Type of Survey	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
7. Science will be important to me in my life's work.	STEM Academy	Pre- Survey	0.0 (n = 0)	14.3 (n = 4)	10.7 (n = 3)	35.7 (n = 10)	39.3 (n = 11)
		Post- Survey	0.0 (n = 0)	10.7 (n = 3)	32.1 (n = 9)	25.0 (n = 7)	32.1 (n = 9)
	non-STEM Academy	Pre- Survey	3.6 (n = 1)	0.0 (n = 0)	25.0 (n = 7)	39.3 (n = 11)	32.1 (n = 9)
		Post- Survey	0.0 (n = 0)	10.7 (n = 3)	46.4 (n = 13)	28.6 (n = 8)	14.3 (n = 4)
8. I can handle most subjects well, but I cannot do a good job with science.	STEM Academy	Pre- Survey	50.0 (n = 14)	39.3 (n = 11)	7.1 (n = 2)	3.6 (n = 1)	0.0 (n = 0)
		Post- Survey	50.0 (n = 14)	39.3 (n = 11)	7.1 (n = 2)	3.6 (n = 1)	0.0 (n = 0)
	non-STEM Academy	Pre- Survey	14.3 (n = 4)	39.3 (n = 11)	35.7 (n = 10)	3.6 (n = 1)	7.1 (n = 2)
		Post- Survey	14.3 (n = 4)	35.7 (n = 10)	28.6 (n = 8)	17.9 (n = 5)	3.6 (n = 1)

(continued)

Table 4.12

Expanded Responses to Science Self-Efficacy for All Participants (%) (cont.)

Survey Item	Type of Program	Type of Survey	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
9. I can handle most subjects well, but I cannot do a good job with science.	STEM Academy	Pre- Survey	3.6 (n = 1)	10.7 (n = 3)	14.3 (n = 4)	39.3 (n = 11)	32.1 (n = 9)
		Post- Survey	10.7 (n = 3)	3.6 (n = 1)	25.0 (n = 7)	25.0 (n = 7)	35.7 (n = 10)
	non-STEM Academy	Pre- Survey	0.0 (n = 0)	17.9 (n = 5)	42.9 (n = 12)	17.9 (n = 5)	21.4 (n = 6)
		Post- Survey	0.0 (n = 0)	10.7 (n = 3)	50.0 (n = 14)	21.4 (n = 6)	17.9 (n = 5)

Table 4.13

Collapsed Responses to Science Self-Efficacy for All Participants (%)

Survey Item	Type of Program	Type of Survey	Strongly Disagree/Disagree	Agree/Strongly Agree
1. I am sure of myself when I do science.	STEM Academy	Pre-Survey	0.0 (n = 0)	89.3 (n = 25)
		Post-Survey	3.6 (n = 1)	85.7 (n = 24)
	non-STEM Academy	Pre-Survey	7.1 (n = 2)	60.7 (n = 17)
		Post-Survey	3.6 (n = 1)	53.6 (n = 15)
2. I would consider a career in science.	STEM Academy	Pre-Survey	14.3 (n = 4)	53.6 (n = 15)
		Post-Survey	17.9 (n = 5)	60.7 (n = 17)
	non-STEM Academy	Pre-Survey	10.7 (n = 3)	57.1 (n = 16)
		Post-Survey	10.7 (n = 3)	42.9 (n = 12)

(continued)

Table 4.13

Collapsed Responses to Science Self-Efficacy for All Participants (%) (cont.)

Survey Item	Type of Program	Type of Survey	Strongly Disagree/Disagree	Agree/Strongly Agree
3. I expect to use science when I get out of school.	STEM Academy	Pre-Survey	7.1 (n = 2)	64.3 (n = 18)
		Post-Survey	10.7 (n = 3)	71.4 (n = 20)
	non-STEM Academy	Pre-Survey	7.1 (n = 2)	57.1 (n = 16)
		Post-Survey	7.1 (n = 2)	53.6 (n = 15)
4. Knowing science will help me earn a living.	STEM Academy	Pre-Survey	7.1 (n = 2)	71.4 (n = 20)
		Post-Survey	7.1 (n = 2)	71.4 (n = 20)
	non-STEM Academy	Pre-Survey	10.7 (n = 3)	53.6 (n = 15)
		Post-Survey	14.3 (n = 4)	53.6 (n = 15)

(continued)

Table 4.13

Collapsed Responses to Science Self-Efficacy for All Participants (%) (cont.)

Survey Item	Type of Program	Type of Survey	Strongly Disagree/Disagree	Agree/Strongly Agree
5. I will need science for my future.	STEM Academy	Pre-Survey	7.1 (n = 2)	82.1 (n = 23)
		Post-Survey	10.7 (n = 3)	71.4 (n = 20)
	non-STEM Academy	Pre-Survey	10.7 (n = 3)	71.4 (n = 20)
		Post-Survey	10.7 (n = 3)	60.7 (n = 17)
6. I know I can do well in science.	STEM Academy	Pre-Survey	0.0 (n = 0)	85.7 (n = 24)
		Post-Survey	0.0 (n = 0)	89.3 (n = 25)
	non-STEM Academy	Pre-Survey	3.6 (n = 1)	67.9 (n = 19)
		Post-Survey	3.6 (n = 1)	60.7 (n = 17)

(continued)

Table 4.13

Collapsed Responses to Science Self-Efficacy for All Participants (%) (cont.)

Survey Item	Type of Program	Type of Survey	Strongly Disagree/Disagree	Agree/Strongly Agree
7. Science will be important to me in my life's work.	STEM Academy	Pre-Survey	14.3 (n = 4)	75.0 (n = 21)
		Post-Survey	10.7 (n = 3)	57.1 (n = 16)
	non-STEM Academy	Pre-Survey	3.6 (n = 1)	71.4 (n = 20)
		Post-Survey	10.7 (n = 3)	42.9 (n = 12)
8. I can handle most subjects well, but I cannot do a good job with science.	STEM Academy	Pre-Survey	89.3 (n = 25)	3.6 (n = 1)
		Post-Survey	89.3 (n = 25)	3.6 (n = 1)
	non-STEM Academy	Pre-Survey	53.6 (n = 15)	10.7 (n = 3)
		Post-Survey	50.0 (n = 14)	21.4 (n = 6)

(continued)

Table 4.13

Collapsed Responses to Science Self-Efficacy for All Participants (%) (cont.)

Survey Item	Type of Program	Type of Survey	Strongly Disagree/Disagree	Agree/Strongly Agree
9. I am sure I could do advanced work in science.	STEM Academy	Pre-Survey	14.3 (n = 4)	71.4 (n = 20)
		Post-Survey	14.3 (n = 4)	60.7 (n = 17)
	non-STEM Academy	Pre-Survey	17.9 (n = 5)	39.3 (n = 11)
		Post-Survey	10.7 (n = 3)	39.3 (n = 11)

Differences were also seen in girls' science self-efficacy between their pre- and post-survey data in the STEM Academy. On the pre-survey, 64.3% participants believed they would use science when they got out of school while on the post-survey, 71.4% agreed. On the pre-survey, 82.1% participants said they would need science for their future while 71.4% agreed on the post-survey. On the pre-survey, 53.6% participants would consider a career in science while on the post-survey 60.7% said they would consider it. Then, 85.7% participants felt, on the pre-survey, that they do well in science and 89.3% participants felt that they did well in science on the post-survey. On the pre-survey, 71.4% participants believed they could do advanced work in science while only 60.7% participants agreed/strongly agreed on the post survey.

Research Question Three

Research question three, *Does participation in a sixth grade STEM Academy influence* girls' *self-efficacy in engineering and technology?*, was answered using the nine items related to the engineering and technology construct of the survey. The engineering and technology construct of the survey measured participants' attitudes and self-confidence in engineering and technology. Participants responded to a 5-point Likert Scale (1 = *Strongly Disagree*, 2 = *Disagree*, 3 = *Neutral*, 4 = *Agree*, 5 = *Strongly Agree*).

At the beginning of the fall semester prior to the school year starting, a baseline equivalence of engineering and technology self-efficacy was established with participants intending to participate in the STEM Academy and participants not intending to participate in the STEM Academy. Table 4.14 shows the data of the baseline equivalence. Results of the independent t-test indicated that the girls intending to participate in the STEM Academy did not have a higher engineering and technology self-efficacy, $t(47.61) = 1.44$, $p = 0.156$. On average, girls who intended to enroll in the STEM Academy (M = 34.54) did not report a higher engineering and technology self-efficacy than girls who did not intend to enroll in the STEM Academy (M = 32.25). This suggested that students, prior to the start of the program, who were intending to enroll in the STEM Academy and not intending to enroll in the STEM Academy program showed no difference in their engineering and technology self-efficacy at the beginning of the school year prior.

Table 4.14

Baseline Equivalence: Engineering and Technology Self-efficacy

Type of Program	N	M	SD	*t*-value	df	*p*-value
1. STEM Academy Program	28	34.54	6.94	1.44	54	0.16
2. Non-STEM Academy Program	28	32.25	4.73			

*Statistically insignificant (p < .05)

At the end of the fall semester, girls participating in the STEM Academy and girls not participating in the STEM Academy were administered the same survey as administered in the beginning of the fall semester to determine if participation in a sixth grade STEM Academy influenced engineering and technology self-efficacy in girls. Table 4.15 shows the results of the independent t-test. Results of the independent t test indicated that participating in the STEM Academy did not influence engineering and technology self-efficacy, $t(54) = 1.655$, $p = 0.104$. On average, girls participating in the STEM Academy (M = 34.75) did not report a higher engineering and technology self-efficacy than girls not participating in the STEM Academy (M = 31.57). This suggested that participating in the STEM Academy did not influence girls' engineering and technology self-efficacy.

Table 4.15

Type of Program's Influence on Engineering and Technology Self-Efficacy

Type of Program	N	M	SD	*t*-value	df	*p*-value
1. STEM Academy Program	28	34.75	6.74	1.67	54	.10
2. Non-STEM Academy Program	28	21.57	7.60			

*Statistically insignificant (p < .05)

A paired t-test was conducted to determine if a statistically significant mean difference existed in STEM Academy's girls' engineering and technology self-efficacy between their pre- and post- survey data. Results of the paired t-test indicated there was not a statistically significant mean difference between pre- and post- engineering and technology self-efficacy, $t(27)$, = -0.115, p = 0.91. On average, girls' pre-survey data (M = 34.54) did not report a higher engineering and technology self-efficacy than on the post-survey data (M = 34.75). This suggested that there was not a difference between engineering and technology self-efficacy prior to the start of the program and at the end of the fall semester with the girls in the STEM Academy. Table 4.16 shows the results of the paired t-test.

Table 4.16

Paired t-test: Engineering and Technology Self-Efficacy of STEM Academy Participants

Type of Survey	N	M	SD	*t*-value	df	*p*-value
1. Pre-Survey	28	34.54	6.94	-0.12	27	0.91
2. Post-Survey	28	34.75	6.74			

*Statistically insignificant (p < .05)

There were differences in comparing girls participating in the STEM Academy versus girls not participating in the STEM Academy. For example, 60.7% participants in the STEM Academy program agreed/strongly agreed that they liked to imagine creating new products while 57.1% participants not in the STEM Academy program agreed/strongly agreed. Only 17.9% participants in the STEM Academy program disagreed/strongly disagreed that they liked to imagine creating new products while 10.7% participants not in the STEM Academy program disagreed/strongly disagreed to this statement. Then, 46.4% participants in the STEM Academy program and not in the STEM Academy program agreed/strongly agreed that they are good at building and fixing things. While 10.7% participants in the STEM Academy program disagreed/strongly disagreed with feeling like they were good at building and fixing things, only 14.3% participants not in the STEM Academy program disagreed/strongly disagreed. Then, 53.6% participants in the STEM Academy program and 17.9% participants not in the STEM Academy program were interested in what makes machines work. Only 3.6% participants in the STEM Academy program and 17.9% participants not in the STEM Academy program were not interested in what makes machines work.

Next, 53.6% participants in the STEM Academy and not in the STEM Academy programs were curious about how electronics work. While 25.0% participants in the STEM Academy program were not curious about how electronics work, 21.4% participants not in the STEM Academy program were also not curious how electronics work. Only 78.6% participants in the STEM Academy program said they would have the desire to use creativity and innovation in their future work while 57.1% participants not in the STEM Academy program agreed/strongly agreed to this statement. Then, 3.6% participants in the STEM Academy program and 14.3% participants not in the STEM Academy program disagreed/strongly disagreed to wanting to use creativity and innovation in their future work. Additionally, 64.3% participants in the STEM Academy program believed that knowing how to use mathematics and science together will allow them to invent useful things while 57.1% participants not in the STEM Academy program agreed/strongly agreed to this statement. Only 3.6% participants in the STEM Academy program and 10.7% participants not in the STEM Academy program did not believe that knowing how to use mathematics and science together will allow them to invent useful things. Table 4.17 shows the expanded responses and Table 4.18 shows the collapsed responses.

Table 4.17

Expanded Responses to Engineering & Technology Self-Efficacy for All Participants (%)

Survey Item	Type of Program	Type of Survey	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I like to imagine creating new products.	STEM Academy	Pre-Survey	3.6 (n = 1)	7.1 (n = 2)	10.7 (n = 3)	32.1 (n = 9)	46.4 (n = 13)
		Post-Survey	3.6 (n = 1)	14.3 (n = 4)	21.4 (n = 6)	28.6 (n = 8)	32.1 (n = 9)
	non-STEM Academy	Pre-Survey	0.0 (n = 0)	10.7 (n = 3)	25.0 (n = 7)	39.3 (n = 11)	25.0 (n = 7)
		Post-Survey	0.0 (n = 0)	10.7 (n = 3)	32.1 (n = 9)	39.3 (n = 11)	17.9 (n = 5)
2. If I learn engineering, then I can improve things that people use every day.	STEM Academy	Pre-Survey	0.0 (n = 0)	7.1 (n = 2)	21.4 (n = 6)	39.3 (n = 11)	32.1 (n = 9)
		Post-Survey	3.6 (n = 1)	7.1 (n = 2)	10.7 (n = 3)	32.1 (n = 9)	46.4 (n = 13)
	non-STEM Academy	Pre-Survey	3.6 (n = 1)	3.6 (n = 1)	32.1 (n = 9)	35.7 (n = 10)	25.0 (n = 7)
		Post-Survey	0.0 (n = 0)	17.9 (n = 5)	21.4 (n = 6)	42.9 (n = 12)	17.9 (n = 5)

(continued)

Table 4.17

Expanded Responses to Engineering & Technology Self-Efficacy for All Participants (%) (cont.)

Survey Item	Type of Program	Type of Survey	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
3. I am good at building and fixing things.	STEM Academy	Pre-Survey	3.6 (n = 1)	21.4 (n = 6)	25.0 (n = 7)	28.6 (n = 8)	21.4 (n = 6)
		Post-Survey	3.6 (n = 1)	7.1 (n = 2)	42.9 (n = 12)	14.3 (n = 4)	32.1 (n = 9)
	non-STEM Academy	Pre-Survey	0.0 (n = 0)	21.4 (n = 6)	28.6 (n = 8)	42.9 (n = 12)	7.1 (n = 2)
		Post-Survey	0.0 (n = 0)	14.3 (n = 4)	39.3 (n = 11)	28.6 (n = 8)	17.9 (n = 5)
4. I am interested in what makes machines work.	STEM Academy	Pre-Survey	3.6 (n = 1)	17.9 (n = 5)	32.1 (n = 9)	28.6 (n = 8)	17.9 (n = 5)
		Post-Survey	3.6 (n = 1)	0.0 (n = 0)	42.9 (n = 12)	17.9 (n = 5)	35.7 (n = 10)
	non-STEM Academy	Pre-Survey	3.6 (n = 1)	28.6 (n = 8)	21.4 (n = 6)	32.1 (n = 9)	14.3 (n = 4)
		Post-Survey	3.6 (n = 1)	14.3 (n = 4)	42.9 (n = 12)	10.7 (n = 3)	7.1 (n = 2)

(continued)

Table 4.17

Expanded Responses to Engineering & Technology Self-Efficacy for All Participants (%) (cont.)

Survey Item	Type of Program	Type of Survey	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
5. Designing products or structures will be important for my future work.	STEM Academy	Pre-Survey	0.0 (n = 0)	10.7 (n = 3)	17.9 (n = 5)	32.1 (n = 9)	39.3 (n = 11)
		Post-Survey	0.0 (n = 0)	14.3 (n = 4)	25.0 (n = 7)	35.7 (n = 10)	25.0 (n = 7)
	non-STEM Academy	Pre-Survey	3.6 (n = 1)	3.6 (n = 1)	46.4 (n = 13)	39.3 (n = 11)	7.1 (n = 2)
		Post-Survey	0.0 (n = 0)	25.0 (n = 7)	32.1 (n = 9)	25.0 (n = 7)	17.9 (n = 5)
6. I am curious about how electronics work.	STEM Academy	Pre-Survey	0.0 (n = 0)	10.7 (n = 3)	14.3 (n = 4)	46.4 (n = 13)	28.6 (n = 8)
		Post-Survey	0.0 (n = 0)	25.0 (n = 7)	21.4 (n = 6)	17.9 (n = 5)	35.7 (n = 10)
	non-STEM Academy	Pre-Survey	3.6 (n = 1)	3.6 (n = 1)	21.4 (n = 6)	46.4 (n = 13)	25.0 (n = 7)
		Post-Survey	0.0 (n = 0)	21.4 (n = 6)	25.0 (n = 7)	35.7 (n = 10)	17.9 (n = 5)

(continued)

Table 4.17

Expanded Responses to Engineering & Technology Self-Efficacy for All Participants (%) (cont.)

Survey Item	Type of Program	Type of Survey	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
7. I would like to use creativity and innovation in my future work.	STEM Academy	Pre-Survey	0.0 (n = 0)	3.6 (n = 1)	17.9 (n = 5)	32.1 (n = 9)	46.4 (n = 13)
		Post-Survey	0.0 (n = 0)	7.1 (n = 2)	17.9 (n = 5)	25.0 (n = 7)	53.6 (n = 15)
	non-STEM Academy	Pre-Survey	0.0 (n = 0)	7.1 (n = 2)	28.6 (n = 8)	42.9 (n = 12)	21.4 (n = 6)
		Post-Survey	3.6 (n = 1)	10.7 (n = 3)	28.6 (n = 8)	39.3 (n = 11)	17.9 (n = 5)
8. Knowing how to use math and science together will allow me to invent useful things.	STEM Academy	Pre-Survey	0.0 (n = 0)	0.0 (n = 0)	25.0 (n = 7)	39.3 (n = 11)	35.7 (n = 10)
		Post-Survey	0.0 (n = 0)	3.6 (n = 1)	32.1 (n = 9)	25.0 (n = 7)	39.3 (n = 11)
	non-STEM Academy	Pre-Survey	3.6 (n = 1)	3.6 (n = 1)	28.6 (n = 8)	42.9 (n = 12)	21.4 (n = 6)
		Post-Survey	3.6 (n = 1)	7.1 (n = 2)	32.1 (n = 9)	39.3 (n = 11)	17.9 (n = 5)

(continued)

Table 4.17

Expanded Responses to Engineering & Technology Self-Efficacy for All Participants (%) (cont.)

Survey Item	Type of Program	Type of Survey	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
9. I believe I can be successful in a career in engineering.	STEM Academy	Pre-Survey	7.1 (n = 2)	21.4 (n = 6)	17.9 (n = 5)	32.1 (n = 9)	21.4 (n = 6)
		Post-Survey	0.0 (n = 0)	10.7 (n = 3)	21.4 (n = 6)	32.1 (n = 9)	35.7 (n = 10)
	non-STEM Academy	Pre-Survey	3.6 (n = 1)	10.7 (n = 3)	5.0 (n = 14)	25.0 (n = 7)	10.7 (n = 3)
		Post-Survey	0.0 (n = 0)	21.4 (n = 6)	32.1 (n = 9)	25.0 (n = 7)	21.4 (n = 6)

Table 4.18

Collapsed Responses to Engineering & Technology Self-Efficacy for All Participants (%)

Survey Item	Type of Program	Type of Survey	Strongly Disagree/Disagree	Agree/Strongly Agree
1. I like to imagine creating new products.	STEM Academy	Pre-Survey	10.7 (n = 3)	78.6 (n = 22)
		Post-Survey	17.9 (n = 5)	60.7 (n = 17)
	non-STEM Academy	Pre-Survey	10.7 (n = 3)	64.3 (n = 18)
		Post-Survey	10.7 (n = 3)	57.1 (n = 16)
2. If I learn engineering, then I can improve things that people use every day.	STEM Academy	Pre-Survey	7.1 (n = 2)	71.4 (n = 20)
		Post-Survey	10.7 (n = 3)	78.6 (n = 22)
	non-STEM Academy	Pre-Survey	7.1 (n = 2)	60.7 (n = 17)
		Post-Survey	17.9 (n = 5)	60.7 (n = 17)

(continued)

Table 4.18

Collapsed Responses to Engineering & Technology Self-Efficacy for All Participants (%) (cont.)

Survey Item	Type of Program	Type of Survey	Strongly Disagree/Disagree	Agree/Strongly Agree
3. I am good at building and fixing things.	STEM Academy	Pre-Survey	25.0 (n = 7)	50.0 (n = 14)
		Post-Survey	10.7 (n = 3)	46.4 (n = 13)
	non-STEM Academy	Pre-Survey	21.4 (n = 6)	50.0 (n = 14)
		Post-Survey	14.3 (n = 4)	46.4 (n = 13)
4. I am interested in what makes machines work.	STEM Academy	Pre-Survey	21.4 (n = 6)	46.4 (n = 13)
		Post-Survey	3.6 (n = 1)	53.6 (n = 15)
	non-STEM Academy	Pre-Survey	32.1 (n = 9)	46.4 (n = 13)
		Post-Survey	17.9 (n = 5)	17.9 (n = 5)

(continued)

Table 4.18

Collapsed Responses to Engineering & Technology Self-Efficacy for All Participants (%) (cont.)

Survey Item	Type of Program	Type of Survey	Strongly Disagree/Disagree	Agree/Strongly Agree
5. Designing products or structures will be important for my future work.	STEM Academy	Pre-Survey	10.7 (n = 3)	71.4 (n = 20)
		Post-Survey	14.3 (n = 4)	60.7 (n = 17)
	non-STEM Academy	Pre-Survey	7.1 (n = 2)	46.4 (n = 13)
		Post-Survey	25.0 (n = 7)	39.3 (n = 12)
6. I am curious about how electronics work.	STEM Academy	Pre-Survey	0.0 (n = 0)	75.0 (n = 21)
		Post-Survey	25.0 (n = 7)	53.6 (n = 15)
	non-STEM Academy	Pre-Survey	7.1 (n = 2)	71.4 (n = 20)
		Post-Survey	21.4 (n = 6)	53.6 (n = 15)

(continued)

Table 4.18

Collapsed Responses to Engineering & Technology Self-Efficacy for All Participants (%) (cont.)

Survey Item	Type of Program	Type of Survey	Strongly Disagree/Disagree	Agree/Strongly Agree
7. I would like to use creativity and innovation in my future work.	STEM Academy	Pre-Survey	3.6 (n = 1)	78.6 (n = 22)
		Post-Survey	3.6 (n = 1)	78.6 (n = 22)
	non-STEM Academy	Pre-Survey	7.1 (n = 2)	71.4 (n = 20)
		Post-Survey	14.3 (n = 4)	57.1 (n = 16)
8. Knowing how to use math and science together will allow me to invent useful things.	STEM Academy	Pre-Survey	0.0 (n = 0)	75.0 (n = 21)
		Post-Survey	3.6 (n = 1)	64.3 (n = 18)
	non-STEM Academy	Pre-Survey	7.1 (n = 2)	71.4 (n = 20)
		Post-Survey	10.7 (n = 3)	57.1 (n = 16)

(continued)

Table 4.18

Collapsed Responses to Engineering & Technology Self-Efficacy for All Participants (%) (cont.)

Survey Item	Type of Program	Type of Survey	Strongly Disagree/Disagree	Agree/Strongly Agree
9. I believe I can be successful in a career in engineering.	STEM Academy	Pre-Survey	28.6 (n = 8)	53.6 (n = 15)
		Post-Survey	10.7 (n = 3)	67.9 (n = 19)
	non-STEM Academy	Pre-Survey	14.3 (n = 4)	35.7 (n = 10)
		Post-Survey	21.4 (n = 6)	46.4 (n = 13)

Differences were seen in girls' engineering and technology self-efficacy between their pre- and post-survey data in the STEM Academy. On the pre-survey, 78.6% participants in the STEM Academy program liked to imagine creating new products and 60.7% agreed/strongly agreed to this statement on the post-survey. Next, 25.0% participants on the pre-survey and 10.7% participants on the post-survey said they were not good at building and fixing things. On the pre-survey, 75.0% participants said they were curious about how electronics worked, while on the post-survey, 53.6% participants agreed. On the pre-survey, 28.6% participants disagreed/strongly disagreed to believing they would be successful in a career in engineering, while 10.7% participants on the post-survey disagreed/strongly disagreed.

Research Question Four

Research question four, *Is there a statistically significant mean difference in girls' STEM self-efficacy between pre and post survey data in a STEM Academy?*, was answered using the 26-items related to all three of the constructs (mathematics, science, and engineering and technology). The STEM self-efficacy in its entirety measured participants' attitudes and self-confidence in mathematics, science, and engineering and technology. Participants responded to a 5-point Likert Scale (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree).

The composite score for all three constructs, (mathematics, science, and engineering and technology) were found for each of the pre- and post- surveys. A paired t-test was conducted to determine if a statistically significant mean difference existed in the STEM Academy's girls' STEM self-efficacy between their pre- and post-survey data. Table 4.19 shows the data of the paired t-test. Results of the paired t-test indicated there was not a statistically significant mean difference between pre- and post-STEM self-efficacy, $t(27) = -0.077$, $p = 0.939$. On average, girls' pre-survey data ($M = 99.39$) did not report a higher STEM self-efficacy than on the post-survey data (M = 99.75). This suggested that the girls, as a whole, prior to participating in the STEM Academy had a previously high self-efficacy in STEM.

Table 4.19

Paired t-test: STEM Self-Efficacy of STEM Academy Participants

Type of Survey	N	M	SD	*t*-value	df	*p*-value
1. Pre-Survey	28	99.39	15.50	-0.77	27	0.94
2. Post-Survey	28	99.75	16.62			

*Statistically insignificant (p < .05)

Due to these results suggesting no statistically significant mean difference existing between pre- and post-survey data on STEM Academy's girls' STEM self-efficacy, another paired t-test was conducted to compare STEM self-efficacy in pre- and post- survey data with participants in specific self-efficacy ranges. Table 4.20 shows these ranges that the participants were grouped into. Participants were grouped into three ranges: low STEM self-efficacy, moderate STEM self-efficacy, and high STEM self-efficacy. There was a maximum of 130 points possible in the survey because there were 26 questions related to STEM self-efficacy and the 5- point Likert scale. One hundred thirty was divided by three (the number of groups) resulting in 43. Then, the three groups were established with given ranges. Students with a composite score ranging between 0-43 points were placed in a low STEM self-efficacy group, which consisted of zero participants. Students with a composite score of 44-87 points, six students, were placed in the moderate STEM self-efficacious range and 88-130 points, 22 students, were placed in the high STEM self-efficacious range. Given that none of the participants fell into the low STEM self-efficacy range, a paired t-test was not conducted.

Table 4.20

STEM Self-Efficacy Ranges

Range Level	Likert Scale Points	Number of Participants
1. Low STEM Self-Efficacy	0-43	0
2. Moderate STEM Self-Efficacy	44-87	6
3. High STEM Self-Efficacy	88-130	22

A paired t-test was conducted on the six participants within the moderate STEM self-efficacy range to determine if a statistically significant mean difference existed between their pre- and post- survey data. Table 4.21 shows the data of the paired t-test. Results of the paired t-test indicated that a statistical significant mean difference did exist between pre- and post- survey data, $t(5) = -3.853$, $p = .012$. On average, girls' pre-survey data (M = 78.67) did report a higher STEM self-efficacy than on the post- survey data (M = 102.67). Participants having a moderate STEM self-efficacy did show a higher STEM self-efficacy between pre- and post- survey data.

Table 4.21

Paired t-test: Moderate Self-Efficacious STEM Academy Participants

Type of Survey	N	M	SD	*t*-value	df	*p*-value
1. Pre-Survey	6	78.67	6.62	-3.85	5	0.12
2. Post-Survey	6	102.67	16.60			

*Statistically significant ($p < .05$)

A paired t test was also conducted on the 22 participants considered to have a high STEM self-efficacy to determine if a statistically significant mean difference existed between their pre- and post- survey data. Table 4.22 shows the data of the paired t-test. Results of the paired t-test indicated that a statistical significant mean difference did not exist between pre- and post-survey data, $t(21) = 1.251$, $p = .225$. On average, females' pre-survey data (M = 105.05) did not report a higher STEM self-efficacy than on the post-survey data (M = 98.95). Participants having a high STEM self-efficacy did not show a higher STEM self-efficacy between pre- and post- survey data. This suggests that these participants previously had a higher STEM self-efficacy which did not reflect an increase.

Table 4.22

Paired t-test: High Self-Efficacious STEM Academy Participants

Type of Survey	N	M	SD	*t*-value	df	*p*-value
1. Pre-Survey	22	105.05	11.93	1.25	21	0.23
2. Post-Survey	22	98.95	16.93			

*Statistically insignificant (p < .05)

Differences were also seen in the girls' STEM self-efficacy between the pre- and post-survey data in the STEM Academy. Table 4.23 shows the expanded responses and Table 4.24 shows the collapsed responses of students' responses in the STEM Academy program. On the pre-survey, 35.7% participants disagreed/strongly disagreed that mathematics was their worst subject, but on the post-survey 64.3% participants disagreed/strongly disagreed. On the pre-survey, 89.3% participants believed they could get good grades in mathematics while only 64.3% participants on the post-survey agreed/strongly agreed. Then, 75.0% participants on the pre-survey and 57.1% participants on the post-survey agreed/strongly agreed that science will be important to them in their work in their future. On the pre-survey, 71.4% participants agreed/strongly agreed that they could do advanced work in science while 60.7% participants agreed/strongly agreed on the post-survey. On the pre-survey, 21.4% participants disagreed/strongly disagreed to being interested in what makes machines work while on the post-survey 3.6% participants disagreed/strongly disagreed. On the pre-survey, 28.6% participants did not believe they would be successful in an engineering career while 10.7% participants believed this as well.

Table 4.23

Expanded Responses to STEM Self-Efficacy for STEM Academy Participants (%)

Survey Item	Type of Survey	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. Math has been my worst subject.	Pre-Survey	17.9 (n = 5)	17.9 (n = 5)	46.4 (n = 13)	10.7 (n = 3)	7.1 (n = 2)
	Post-Survey	21.4 (n = 6)	42.9 (n = 12)	14.3 (n = 4)	17.9 (n = 5)	3.6 (n = 1)
2. I would consider choosing a career that uses math.	Pre-Survey	0.0 (n = 0)	17.9 (n = 5)	32.1 (n = 9)	35.7 (n = 10)	14.3 (n = 4)
	Post-Survey	3.6 (n = 1)	17.9 (n = 5)	21.4 (n = 6)	28.6 (n = 8)	28.6 (n = 8)
3. Math is hard for me.	Pre-Survey	17.9 (n = 5)	32.1 (n = 9)	17.9 (n = 5)	28.6 (n = 8)	3.6 (n = 1)
	Post-Survey	28.6 (n = 8)	21.4 (n = 6)	25.0 (n = 7)	17.9 (n = 5)	7.1 (n = 2)
4. I am the type of student to do well in math.	Pre-Survey	0.0 (n = 0)	14.3 (n = 4)	39.3 (n = 11)	32.1 (n = 9)	14.3 (n = 4)
	Post-Survey	3.6 (n = 1)	10.7 (n = 3)	35.7 (n = 10)	35.7 (n = 10)	14.3 (n = 4)

(continued)

Table 4.23

Expanded Responses to STEM Self-Efficacy for STEM Academy Participants (%) (cont.)

Survey Item	Type of Survey	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
5. I can handle most subjects, but I cannot do a good job with math.	Pre-Survey	25.0 (n = 7)	35.7 (n = 10)	10.7 (n = 3)	28.6 (n = 8)	0.0 (n = 0)
	Post-Survey	28.6 (n = 8)	39.3 (n = 11)	10.7 (n = 3)	17.9 (n = 5)	3.6 (n = 1)
6. I am sure I could do advanced work in math	Pre-Survey	3.6 (n = 1)	10.7 (n = 3)	17.9 (n = 5)	50.0 (n = 14)	17.9 (n = 5)
	Post-Survey	3.6 (n = 1)	14.3 (n = 4)	21.4 (n = 6)	28.6 (n = 8)	32.1 (n = 9)
7. I can get good grades in math.	Pre-Survey	0.0 (n = 0)	3.6 (n = 1)	7.1 (n = 2)	67.9 (n = 19)	21.4 (n = 6)
	Post-Survey	0.0 (n = 0)	7.1 (n = 2)	28.6 (n = 8)	35.7 (n = 10)	28.6 (n = 8)
8. I am good at math.	Pre-Survey	0.0 (n = 0)	17.9 (n = 5)	28.6 (n = 8)	39.3 (n = 11)	14.3 (n = 4)
	Post-Survey	0.0 (n = 0)	7.1 (n = 2)	35.7 (n = 10)	46.4 (n = 13)	10.7 (n = 3)

(continued)

Table 4.23

Expanded Responses to STEM Self-Efficacy for STEM Academy Participants (%) (cont.)

Survey Item	Type of Survey	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
9. I am sure of myself when I do science.	Pre-Survey	0.0 (n = 0)	0.0 (n = 0)	10.7 (n = 3)	39.3 (n = 11)	50.0 (n = 14)
	Post-Survey	0.0 (n = 0)	3.6 (n = 1)	10.7 (n = 3)	46.4 (n = 13)	39.3 (n = 11)
10. I would consider a career in science.	Pre-Survey	7.1 (n = 2)	7.1 (n = 2)	21.4 (n = 6)	32.1 (n = 9)	21.4 (n = 6)
	Post-Survey	0.0 (n = 0)	17.9 (n = 5)	21.4 (n = 6)	25.0 (n = 7)	35.7 (n = 10)
11. I expect to use science when I get out of school.	Pre-Survey	0.0 (n = 0)	7.1 (n = 2)	17.9 (n = 5)	28.6 (n = 8)	35.7 (n = 10)
	Post-Survey	0.0 (n = 0)	10.7 (n = 3)	17.9 (n = 5)	50.0 (n = 14)	21.4 (n = 6)
12. Knowing science will help me earn a living.	Pre-Survey	3.6 (n = 1)	3.6 (n = 1)	21.4 (n = 6)	35.7 (n = 10)	35.7 (n = 10)
	Post-Survey	0.0 (n = 0)	7.1 (n = 2)	21.4 (n = 6)	35.7 (n = 10)	35.7 (n = 10)

(continued)

Table 4.23

Expanded Responses to STEM Self-Efficacy for STEM Academy Participants (%) (cont.)

Survey Item	Type of Survey	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
13. I will need science for my future.	Pre-Survey	0.0 (n = 0)	7.1 (n = 2)	10.7 (n = 3)	42.9 (n = 12)	39.3 (n = 11)
	Post-Survey	0.0 (n = 0)	10.7 (n = 3)	17.9 (n = 5)	35.7 (n = 10)	35.7 (n = 10)
14. I know I can do well in science.	Pre-Survey	0.0 (n = 0)	0.0 (n = 0)	14.3 (n = 4)	35.7 (n = 10)	50.0 (n = 14)
	Post-Survey	0.0 (n = 0)	0.0 (n = 0)	10.7 (n = 3)	35.7 (n = 10)	53.6 (n = 15)
15. Science will be important to me in my life's work.	Pre-Survey	0.0 (n = 0)	14.3 (n = 4)	10.7 (n = 3)	35.7 (n = 10)	39.3 (n = 11)
	Post-Survey	0.0 (n = 0)	10.7 (n = 3)	32.1 (n = 9)	25.0 (n = 7)	32.1 (n = 9)
16. I can handle most subjects well, but I cannot do a good job with science.	Pre-Survey	50.0 (n = 14)	39.3 (n = 11)	7.1 (n = 2)	3.6 (n = 1)	0.0 (n = 0)
	Post-Survey	50.0 (n = 14)	39.3 (n = 11)	7.1 (n = 2)	3.6 (n = 1)	0.0 (n = 0)

(continued)

Table 4.23

Expanded Responses to STEM Self-Efficacy for STEM Academy Participants (%) (cont.)

Survey Item	Type of Survey	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
17. I can handle most subjects well, but I cannot do a good job with science.	Pre-Survey	3.6 (n = 1)	10.7 (n = 3)	14.3 (n = 4)	39.3 (n = 11)	32.1 (n = 9)
	Post-Survey	10.7 (n = 3)	3.6 (n = 1)	25.0 (n = 7)	25.0 (n = 7)	35.7 (n = 10)
18. I like to imagine creating new products.	Pre-Survey	3.6 (n = 1)	7.1 (n = 2)	10.7 (n = 3)	32.1 (n = 9)	46.4 (n = 13)
	Post-Survey	3.6 (n = 1)	14.3 (n = 4)	21.4 (n = 6)	28.6 (n = 8)	32.1 (n = 9)
19. If I learn engineering, then I can improve things that people use every day.	Pre-Survey	0.0 (n = 0)	7.1 (n = 2)	21.4 (n = 6)	39.3 (n = 11)	32.1 (n = 9)
	Post-Survey	3.6 (n = 1)	7.1 (n = 2)	10.7 (n = 3)	32.1 (n = 9)	46.4 (n = 13)
20. I am good at building and fixing things.	Pre-Survey	3.6 (n = 1)	21.4 (n = 6)	25.0 (n = 7)	28.6 (n = 8)	21.4 (n = 6)
	Post-Survey	3.6 (n = 1)	7.1 (n = 2)	42.9 (n = 12)	14.3 (n = 4)	32.1 (n = 9)

(continued)

Table 4.23

Expanded Responses to STEM Self-Efficacy for STEM Academy Participants (%) (cont.)

Survey Item	Type of Survey	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
21. I am interested in what makes machines work.	Pre-Survey	3.6 (n = 1)	17.9 (n = 5)	32.1 (n = 9)	28.6 (n = 8)	17.9 (n = 5)
	Post-Survey	3.6 (n = 1)	0.0 (n = 0)	42.9 (n = 12)	17.9 (n = 5)	35.7 (n = 10)
22. Designing products or structures will be important for my future work.	Pre-Survey	0.0 (n = 0)	10.7 (n = 3)	17.9 (n = 5)	32.1 (n = 9)	39.3 (n = 11)
	Post-Survey	0.0 (n = 0)	14.3 (n = 4)	25.0 (n = 7)	35.7 (n = 10)	25.0 (n = 7)
23. I am curious about how electronics work.	Pre-Survey	0.0 (n = 0)	10.7 (n = 3)	14.3 (n = 4)	46.4 (n = 13)	28.6 (n = 8)
	Post-Survey	0.0 (n = 0)	25.0 (n = 7)	21.4 (n = 6)	17.9 (n = 5)	35.7 (n = 10)
24. I would like to use creativity and innovation in my future work.	Pre-Survey	0.0 (n = 0)	3.6 (n = 1)	17.9 (n = 5)	32.1 (n = 9)	46.4 (n = 13)
	Post-Survey	0.0 (n = 0)	7.1 (n = 2)	17.9 (n = 5)	25.0 (n = 7)	53.6 (n = 15)

(continued)

Table 4.23

Expanded Responses to STEM Self-Efficacy for STEM Academy Participants (%) (cont.)

Survey Item	Type of Survey	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
25. Knowing how to use math and science together will allow me to invent useful things.	Pre-Survey	0.0 (n = 0)	0.0 (n = 0)	25.0 (n = 7)	39.3 (n = 11)	35.7 (n = 10)
	Post-Survey	0.0 (n = 0)	3.6 (n = 1)	32.1 (n = 9)	25.0 (n = 7)	39.3 (n = 11)
26. I believe I can be successful in a career in engineering.	Pre-Survey	7.1 (n = 2)	21.4 (n = 6)	17.9 (n = 5)	32.1 (n = 9)	21.4 (n = 6)
	Post-Survey	0.0 (n = 0)	10.7 (n = 3)	21.4 (n = 6)	32.1 (n = 9)	35.7 (n = 10)

Table 4.24

Collapsed Responses to STEM Self-Efficacy for STEM Academy Participants (%)

Survey Item	Type of Survey	Strongly Disagree/Disagree	Agree/Strongly Agree
1. Math has been my worst subject.	Pre-Survey	35.7 (n = 10)	17.9 (n = 5)
	Post-Survey	64.3 (n = 18)	21.4 (n =6)
2. I would consider choosing a career that uses math.	Pre-Survey	17.9 (n = 5)	50.0 (n = 14)
	Post-Survey	21.4 (n =6)	57.1 (n = 16)
3. Math is hard for me.	Pre-Survey	50.0 (n = 14)	32.1 (n = 9)
	Post-Survey	50.0 (n = 14)	25.0 (n = 7)
4. I am the type of student to do well in math.	Pre-Survey	14.3 (n = 4)	46.4 (n = 13)
	Post-Survey	14.3 (n = 4)	50.0 (n = 14)

(continued)

Table 4.24

Collapsed Responses to STEM Self-Efficacy for STEM Academy Participants (%) (cont.)

Survey Item	Type of Survey	Strongly Disagree/Disagree	Agree/Strongly Agree
5. I can handle most subjects, but I cannot do a good job with math.	Pre-Survey	60.7 (n = 17)	28.6 (n = 8)
	Post-Survey	67.9 (n = 19)	21.4 (n = 6)
6. I am sure I could do advanced work in math.	Pre-Survey	14.3 (n = 4)	67.9 (n = 19)
	Post-Survey	17.9 (n = 5)	60.7 (n = 17)
7. I can get good grades in math.	Pre-Survey	3.6 (n = 1)	89.3 (n = 25)
	Post-Survey	7.1 (n = 2)	64.3 (n = 18)
8. I am good at math.	Pre-Survey	17.9 (n = 5)	53.6 (n = 15)
	Post-Survey	7.1 (n = 2)	57.1 (n = 16)

(continued)

Table 4.24

Collapsed Responses to STEM Self-Efficacy for STEM Academy Participants (%) (cont.)

Survey Item	Type of Survey	Strongly Disagree/Disagree	Agree/Strongly Agree
9. I am sure of myself when I do science.	Pre-Survey	0.0 (n = 0)	89.3 (n = 25)
	Post-Survey	3.6 (n = 1)	85.7 (n = 24)
10. I would consider a career in science.	Pre-Survey	14.3 (n = 4)	53.6 (n = 15)
	Post-Survey	17.9 (n = 5)	60.7 (n = 17)
11. I expect to use science when I get out of school.	Pre-Survey	7.1 (n = 2)	64.3 (n = 18)
	Post-Survey	10.7 (n = 3)	71.4 (n = 20)
12. Knowing science will help me earn a living.	Pre-Survey	7.1 (n = 2)	71.4 (n = 20)
	Post-Survey	7.1 (n = 2)	71.4 (n = 20)

(continued)

Table 4.24

Collapsed Responses to STEM Self-Efficacy for STEM Academy Participants (%) (cont.)

Survey Item	Type of Survey	Strongly Disagree/Disagree	Agree/Strongly Agree
13. I will need science for my future.	Pre-Survey	7.1 (n = 2)	82.1 (n = 23)
	Post-Survey	10.7 (n = 3)	71.4 (n = 20)
14. I know I can do well in science.	Pre-Survey	0.0 (n = 0)	85.7 (n = 24)
	Post-Survey	0 (n = 0)	89.3 (n = 25)
15. Science will be important to me in my life's work.	Pre-Survey	14.3 (n = 4)	75.0 (n = 21)
	Post-Survey	10.7 (n = 3)	57.1 (n = 16)
16. I can handle most subjects well, but I cannot do a good job with science.	Pre-Survey	89.3 (n = 25)	3.6 (n = 1)
	Post-Survey	89.3 (n = 25)	3.6 (n = 1)

(continued)

Table 4.24

Collapsed Responses to STEM Self-Efficacy for STEM Academy Participants (%) (cont.)

Survey Item	Type of Survey	Strongly Disagree/Disagree	Agree/Strongly Agree
17. I am sure I could do advanced work in science.	Pre-Survey	14.3 (n = 4)	71.4 (n = 20)
	Post-Survey	14.3 (n = 4)	60.7 (n = 17)
18. I like to imagine creating new products.	Pre-Survey	10.7 (n = 3)	78.6 (n = 22)
	Post-Survey	17.9 (n = 5)	60.7 (n = 17)
19. If I learn engineering, then I can improve things that people use every day.	Pre-Survey	7.1 (n = 2)	71.4 (n = 20)
	Post-Survey	10.7 (n = 3)	78.6 (n = 22)
20. I am good at building and fixing things.	Pre-Survey	25.0 (n = 7)	50.0 (n = 14)
	Post-Survey	10.7 (n = 3)	46.4 (n = 13)

(continued)

Table 4.24

Collapsed Responses to STEM Self-Efficacy for STEM Academy Participants (%) (cont.)

Survey Item	Type of Survey	Strongly Disagree/Disagree	Agree/Strongly Agree
21. I am interested in what makes machines work.	Pre-Survey	21.4 (n = 6)	46.4 (n = 13)
	Post-Survey	3.6 (n = 1)	53.6 (n = 15)
22. Designing products or structures will be important for my future work.	Pre-Survey	10.7 (n = 3)	71.4 (n = 20)
	Post-Survey	14.3 (n = 4)	60.7 (n = 17)
23. I am curious about how electronics work.	Pre-Survey	0.0 (n = 0)	75.0 (n = 21)
	Post-Survey	25.0 (n = 7)	53.6 (n = 15)
24. I would like to use creativity and innovation in my future work.	Pre-Survey	3.6 (n = 1)	78.6 (n = 22)
	Post-Survey	3.6 (n = 1)	78.6 (n = 22)

(continued)

Table 4.24

Collapsed Responses to STEM Self-Efficacy for STEM Academy Participants (%) (cont.)

Survey Item	Type of Survey	Strongly Disagree/Disagree	Agree/Strongly Agree
25. Knowing how to use math and science together will allow me to invent useful things.	Pre-Survey	0.0 (n = 0)	75.0 (n = 21)
	Post-Survey	3.6 (n = 1)	64.3 (n = 18)
26. I believe I can be successful in a career in engineering.	Pre-Survey	28.6 (n = 8)	53.6 (n = 15)
	Post-Survey	10.7 (n = 3)	67.9 (n = 19)

Research Question Five

Research question, five, *How does participation in a sixth grade STEM Academy affect girls' perceptions of STEM self-efficacy?*, was answered using a qualitative priori and inductive coding process. To gain a more comprehensive understanding of girls' perceptions of STEM self-efficacy, 10 girls from the sixth grade STEM Academy were purposefully selected to participate in focus group at two points of the study, prior to the start of the STEM Academy program and at the end of the fall semester. Participants were identified and referred to using pseudonyms, Student A, Student B, Student C, Student D, Student E, Student F, Student G, Student H, Student I, and Student J. To answer the research question, themes were categorized and subcategorized.

The main thematic categories that emerged from the qualitative data were the following: (a) content related perceptions; (b) perceptions related to failure and asking for help from the teacher; (c) perceptions related to success in engineering; (d) future STEM course and career selection; (e) perceptions of gender disparity; and (f) teacher influence on self-perception. Within these main thematic categories, subcategories were created to gather a more insightful analysis of students' perceptions of STEM self-efficacy.

Content Related Perceptions

Participants were asked questions related to specific subjects and their feelings and perceptions related to these subject areas. Responses analyzed and grouped together in similar subject areas to form subcategories (a) perceptions of mathematics self-efficacy; (b) perceptions of science self-efficacy; (c) perceptions of engineering self-efficacy; and (d) perceptions of technology self-efficacy. Table 4.25 shows the girls' responses related to their how their perceived they did in each of the content areas.

Table 4.25

Girls' Perceptions in Self-Efficacy

		Content Related Perceptions in Self-Efficacy (Do I Think I'm Good at It?)			
		Mathematics	Science	Engineering	Technology
Student	A	Yes	Yes	Yes	No
	B	Yes	Yes	Yes	Yes
	C	Yes	Yes	Yes	Yes
	D	No	Yes	Yes	Yes
	E	No	No	Yes	No
	F	Yes	No	Yes	No
	G	No	Yes	Yes	Yes
	H	Yes	Yes	Yes	Yes
	I	No	Yes	Yes	No
	J	Yes	No	Yes	No

The sixth grade girls participating in the focus groups had different teachers during the school year. They also came from a variety of elementary schools in the district where they also had different teachers. These differences in teachers, elementary schools, classroom environments could all provide different experiences and opportunities of STEM learning for the participants prior to enrolling in the STEM Academy. As a result, girls' perceptions of self-efficacy may be attributed to these differences.

Perceptions of mathematics self-efficacy. Participants were asked questions about mathematics and their feelings of the subject. Overall, most of the students felt that they were good at mathematics (see Table 4.25). There were a few students who expressed their dislike for mathematics. For example, Student A, in August, stated, "I feel like I am good at math, but I don't really like it. There's a lot that you have to remember and I find myself getting stressed out until I get the answer right." In December, when asked again about how she felt she did in mathematics class, she responded similarly. The months she spent in her mathematics class in the STEM Academy program did not change her feelings. However, Student D's perceptions of her mathematics class were a little different. In August, she believed that she was not good at mathematics even though she enjoyed the class. By December, her feelings had changed slightly. She stated that she hated mathematics class because it was too hard and she never knew any of the answers. She said, "How can I be good at something that I just don't understand and it doesn't make sense to me!" Student E jumped in to the discussion and shook her head saying, "Sometimes I don't understand the problem and I have no idea what I am doing either. Math is not a fun subject for me." She stated that she did not like mathematics either in the beginning of the school year and had hoped the STEM Academy program would have helped her feel better about mathematics but it hadn't yet. This suggests that Student E expected the STEM Academy to help change her viewpoint of mathematics and how she would feel about completing mathematical tasks and assignments. The STEM Academy would be a safe place where Student E hoped that her perception of mathematics would be more positive.

Student F, however, really liked her mathematics class in the STEM Academy program. In August, she said mathematics was her favorite subject "because I do so well in it. It's easy for me." By December, when she was asked again how she felt about mathematics, she responded, “I still like math. This year is a little harder because of the integers, but I think I am still doing well in it.” She was pleased with her progress in class even though it was not as easy as it used to be for her. This suggests that Student F’s perceptions of her mathematical abilities were cultivated through the STEM Academy where she continued to feel successful in mathematics class. Student H agreed that math was an easy subject for her and she really enjoyed it because she got to learn new things. She did comment that even though she liked mathematics, she felt she could do better because “I wasn’t trying as hard as I could since math came easy to me”, suggesting that the STEM Academy helped her keep a positive outlook in her ability to solve mathematical problems. Student I stated, in August, that mathematics was her least favorite subject because it was “too hard of a subject and takes too long to solve problems”. With her fist in the air, she stated, “I get mad a lot in math class because it’s just too much work and I don’t like learning the hard things.” She said she wished it were easier for her to solve the problems so she could actually enjoy it.

Responses from the girls implied that those who felt they were good in mathematics felt that way before participating in the STEM Academy. After participating in the program, these girls still perceived their mathematics self-efficacy positively. As a result, it is evident that girls’ perceptions of their mathematical abilities were not initially affected by the STEM Academy. However, the STEM Academy did maintain their positive self-perception in their mathematics abilities. The girls who did not feel confident in their mathematical abilities prior to participating in the STEM Academy did not demonstrate a change in their perceptions after participating in the program. This suggests that the STEM Academy did not affect their perceptions of their mathematical self-efficacy.

Perceptions in science self-efficacy. Questions related to how participants felt about science were asked in August prior to the start of the STEM Academy program and in December, at the end of the fall semester. Most of the students felt confident in their abilities to complete scientific tasks and assignments. Some students perceived their abilities a little less favorably, but most of the girls believed that science was fun and not a difficult class for them (see Table 4.25). For example, in August, Student B smiled and stated, "I think I am really good at science. It doesn't seem that hard because you just have to listen to the steps of the experiments." By December, she stated that she still felt that she was good in science even though the science experiments were becoming harder. Student C agreed with her. In August, she stated that science was also a fun class because it came easy to her. She said she did not struggle in science and was good at it. In December, she excitedly said that science was her favorite subject and she still did not struggle. She stated, "I rarely get stuck in science because it just comes easy to me. I don't struggle at all in science class." This suggests that the girls viewed their participation in the STEM Academy positively and knew that they could be successful in their science classrooms.

Student H had similar feelings of her science self-efficacy. She stated, "I feel confident in that class because not only does the teacher teach us what we need to know, but I get extremely good grades in it so it actually makes me feel more better than the other subjects." This was her perception in August and when asked again in December, she responded that science was still her favorite because she was still getting good grades. She also said that she still felt pretty confident in science and was sure she would keep her good grades when the school year ended. Student G also felt strongly about her performance and abilities in science in August. A smile grew on her face when she spoke about it. She responded:

> Science is very easy for me right now.   I have never struggled in science so I have been always been good at it. But, I am worried that now that I am going to the sixth grade, it will be harder to understand but I will still try my best.

When Student G was asked again in December about her feelings about her performance and abilities in science, she responded less positively than she did in August. She stated, “I am struggling for the first time in science and I don’t like it. I’m confident I can do the work but it’s very hard. I don’t think I am doing as well as I used to do.” This suggests that either the content is harder for the student to grasp or the STEM Academy program is not helping Student G in a manner where she feels successful.

Student F, however, did not speak favorable about her abilities in science. In August, she responded, “I feel like I’m not very good at science. I understand some of it but some other parts I feel clueless and I don’t understand.”   In December, when asked again about her feelings about her abilities in science, she remained unchanged with her previous perceptions. She stated, “This year is getting harder in science and there’s more and more that I don’t understand. I’m still trying hard but I really don’t think I’m doing well.” Student J responded similarly about her feelings about her performance in science. In August, she sullenly said that science was interesting but she did not feel she was good at it. She reported that she has a difficult time understanding the science concepts so it is harder to remember everything she learned. In December, she stated, “This year in science hasn’t been as hard as I imagined, but I’m still having a hard time with understanding the lessons. It’s still not my favorite subject because I just don’t do as well in it.” This suggests that Student J’s participation in the STEM Academy did not affect the way she perceived her abilities to complete scientific tasks or in her scientific learning.

Responses from the girls implied that those who felt they were good in science felt that way before participating in the STEM Academy. After participating in the program, these girls still perceived their science self-efficacy positively. As a result, it is evident that girls' perceptions of their science abilities were not initially affected by the STEM Academy. However, the STEM Academy may have maintained their positive self-perception in their science abilities. The girls who did not feel confident in their science abilities prior to participating in the STEM Academy did not demonstrate a change in their perceptions after participating in the program. This suggests that the STEM Academy did not affect their perceptions of their science self-efficacy.

Perceptions in engineering self-efficacy. During the interviews, students were asked questions related to their self-efficacy in engineering. All 10 of the participants felt confident in their engineering abilities (see Table 4.25). They also stated that they had not done a great deal of engineering in previous grades at school. Most of their engineering experience was done in out-of-school time (OST) programs or at home. The girls who had experience in OST programs had participated in some sort of a formal engineering program with their school. However, by December, all participants had done an engineering project in the classroom related to Project Based Learning (PBL). The PBL was called "Helmet Safety: Protecting Your Brain". They were tasked with going through the Engineering Design Process (EDP) to build a helmet that could prevent a paintball pellet from exploding inside the helmet when the helmet was dropped from the top of a ladder. Their responses reflected their experiences and exposure to engineering tasks and assignments in prior OST programs and in the STEM Academy.

In August, Student A stated that she thought she was good at engineering because she enjoyed taking things apart and building them back together. She responded that she did a lot of that with her father at home because he worked on cars. She stated that because of that, she learned how good she was designing and building items. In December, when asked about her feelings on her abilities in engineering, she stated that the PBL they completed was "amazing" and hoped they would do more. Student H had a similar experience. In August, she stated that the only engineering she had experience with was building with Legos at home. She said, "I like to build with Legos because there are many ways to design something. It's small enough to use your creativity and show how good of a builder you are." In December, she stated that the PBL she did was her first one and she had really learned a lot from it. She stated, "I always thought building real life things was too hard to do but this PBL taught me a lot about what I can do." She stated that she looked forward to the PBL they would do in the spring semester because she would be able to design and build something else that was "purposeful and meaningful". This suggests that the girls had a positive experience with their engineering learning in the STEM Academy and this resulted in a higher self-efficacy in engineering.

A few students in August discussed their previous engineering experiences in OST programs and how they felt about it. Student B stated that the previous year she was in a Girls in STEM OST program and she had the opportunity to build and design robots. She felt she was very good at building the robots because she was able to be creative with them. She said, "I hope this year I get to work with robots again because I want to see if maybe I can do that in the future." Student B was interested in designing and building robots as a career and was excited that she had the prior experience to engage in it to determine whether or not this could be an option for her. When asked again in December about her feelings related to her performance in engineering, she said the only engineering task she had done thus far was the PBL. She stated she felt that she did really well on it and it was fun to do, but it was also challenging. She said she wanted to give up and let someone else in her group take over, but "If I think I want to be an engineer, I need to complete the hard parts so I did". It is evident that Student B knew the benefits of continuing on the project and not giving up. She knew that in order to attain her goal of being an engineer, she would need to be persistent in her tasks. The STEM Academy allowed for this opportunity to occur where she came to the realization of the importance of never giving up. Without the STEM Academy, another student may not have continued on with the task to complete it for she may have considered it to be not as important of a quality to have, persistence.

Student C also had previous experiences with STEM tasks from a STEM camp she participated in the previous summer. In August, she stated that she "loved designing and building things". She discussed the STEM camp and how she remembers building a car with Legos and connecting it to the computer to make it work. She stated that was her favorite part of the camp and really enjoyed "problem solving and troubleshooting" with other people in her group. She, then, mentioned, "That STEM camp really helped me see engineering more positively because I know I really liked building and designing cars and now who knows what else I may like to build or design." When asked again in December how she felt she does with engineering tasks, she responded, "I love it! I think I want to be an engineer but I just don't know what type. We learned about different types of engineers. Whatever I decide, I know I will be good at." She stated that the PBL really made her look at engineering in a different way from what she learned during the STEM camp. She said that now her options were open to decide which type of engineer she wanted to be but knew that she would be good at it because she really enjoyed building and designing things. All of the students viewed their experiences with engineering and completing the PBL as positive. The PBL was selective to the STEM Academy, which suggests that participation in the STEM Academy affected their perceptions of their engineering self-efficacy in completing their PBL.

Responses from the girls suggest that the girls that entered the program with a prior positive perception in their engineering abilities were a result of their prior experiences. Participating in the STEM Academy continued to positively influence their perception in their engineering self-efficacy. This implies that the STEM Academy did affect their perception of their abilities by continuing to grow their self-efficacy in engineering. The girls who did not have prior experience with engineering tasks demonstrated a positive perception in their self-efficacy by participating in the STEM Academy.

Perceptions in technology self-efficacy. Participants were asked how they felt they did using technology in the classroom or outside the school. They were asked about their experiences using a variety of technology apps, web 2.0 tools, and computer science programs like coding or even 3D printing during school or during OST programs funded by the school. The girls were asked about their perceptions of their technology abilities prior to the start of the program and at the end of the semester. Responses varied from positive to unfavorable feelings in their abilities (see Table 4.25). Some girls did not feel that their abilities in technology were successful while other girls viewed their abilities more favorably. Student E stated that she enjoyed using technology because it was better than using textbooks, but said she had minimal experience with it because her "previous teachers really did not feel comfortable using it so they never let us". When asked again in December, she said she was using it more often because of the STEM Academy. She stated, "My teacher really likes using the iPad for us to make things to show our learning and I have had to learn as we go." She also stated, "Doing research is hard because you don't know what is true on the internet." She said her teacher encourages the students to use an app from the iPad to showcase their learning and "sometimes that can be hard because I don't know what to do." She continued to state that she struggled using the required app because she was unfamiliar with it and was not confident in using it to showcase her learning of the content. The STEM Academy was negatively affecting her self-efficacy in the use of technology because she was not as comfortable with using the proposed apps and was not sure if she would be able to use it successfully in her presentation. However, she beamed as she stated how much she has learned and is looking forward to the rest of the school year to see what else she can learn about integrating technology. This suggests that even though her self-efficacy may not have been high in technology, she was willing to learn how to use more of the programs on the iPad to show her learning.

Student G, on the other hand, was well versed with using technology. She stated, in August, that she was "confident in technology" because she used it a lot at home for coding, completing assignments, and playing games. She said that she really enjoyed learning to code and wondered if she would get more opportunities in the STEM Academy to continue to learn. In December, she stated similar perceptions, saying, "Our STEM block teacher teaches us how to code and I have learned much more. I have coded a program to draw snowflakes and that was amazing!" She also discussed how the class had improved her coding skills and had helped her get better where one day maybe she will "create a robotic arm that can be coded to perform different tasks for someone."

Student D also had positive views about integrating technology. She said, in August, that she loved learning how to code from her previous teacher, but still struggled with some aspects of coding. She stated, "When I figured out a hard code, I felt smart, like I could accomplish anything. I hope I can learn more coding in the STEM Academy so I can be even better." Her responses did not change much when asked again in December. She stated that she is happy when she uses technology in the classroom, especially when her teacher lets her code. She also mentioned that they use a lot of computers and iPads in their class to do research and make products for their assignments. She stated:

> This was the hardest part for me because I didn't know all the apps or programs our teacher told us to try using. I had to figure it out and teach myself, but I did it. It makes me feel good about myself that I was able to do this.

She stated again how good she was at teaching herself to use various technology tools and programs. This demonstrates that the STEM Academy teachers are attempting to integrate more iPad apps and web based programs with the girls to show their learning besides using simply pencil and paper.

Not all students had a positive outlook on their performance abilities with technology, though. Student I stated that she "hated technology and wished everything was paper and pencil". She mentioned that she did not understand how to do all the different presentation apps that her teachers over the year have wanted her to do. She said:

> They never taught me how to use the apps and wanted us to just play around with the app, which I hated. I needed them to stop and show me how to use it and why one is better than the other.

Some of the apps did not make sense to her, she stated. She believed she was not good at producing products using the iPad apps. In December, she was asked again about her feelings in how she performed in technology. She remained consistent with her August feelings. She said that her teacher this year was better at explaining the different types of programs or apps they would be using, but it still did not make sense to her. She said that she was not confident in using it and wished she could just make her products out of poster boards. This suggests that the STEM Academy had a negative impact on her perceptions of technological usage in the classroom because using the different web based programs or iPad apps did not make sense to her. As such, the STEM Academy teacher should be more aware of this and more consistently help students feel successful in their use of the web based programs and iPad apps.

Responses from the girls implied that those who initially felt they were good in using technology programs or devices for instructional usage did so because of prior experiences. After participating in the program, most of the girls still perceived their abilities in technology positively. As a result, it is evident that the girls' perceptions of their self-efficacy in technology may have been maintained with their experience in the STEM Academy. Some of the girls who initially did not feel confident in their abilities to use technology programs and devices did not show an increase in their self-efficacy after participating in the STEM Academy. This suggests that the STEM Academy did not affect their perceptions of their technology self-efficacy. Some of the girls' self-efficacy in technology was not affected by their participation in the STEM Academy because of the lack of teacher experience or knowledge in using technology in the classroom. As a result, girls' perceptions of their own abilities to use technology to demonstrate learning can be affected by the teacher's level of expertise and knowledge in using technology.

Perceptions of Failure and Seeking Help from the Teacher

The next thematic category was how participants' perceived failure in various situations and learning environments and how they felt about asking for help. Participants were asked questions related to this during the August and December focus groups. There was a variety of responses of how student felt about not being successful in completing a task and their willingness to ask their teacher for help.

Several students, in August before the STEM Academy program began, stated that they get nervous or stress themselves out when they do not know how to do something, have the answer to a question, or are unsuccessful in a task. Student A stated that if she does not understand a mathematics problem, she will continue to try until she figures it out. She said other students tell her to move on to the next question, but she is "too stressed out to move on without solving the problem I am on". She also stated that she did not want to ask a lot of questions because she perceived her teacher to be annoyed with students who do this in class.   This implies that the student did not feel safe asking for help in her classroom in the STEM Academy. Nor does she feel that the teacher in the STEM Academy will respond favorably to her question or need for help.

Student B admitted that she cried when she could not solve a problem in mathematics or science. She stated that she gets frustrated a lot when she cannot solve something and begins to cry. During an engineering assignment or task, she stated that she would not cry, but she would keep trying to complete the task because she believed she could do it. In August, Students C and D hung their heads down and whispered that they get frustrated when they fail at a task because they felt they should be able to do it. Student C admitted to not asking for help because she was embarrassed and believed the other students in class would make fun of her. Student D admitted to knowing a lot more in elementary school so this was uncommon for her to be confused or fail at a mathematics or science assignment. She stated that she never had to ask the teacher for help because she always understood everything, but now she is seeing that more and more she is confused in mathematics and science class.

At the end of the fall semester, Students C and D were asked the same questions regarding asking for help. Student C said that she has been trying not to get frustrated during class when she does not get something correct because "getting mad will not help you be successful, only persistence and understanding will". Student D however admitted to still becoming mad and frustrated when she was unsuccessful in a given task because she felt she should know how to do it and it should not be as difficult of a task as it was to her. This suggests that some of the girls do not know how to address their frustrations and their concerns in the STEM Academy. Perhaps they also do not feel that the teacher is capable or willing to help them sort through their frustrations and lack of confidence in their abilities when they struggle with a given assignment or task.

Student G had a different perspective of asking for help. She stated that she "would feel great because then I would understand the problem and I know the teachers are supposed to help when I get stuck. It is their job so I need to let them do their job." She continued to suggest that it is important to ask for help when you do not understand something because by asking a question, you may be helping someone else who also does not understand. This implies that Student G has a positive perception of her ability in asking for help and is confident or comfortable in doing so because she sees the value in doing so.

Participants were also asked how they would feel if something they were engineering or building did not work properly. Student A stated that she did not mind if that happened because she would continue to try to get it to function properly. She continued to say that she would "keep building and redesigning until I could figure it out because I do not want to give up so quickly". However, Student D had a different opinion. She felt that when her building projects failed, she grew frustrated and angry because "I wasted all that time for nothing." She said several times that her teacher consistently told her that it is not all about the end result, that the process is important too because it is where you learn what will work and not work. But, she still felt like a failure when her task failed. Student J admitted that she also gets frustrated when her project design fails because other people make it appear so easy and she cannot understand why it is not for her. This suggests that her teacher in the STEM Academy is not helping her feel confident in her ability to succeed or to continue trying to complete a given task or assignment.

Perceptions of Success in Engineering

This thematic category stemmed from responses related to how the participants felt when they succeeded in an engineering task or assignment. Participants were asked questions related to this during both focus groups, prior to the start of the STEM Academy program and at the end of the fall semester. Most of the participants stated that if they were successful on an engineering task, they would feel proud of themselves and happy. For example, Student B, in August, nodded excitedly that building and engineering a successful design would make her "happy because I know I did a good job building it". Student H agreed with this and stated that she feels proud after a task because she knows she accomplished something. Student I also indicated that when she successfully builds something she feels proud of herself because "it looks good." "I am proud of myself because I did it and I know I can do more", said Student J. Being proud of themselves in their accomplishment in engineering was a common theme that was evident in the focus groups.

Feelings of accomplishment remained the same even at the end of the fall semester. Student C raised her hand in excitement to answer that she likes when the teacher calls on her because she gets the chance to show the teacher what she knows. Student D exclaimed that she is pleased with herself when she completes a difficult task because "I know that I tried my best and it worked." Student E stated the same sentiment. She said, "The best part of completing a challenging task is knowing that I worked hard on it and I was successful." Students were consistent about their feelings regarding success and their accomplishments in building and designing in the STEM Academy. It was evident that the participants took great pride in accomplishing difficult tasks. This suggests that the girls felt confident in their abilities to complete engineering challenges in the STEM Academy and they had positive perceptions of their successful completion.

Teacher Influence on Self-Perception

Participants were asked numerous questions regarding how teachers influenced how they perceived specific subjects, helped build their confidence in specific subjects, and if teachers changed the way participants viewed their abilities in these subjects. These questions were asked prior to the start of the STEM Academy program, in August. Student responses varied from negative on how their teacher influenced their confidence and perception of different subjects to more positive where students perceived their ability more in a supportive and encouraging manner. Student A stated that her fifth grade teacher made mathematics look easy so “I was able to really learn how to solve the problems because he broke everything down in a simple, understandable way.” She commented that this teacher helped her see how to solve harder mathematical problems by breaking it down to easily understandable steps. She hoped that her new sixth grade teacher would be “good like my last teacher so I can continue understanding the different questions and know what I am doing.” She continued to say that her confidence in her mathematics skills were higher than other subjects because mathematics always made sense to her because of her fifth grade teacher. Student D agreed and stated that her second grade teacher also made mathematics look easy. She said she really understood the subject and thought she would always be successful in mathematics class. But, she stated, she was concerned because:

> …sixth grade is harder math and I don’t know if my teacher will be good so I can do a good job. I wish my second grade teacher could be my sixth grade teacher. Then, I know for sure that I will be successful.

Student B had a similar story to tell. She said she felt like the best teacher to influence her self-confidence was her fourth grade teacher because she would tell her, "It's okay if you don't get the answer right. The important thing is to try and keep working on it, no matter what." Student B said that has helped her in all her mathematics classes to keep working hard on the different lessons. She stated that she hears her teacher's voice remind her to keep trying and to never give up on her mathematics problems. This suggests that some of the girls' self-confidence and self-efficacy was cultivated by several of their previous school teachers. These teachers helped to shape the girls' self-perceptions of their abilities and influence them in different ways. For Student G, her third grade teacher was the one to "help me believe in myself and get the confidence I needed to pass the STAAR [state assessment] test". She said that her teacher inspired her to always try her best and no matter what, to always take risks to grow as a learner. This implies that the students' perceptions in their abilities were influenced by previous teachers. This suggests that any teacher has the capability of positively influencing girls.

Unfortunately, one student did not have similar feelings or perceptions regarding her teachers. She held a rather negative perception of her teachers. Student H said that she has never really had a teacher to help her be successful. She stated that all her teachers were not really good at helping her believe neither in herself nor in building her confidence in any of the subject areas. She continued to sadly explain that even her current teacher "does not even seem confident in her own ability, so how can she help me be a better student?" She said that she loves science but her teacher's "lack of confidence is not helping to grow my own". She stated that she wished she could have just one teacher that can help her grow in science because she is considering being a doctor. She said, "If I don't get a good teacher to help me I do not think I will choose to be a doctor because I don't want to hurt someone if I am not very confident in my own ability." Students' perceptions of their teachers' influences played a large role in their self-efficacy in completing tasks. For example, Student H had not had a teacher to help her grow as a learner or to help build her own confidence. This implies that not one teacher had positively influenced her in her own abilities to complete tasks or assignments. This was in contrast to the other participants' experiences.

Future STEM Course and Career Selection

Participants were asked during both focus group times if they believed they would pursue a STEM career or major in a STEM field in college. There were a variety of responses in August from wanting to choose STEM as a course pathway to not being interested at all. Out of the ten participants, six students expressed interest in majoring in STEM when they go to college, when asked in August. Student A stated that she would be choosing a STEM major in college because she wanted to work for NASA and knew a degree in STEM would be "highly beneficial". She stated that she knew she would be able to do it because of her love for learning. Student B stated, "I want to build prosthetics for people in need so I know a degree in STEM would be the right choice." She also stated that she would be open to taking more engineering and technology classes if it meant she could build prosthetics. Student C, on the other hand, was not clear on her decision of a specific job in the future. She stated that she "loved engineering and technology" but was not sure what she wanted to do with that degree. She said she was considering being an architect, computer programmer, or even an engineer on an oil rig. She stated that hopefully by the end of the school year, the STEM Academy would have helped her decide what she wanted to be.

Student G shared excitedly as she clapped her hands that her dream is to be a cancer doctor for children so she would need to major in STEM or just science. She also stated, “Maybe by the time I go to college, I will have to learn more engineering and technology like the 3D printer, to help kids with cancer. That would be so cool to do.” She stated that she could not wait to see what she can do to better support and help kids with cancer. Student H also stated that she wanted to be a doctor so she would major in STEM or simply science. She stated, “I know STEM is what I would need if I wanted to be a doctor.” Student J also shared the same viewpoint. She stated, “My dream is to be a doctor so majoring in STEM is what I will have to do to make my dream come true.” All six of these participants were smiling as they spoke about their dream careers sand how STEM would be the right major when they get to college. None of the participants mentioned specific STEM related courses, rather they mentioned what their dream job was and if STEM would be a plausible choice for them.

The other four participants had other dreams or interests. Student D stated that she would not major in STEM because she wanted to be a police officer. She stated, “STEM really wouldn’t help me in being a cop so I doubt I will even bother majoring in it.” Student E stated that she wanted to be a physical therapist or a fashion designer so she would not need STEM as a major. Student F was not sure what she wanted to be in her future. She stated that she was unsure of where she would end up so STEM could be a possibility, but she was doubtful. Student I stated that she wanted to be an author so could not “see how STEM would help” her accomplish that goal. This suggests that the STEM Academy has been a positive influence and program in helping girls choose STEM as a course selection or as a career in their future.

In December, students were asked again about their interest to major in STEM in college. The six participants who had previously stated they would pursue a major in STEM did not waver in their decisions. They still wished to major in STEM when they went to college. However, of the four participants who said they would not major in

STEM, two of them had changed their minds. Student D previously stated she wanted to be a police officer. By the end of the fall semester in the STEM Academy, she stated that she loved science and doing experiments so she was considering majoring in science. She stated she was not sure what she wanted to do with this major but that she would most likely major in science. The other student to have changed her mind was Student E. Previously, she stated that she wanted to be a fashion designer or a physical therapist. However, she stated that she changed her mind, as well. She said that she still wanted to be a designer, but no longer a fashion designer. She wanted to design and build things like an engineer but wondered if she could fit in fashion somehow. Both students stated that being in the STEM Academy had helped them be better at STEM and complete different challenges and that was why they changed their mind. As a result, the STEM Academy had positively influenced these girls to select a STEM pathway or a career in their future because their self-efficacy in STEM had increased.

Perceptions of Gender Disparity

In August, participants in the STEM Academy were asked several questions related to gender disparity such as "*How would you feel if you heard someone say that boys are smarter than girls?"* and their responses were coded according to this theme. Their responses all were consistent in feeling this was unacceptable. Many of them responded that they would be angry hearing that males are better at achieving specific tasks than females. Student H said, "I would feel offended because that's like calling us dumb and we are just the same as the boys in math." She believed that both genders were equal and should be treated as such. She also exclaimed that just because boys are good at something does not mean than girls are not. She shook her head in disbelief when she was asked about her feelings related to people's perceptions of gender equality. She said with feeling, "I would be offended because why can't we [as girls] be anything and why are [the boys] always claiming to be smarter?" She did not agree with the perception that males were better at specific tasks compared to the females. She was adamant that both genders should be given the opportunity to be successful and to prove their own intelligence and achievement.

One student in particular believed the gender disparity statements were not acceptable because they were sexist remarks. In fact, Student I disapprovingly stated, "That's such a sexist thing to say and I don't agree at all!" This student was unwavering in her belief that the people who say that males are better at certain things than females were sexist and "they should get with the program!" Student C completely agreed with Student I and confirmed her exclamation. Student C said that if she ever heard someone say that males could do mathematics or engineering better than a female, she would demand a competition to prove that females could do anything that the males could do. She also repeatedly stated:

> It makes no difference what gender you are because you can't say that all males are better than females in something. You can't compare people like that and I would look forward to proving it to them in a competition. That's how I would prove that I am smarter than a boy in some challenges.

Student B stated something similar. She stated strongly that she would "show them an article of all the times when girls proved to be better than the boys and make those people who believed differently read the article." She felt that "it is a horrible thing to say for something that is not necessarily true and I cannot believe that people believe it." She said she would even enter a competition to prove that she is better at specific things compared to males and other people need to realize that. She hoped after reading the article people would be more careful in voicing such remarks that hurt females. Some participants believed that it was a misconception that people had. Student J stated:

> Most people believe that only men can be scientists because they don't see all the women who are great in science. These people don't give credit to women scientists because the world is mostly looking at the males. But, that's not okay because the women scientists are just as good as the men, but they are misunderstood.

This implies that the girls had great confidence in themselves as girls and knew that their abilities are not defined by their gender. The girls perceived themselves to be just as qualified or smart as the boys, and were willing to challenge anyone who said or thought any different.

Conclusion

This chapter provided a detailed description of the demographic characteristics of the participants. It also included the findings for each of the research questions. Chapter 5 will include the summary, implications, and conclusions for this research study.

CHAPTER V:

SUMMARY, IMPLICATIONS, AND RECOMMENDATIONS

The purpose of this mixed-methods study was to examine the influence of participating in a STEM Academy on girls' STEM self-efficacy. The influence of various STEM programs on girls' self-efficacy have been well documented in research literature, but the influence of a STEM Academy program needs more exploration. To quantify girls' self-efficacy in mathematics, science, engineering and technology, and STEM, 56 sixth grade girls were asked to complete the *Student Attitudes toward STEM* (S-STEM) *–Middle and High School Students (6-12th grades) Survey*. A sample of 28 girls in a sixth grade STEM Academy were individually matched to a sample of 28 sixth grade girls not participating in a STEM Academy in an urban school district in southeast Texas. Students in the STEM Academy participated in small focus groups consisting of 10 students. This chapter included a summary of the findings for each of the research questions, implications for administrators and teachers, and recommendations for future research.

Summary

The purpose of this sequential mixed-methods study was to examine the influence of participating in a STEM Academy on girls' STEM self-efficacy. This study addressed the following research questions:

1. Does participation in a sixth grade STEM Academy influence girls' self-efficacy in mathematics?
2. Does participation in a sixth grade STEM Academy influence girls' self-efficacy in science?

3. Does participation in a sixth grade STEM Academy influence girls' self-efficacy in engineering and technology?
4. Is there a statistically significant mean difference in girls' STEM self-efficacy between pre and post survey data in the STEM Academy?
5. How does participation in a sixth grade STEM Academy affect girls' perceptions of STEM self-efficacy?

Research Question 1

The current study found that participation in a sixth grade STEM Academy positively influenced participating STEM Academy girls' self-efficacy in mathematics when compared to girls' in the non-STEM Academy program. Prior to participation in the STEM Academy program, students already had a higher mathematics self-efficacy compared to the students in not participating in the STEM Academy program. This could be because girls participating in the STEM Academy may have had experience and participation in previous STEM programs or lessons, which may have contributed to an already high mathematics self-efficacy. However, once baseline equivalence was established, the results showed an increase in self-efficacy in mathematics in the girls who were participating in the STEM Academy.

Students' self-efficacy in mathematics. The findings of this research were consistent with research findings of Frost and Weist (2007), who found that students who participated in a Mathematics Camp demonstrated an increase in mathematics self-efficacy and mathematics self-confidence. Based on the quantitative findings from this current study, it is evident that the STEM Academy program did increase participating girls' mathematics STEM self-efficacy compared to girls not participating in the STEM Academy program. According to Bandura et al. (2001), when female high school students are not provided the opportunity to participate in a STEM or mathematics program, their mathematics self-efficacy suffers. The mathematics self-efficacy of male high school students however, continues to persist at a higher level than that of female students, regardless of the presence of mathematics or STEM programs. One reason for these puzzling findings could be that Bandura et al. (2001) study did not include participants enrolled in a specific STEM or mathematics program to determine if an influence existed. As such, their results showed how males' and females' mathematics self-efficacy was influenced over time in high school. Based on the quantitative findings from this current study, it is suggested that females' mathematics self-efficacy may continue to increase as students approach high school, if they are enrolled in a STEM Academy program or a mathematics program that will increase their self-efficacy.

Research Question 2

The current study did find that participation in a sixth grade STEM Academy positively influenced girls' self-efficacy in science when compared to girls' in the non-STEM Academy program. This implies that the STEM Academy program did positively influence participating girls' self-efficacy in science. Prior to the beginning of the school year, the science self-efficacy of girls intending to participate in the STEM Academy and girls not intending to participate in the STEM Academy were similar. Neither group demonstrated a higher self-efficacy in science prior to participation. This suggests that participants in the STEM Academy program did not begin the program with a pre-existing high self-efficacy in science.

Students' self-efficacy in science. An increase in science self-efficacy was found in this research study which is consistent with Wallace and Hattingh's (2014) study. Wallace and Hattingh (2014) found that girls' had a positive outlook and attitude toward science when they engaged in a learning environment that was conducive to building their science self-efficacy. Based on the quantitative findings from this current research study, this suggests that a learning environment, like the STEM Academy program, is an effective means to build or increase girls' science self-efficacy.

Research Question 3

The current study did not find that participation in a sixth grade STEM Academy influenced girls' self-efficacy in engineering and technology when compared to girls not participating in the STEM Academy program. This implies that the STEM Academy did not positively influence participating girls' self-efficacy in engineering and technology. Prior to the beginning of the school year, the engineering and technology self-efficacy of girls intending to participate in the STEM Academy and girls not intending to participate in the STEM Academy were similar. Neither group demonstrated a higher self-efficacy in engineering and technology prior to participation. This suggests that participants in the STEM Academy program did not begin the program with a pre-existing high self-efficacy in engineering and technology.

Students' self-efficacy in engineering and technology. No increase in engineering and technology self-efficacy was found in this current research study which is consistent with one facet of the findings of Master, Cheryan, Moscatelli, and Meltzoff (2017). Master et al. (2017) found that girls who participated in a robots and computer science program did not demonstrate an increase in engineering and technology self-efficacy. Based on this current research study's quantitative findings, girls' self-efficacy in engineering and technology did not increase as a result of their participation in a STEM Academy program. However, another component to Master et al.'s (2017) study was inconsistent with this current study's findings. They found that girls, who had been given the opportunity to build, design, and code a robot demonstrated a higher self-efficacy in engineering and technology than did girls who did not have the same opportunity. Additionally, Chukwurah and Klein-Gardner (2014) found that girls who had participated in an engineering program demonstrated a higher engineering self-efficacy compared to those who did not participate in the program. Finally, Bystydzienski, Eisenhart, and Bruning (2015) found that girls who participated in an engineering program also demonstrated a higher engineering self-efficacy. This is not consistent to this current research study. All three of these studies suggest that girls' self-efficacy in engineering and technology could be positively influenced by participation in a STEM Academy program, if engineering and technology experiences are provided. However, this current research study did not have similar findings.

One possible reason the current research study did not find that participation in a sixth grade STEM Academy program positively influenced girls' self-efficacy in engineering and technology when compared to girls not participating in the STEM Academy program is that the girls in the STEM Academy program did not engage in any engineering or technology experiences. Thus, no influence was found. Another reason could be that participants in this current study (both girls in the STEM Academy and girls not in the STEM Academy) may have had pre-existing experiences with engineering and technology, thus making no influence evident. Finally, teachers may not be providing an effective or meaningful curriculum or lessons that promote engineering and technology learning in the STEM Academy, thus making it difficult for participating girls to build their engineering and technology self-efficacy. Craig (2014) found that female students who were given the opportunity to learn robotics had a higher self-efficacy because they were engaged in critical thinking, problem solving, and developing their spatial abilities. Thus, providing opportunities for female students to engage in these experiences may contribute to building their self-efficacy in engineering and technology.

Research Question 4

The current study did not find a statistically significant mean difference in girls' STEM self-efficacy between pre- and post- survey data in the STEM Academy. This implies that the girls, as a whole, prior to participating in the STEM Academy, already had a pre-existing high self-efficacy in STEM. The six girls in the STEM Academy program who had a moderate self-efficacious level in STEM did show an increase in their STEM self-efficacy, but it was not enough to show significance for the group, as a whole.

Students' STEM self-efficacy in the STEM academy. No statistically significant mean difference was found in this current study which was consistent with Brown et al.'s (2017) findings. They found that girls participating in a STEM program had a lower self-efficacy than boys participating in the program. The girls' self-efficacy in STEM was influenced by their belief that they would not be able to keep up with the boys in their classes. Based on this current study's quantitative data, it suggests that girls' STEM self-efficacy is not influenced by participation in a STEM program. Consequently, other literature refutes this current study's findings. Hizieak-Clark et al.'s (2015) findings reflected an increase in participants' self-efficacy in mathematics due to participation in a STEM program. This suggests that the current study's quantitative results should have found that girls participating in the STEM Academy demonstrate a higher STEM self-efficacy comparing pre- and post-survey data. However, this was not evident. Based on the quantitative findings from this study, it is suggestive that the STEM Academy program did not increase girls' STEM self-efficacy.

There could be several explanations for this discrepancy. First, students prior to participating in the STEM Academy program may have had a high self-efficacy in STEM, which is why they applied for the program. These girls already showed an interest in STEM so their self-efficacy was already high. Only six of the girls prior to participating in the STEM Academy program, had a moderate STEM self-efficacy. These six did demonstrate an increase in their STEM self-efficacy after participating in the STEM Academy program. However, the scores of the six females in the moderate self-efficacious range were not high enough to influence the scores of all participants, thus the findings of the current research study did not indicate that the STEM Academy positively influenced participants' STEM self-efficacy. Additionally, the STEM Academy curriculum itself may be inadequate, resulting in no effect on participants' STEM self-efficacy. Finally, the lack of STEM Academy female role models may also contribute to this discrepancy in the current study's findings. Wolverton et al. (2015) interviewed Dr. Linda S. Birnbaum (Toxicologist) who stated that girls need to have access to female role models with STEM careers. These female STEM role models can positively influence girls' attitudes and views of STEM careers and STEM self-efficacy.

Research Question 5

Research question five was answered using a blend of priori and inductive thematic coding processes based on two semi-structured focus groups with 10 STEM Academy students. One focus group was conducted prior to participation in the STEM Academy program and one was conducted at the end of the fall semester. To answer the research question, themes were categorized and subcategorized. The main thematic categories that emerged from the qualitative data were the following: (a) content related perceptions; (b) perceptions related to failure and asking for help; (c) perceptions related to success; (d) future STEM selection; (e) perceptions of gender disparity; and (f) teacher influence on self-perception.

Content related perceptions. Students' responses to content related perceptions were varied based on specific subjects, which are discussed below. Most of the students' perceptions of their abilities did positively change from the first interview to the second interview. This suggests that participating in the STEM Academy did positively influence participating students' perceptions.

Perceptions in mathematics self-efficacy. Participating STEM Academy students expressed their perceptions of their mathematics abilities and their performance in mathematics classes. Several students responded that their perceptions of their mathematics self-efficacy had in fact positively changed from the first interview to the last interview. Some students discussed how mathematics was an easy subject for them; as a result, they got good grades and felt confident in the subject. Two students mentioned how they did not like mathematics and did not feel that they were good at it and during the second interview, their viewpoints had not changed. In general, students expressed how they enjoyed doing mathematics prior to the STEM Academy and shared the same sentiments at the end of the fall semester. The qualitative findings in this current research suggest that strengthening girls' mathematics self-efficacy could result in their increased confidence and success in mathematics. When girls' mathematics self-efficacy increases, their mathematics assertiveness also increases, resulting in higher mathematical confidence levels, similar to that of boys (Fenema, 2000).

Perceptions in science self-efficacy. Girls' responses centered around feelings of accomplishment experienced after completing science tasks and how they perceived their ability to be successful in their science classrooms. Overall, participating girls demonstrated favorable perceptions of their abilities to engage in science and complete science related assignments and tasks. Students stated in both interviews that they felt science was easy for them and that they did not struggle in the subject. Only one student was not consistent with this finding; she stated that since participating in the STEM Academy program, she felt that science content was becoming more difficult and understanding science concepts had become problematic. However overall, students shared positive perceptions of their science self-efficacy after participating in the STEM Academy. Results from this current qualitative study suggest that the STEM Academy is a place for girls to feel confident and successful during their science learning. Wallace and Hattingh (2014) suggested that a safe learning environment is needed for girls to develop and experience positive gains in their self-efficacy, as demonstrated by the students in the STEM Academy.

Perceptions in engineering self-efficacy. Students expressed their perceptions of their engineering abilities and perceptions of their engineering skillset. As a whole, all students shared positive perceptions of their engineering abilities. In general, most students, prior to participating in the STEM Academy, only had experience with engineering at home or in out-of-school time programs in previous years. In all instances, students responded that they felt confident in their abilities to complete an engineering task or assignment because it was fun. Many students stated that even though some of the engineering tasks were difficult to complete, they still enjoyed the process and journey in completing it. Overall, students viewed their perceptions of engineering and their engineering self-efficacy favorably during their participation in the STEM Academy.

Perceptions in technology self-efficacy. Students' responses varied in their perceptions of technological abilities and completing tasks related to technology. This is due to the lack of experience with or exposure to technology of some students in the focus groups. Some students felt confident in their abilities if they were working on a web based program or iPad app that they were comfortable using or had experience with. Many students indicated their lack of confidence was due to unfamiliar apps or programs and inexperience. In many cases, the students who had a more positive outlook on their abilities were students who had more frequent experiences with technology in their previous classes. Those who did not get to experience technology as often were less confident in their abilities. This suggests that students whose past teachers frequently implemented and utilized technology were better prepared and equipped for future technological experiences. These students were more comfortable and confident in their usage. Some students even felt that this one semester of using a technology device was not enough time for them to master its use when they had never used it before. Overall, students in the STEM Academy possessed a variety of perceptions based on their technological exposure and experience.

Perceptions related to failure and asking for help. Regarding perceptions related to having to ask for help when encountering problems completing a task, most of the student participants indicated that they were usually too reluctant and/or embarrassed to ask for help. These students also mentioned that they cry or get mad when they have to ask for help and would prefer not to let the teacher know that help is needed. This suggests that girls in the STEM Academy do not have the confidence to ask for help when needed. They do not want to seem incompetent to other students nor do they want to be made fun of by classmates. They lack the self-confidence in recognizing that asking for help may greatly benefit their learning. They would rather get frustrated, mad, or cry than seek assistance from the teacher. This also suggests that the teacher may not have established a safe learning environment for the females to feel confident in asking for help.

Perceptions related to success. Students discussed their feelings of success related to various tasks or assignments associated with the STEM Academy. Overall, students felt pleased and happy with their abilities to successfully complete various STEM tasks or projects. They shared that they often felt good about themselves when they were able to successfully complete a difficult task. They even expressed their feelings about the sense of accomplishment they feel when they defeat a challenging task. It is evident that the students took great pride in their work and in accomplishing challenging tasks or assignments that were given.

Teacher influence on self-perception. Students responded to questions related to teacher influence on their perception of their STEM abilities. There were varied responses based on who the teacher was that the students were discussing. Many of the students, prior to participation in the STEM Academy program, expressed positive views of their previous teachers. They stated that specific previous grade level teachers made mathematics appear easy and as a result, they were better prepared to understand the mathematical concepts presented. Some students shared that they were reluctant to quit a challenging assignment because they could hear their past teacher's voice encouraging them and cheering them on. This suggests that students respond to positive encouragement and motivation from teachers. A couple of students indicated that they did not have a favorable experience with a specific teacher that might have helped them increase their positive self- perception of their STEM abilities. They stated that some teachers were not confident in their own abilities so they, themselves, were unsure how to increase their own self-confidence. This suggests that teachers' confidence in their own STEM abilities can positively or negatively influence the confidence their female students possess regarding STEM ability and STEM self-efficacy.

Future STEM selection. Students responded to questions related to what career path they would consider choosing during both interviews times. Most of the students believed they would consider pursuing a STEM career in the future, citing STEM professionals including doctors, architects, engineers, or NASA employees. A few students responded that they did not see themselves in a STEM career in the future because it did not relate to their ultimate career choices of fashion designer, police officer, or author. By the end of the fall semester, an additional two students decided they also wanted to pursue a STEM career. Based on the qualitative results of this current study, this suggests that the STEM Academy may have played a role in motivating participants to consider STEM careers. Consequently, more students were interested in a future career in STEM. This may be attributed to the STEM learning that they were engaged in during the first semester of the STEM Academy program. This also suggests that students in the STEM Academy are afforded more opportunities to explore STEM learning which influences their future STEM selection.

Perceptions of gender disparity. Students expressed their feelings about gender disparity and stereotypes. Consistently all the students expressed disdain for anyone who believed that boys were smarter than girls in any specific area, like mathematics, science, engineering, technology, or STEM. Female participants believed that males were not necessarily smarter than girls, but they indicated that is what people believe to be true. Many students felt that the perception of one gender being better at a task or smarter about something was inaccurate and was a stereotype. Students voiced their dissatisfaction to others' perceptions of gender disparity and believed that people are good at different things, that one gender is not necessarily better than the other one. Students expressed their dislike over this misconception and also expressed disappointment in their lack of exposure to women in STEM. The qualitative findings for this current study suggest that more needs to be done to decrease these negative perceptions that girls may hold of themselves, as well as those negative stereotypes that others hold of girls.

Implications

This study examined students' STEM self-efficacy and their perceptions of their STEM self-efficacy, resulting in the need to address the implications for administrators and teachers. District administrators are responsible for creating the curriculum, training teachers, and monitoring implementation. School administrators are tasked with the responsibility of hiring and supporting teachers, monitoring implementation of the curriculum, and fostering a positive climate where teachers are able to learn, grow, and teach students. It is the teacher's job, as first line of instruction, to implement the provided curriculum, encourage and support students, while monitoring student success and growth in a safe, risk free environment.

Implications for District Administrators

For the purpose of this study, district administrators consist of the content (mathematics, science, social studies, technology, language arts, and reading) coordinators who are responsible for writing the curriculum for the district. It is imperative that all content coordinators have a common and unified vision regarding integrating a STEM program within the district. If one content coordinator does not share this STEM vision, the entire STEM program will not be as successful as it could be with all parties on board. It is especially important to have the science, mathematics, and technology coordinators sharing this vision to fully execute and observe the benefits of student achievement, growth, and self-efficacy.

In addition, district administrators need to ensure that purposeful, meaningful, and standards aligned curriculum is not only written but implemented on the campus level. Curriculum should include STEM and Problem Based Learning (PBL) lessons and activities that teachers can easily and readily execute in their classrooms. All lessons should include a hands-on component to ensure students will be engaged in their STEM learning. PBL's should be cross curricula so students can better visualize the bigger picture of the task given instead of seeing it from the perspective of one subject area. Consequently, there may not be an engineering or technology coordinator in every district at the elementary level which can pose problems in ensuring that engineering activities occur within the curriculum. It is, therefore, just as important to guarantee STEM curricula also include an engineering and technology piece where students are given the opportunity to build and design a product and might use technology to showcase their learning. The curricula should include a variety of presentation web 3.0 tools and apps for students to utilize during their learning.

It is also the responsibility of the content coordinators to effectively train teachers in the provided curriculum to encourage confident teaching that is free from misconceptions, and ensure successful implementation of the STEM curriculum. These teacher trainings should include opportunities for teachers to practice what they will be implementing, ask questions, and build their own self-efficacy in teaching what may be an uncomfortable subject. From this current study, it was evident that some teachers in the STEM Academy were not confident or comfortable teaching mathematics, science, or utilizing technology in the classroom. As a result, students were not as confident in their own abilities or learning. This suggests that teachers need to be better prepared and equipped to teach what they are expected to teach to ensure student success, achievement, and positive STEM self-efficacy. Elementary level teachers are generalists; they do not possess a specialized content area like middle and high school teachers. As such, many may not be confident in their abilities to execute certain lessons that are unfamiliar to them. This reluctance can become a daunting obstacle if it is not addressed. To increase their own STEM confidence, elementary teachers should be provided appropriate STEM professional development.

Content coordinators must also seek to provide additional engineering and technology professional developments (PD) for their teachers if it is expected that they implement these subjects in the classroom. Elementary level teachers typically do not possess critical background knowledge necessary for STEM pedagogical success or know how to integrate engineering or technology components in their classroom. As such, it would be beneficial for the content coordinators to offer more engineering and technology PD's so they might become more comfortable and confident in the art of integration. This current study showed that the engineering and technology components of the STEM Academy had no influence upon the female participants' self-efficacy. Therefore, more investigation needs to occur regarding the types of engineering and technological experiences provided in other more successful, similar endeavors and additional PD's in engineering and technology should be provided for elementary STEM teachers to increase their STEM confidence and self-efficacy, which in turn will positively influence the same in their students.

The last implication for content coordinators is the development of out-of-school-time (OST) programs for girls to engage with and participate in. These can include after-school STEM programs, weekend STEM classes, or summer STEM program. This current study has shown that girls need additional support and experiences to not only build their STEM self-efficacy, but to maintain it through the school career. Content coordinators can host an OST STEM program for all girls in the district to participate in or for specific grade levels that the district is interested in engaging. Hosting OST STEM programs for girls would increase their self-efficacy in mathematics, science, engineering, technology, or STEM. This current study shows how important the STEM Academy program is to the girls who participated by helping them increase their mathematics and science self-efficacy. It is critical that additional opportunities, similar to this study's STEM Academy be provided for girls in engineering, technologies, and STEM so that their self-efficacy in these areas might be positively impacted, encouraging them to pursue additional STEM courses and consider STEM careers.

District administrators also include those individuals responsible for hiring and recruiting teachers and school administrators. Thus, it is essential that the right people for the jobs are hired to effectively implement the provided curricula with students. The most qualified school administrator should also be hired who share a similar STEM vision and is prepared to execute that vision with the staff members at that campus. District administrators need to ensure that the best, most qualified staff members are hired to facilitate a successful STEM learning environment at every campus. When that happens, the climate and culture of the school is more likely to change and model a STEM culture that is positive, engaging, purposeful and that supports meaningful learning experiences that are encouraging to both boys and girls. This is why it is imperative for district administrators to hire not out of shortage, but out of the necessity to grow and promote girls' STEM success.

It is also critical to have a knowledgeable district administrator facilitate trainings with teachers on coaching students through challenges, struggles, and building up their self-efficacy. If teachers were equipped for this, they would be better able to create a safe learning environment where girls would be supported and encouraged to take risks, learn and grow from their mistakes, and increase their self-efficacy in STEM. These trainings could also include opportunities for teachers to develop a growth mindset of their own so they are better able to facilitate a growth mindset among their female students. As a result, some of the negative perceptions and gender stereotypes might dissipate because the girls will start believing that they are not limited to what they can accomplish based on their gender.

Implications for School Administrators

School administrators can include principals, assistant principals, or even campus content support specialists. It is critical to ensure that teachers are utilizing the STEM curricula the district has provided so school administrators should regularly monitor and assess teachers for implementation and effectiveness in the use of the curricula. They should observe classes to make sure that teachers are, in fact, utilizing the STEM curricula as it is intended and that is being implemented in a manner that will cultivate student STEM growth and success. Then, they should address any concerns or issues that do not promote student achievement or self-efficacy. Content support specialists could be utilized to model and coach teachers in their own STEM learning and implementation of the curricula. If inconsistency is occurring with the curricula, it is imperative for school administrators to provide feedback and coach teachers so they, too, can grow and learn from their mistakes. As stated before, elementary level teachers may not be specialized in a STEM content area, so it is imperative to prepare and equip them to better support and encourage their female STEM students.

It is essential that school administrators also only hire qualified teachers who are willing and able to go the extra mile with students. A teacher who knows the benefits of an engaging lesson, the power of a growth mindset, and one who is not afraid to dive into the STEM curricula is needed on campuses. Teachers need to be hired according to their determination in seeing student growth and achievement and who have the ability to learn from their mistakes. These teachers need to be put into classrooms where girls struggle to maintain their confidence and already have a defeated mindset before even trying a STEM lesson. School administrators need to carefully evaluate and assess potential teachers to determine if they are qualified to teach and motivate all students to succeed in STEM, but particularly the minority population of girls in that school. These teachers should value hands-on learning and the use of real world scenarios to promote critical thinking, problem solving, collaboration, and creativity. Girls tend to already possess the mindset that they should choose “girl jobs” or that boys are smarter than they are in mathematics and science classes. These stereotypes need not be reinforced by teachers, but broken down to allow more girls to rise up and take a part in their own STEM learning.

On a campus level, it may be a benefit for school administrators to begin OST STEM programs. These programs could provide more students with STEM experiences and learning outside of the classroom. Results from this current study suggested that OST STEM programs, such as coding, robotics, and engineering, greatly improved the girls' self-efficacy in engineering and technology. Many of these girls spoke about their experience in OST STEM programs and the impact that it made on their self-efficacy. Integrating more OST STEM programs at a campus may prove to be even more beneficial to a larger population of girls, thus encouraging more girls in STEM. If schools were to integrate more OST STEM programs during the day, then an adjustment to the school schedule would be helpful. Schools could block out 30 minutes each day where each class has the opportunity to explore or engage in a purposeful and meaningful STEM activity. With more experience and exposure, the girls in the school may begin to see themselves in certain careers that are deemed as "boy jobs" and they may even experience a higher STEM self-efficacy.

School administrators may also find it an option to begin STEM learning in pre-kindergarten. The current study showed that some girls had STEM experiences early on in their schooling while others did not until they were older. Students who are given the opportunity to explore and engage in STEM learning at an early age, may be more likely to not only increase their STEM self-efficacy, but also maintain it as they get older and encounter more challenging and trying STEM learning. The research has shown that girls lose interest in STEM by the time they reach the sixth grade, so why not start them early and continue to cultivate their interest so they will not lose interest?

Implications for Teachers

Teachers must be able to provide a positive learning environment for their students where they are confident to take risks and be free of fear to ask for help. This current study revealed girls who were afraid to ask for help for fear of being laughed at by their classmates. Positive and safe classroom environments are critical to student success. Teachers should also know how to promote positive self-efficacy in their female students, so that these students believe in themselves and their ability to achieve anything they desire. Teachers should also be able to engage their students through hands-on learning and real world scenarios. They are responsible for teaching students how to problem solve, think critically, collaborate with one another, and demonstrate their creativity. A teacher should foster good self-efficacy and self-perceptions in any task that the student is expected to complete. They should effectively and knowledgeably implement the district STEM curriculum and be willing to accept feedback or criticism if mistakes are made.

Teachers should be willing to learn from their mistakes while motivating their students in STEM. They should be willing to attend any PD sessions that may benefit their students' growth and success. If they are not confident or comfortable in teaching mathematics or science, then it is their responsibility to seek further PD's so they themselves will gain confidence before teaching the students. They also should attend additional engineering or technology PD's to learn how to better integrate these subjects in the curricula. It is their job to be the first line of instruction for the student and as such, they are responsible for providing a positive and safe STEM learning environment for girls as well as boys. This current study demonstrated that some of the teachers did not have the ability or the confidence to teach certain STEM subjects to their students. This, in turn, was instrumental in fostering feelings of STEM inadequacy among their students.

If we want to help our girls build their STEM confidence and self-efficacy, then we need to strengthen our first line of instruction, our teachers.

Teachers must also have training and coaching experience to better equip their female students in rejecting misconceptions and gender stereotypes. They should be able to help their female students develop and cultivate a growth mindset where they can visualize and believe that they can achieve whatever it is that they desire. Teachers also need to be aware of biases and stereotypes, and know how to correct misconceptions and positively impact the feelings of STEM inadequacy their female students possess. They should be able to encourage and support the girls in their classrooms when they feel like they are unable to accomplish a task or that they are not as smart as the boys in the classroom. Teachers should not look the other way or give in to these stereotypes because that will simply perpetuate them. Instead, it is critical to help the girls change their mindsets to believe that they are just as capable as the boys and they, too, must continue to try at a task without giving up.

Recommendations for Future Research

This study included findings from feedback (quantitative and qualitative) from students. Even though these findings consisted of data and information about students' perceptions, it is critical to expand the knowledge on this topic through future research. The subsequent recommendations are constructed from this study's data and findings. First, this study took place solely in one intermediate (fifth and sixth grade) school from an urban school district in southeast Texas so results are generalizable to other schools and districts with the same demographics. A larger school district or a school district with different demographics may result in different findings. As such, a recommendation would be to include other schools and school districts with different demographics. Next, this study took place on a school campus that had a STEM Academy program so results are generalizable to other schools in Texas with a similar program. Another school with a different STEM program or not containing a STEM Academy may produce different findings and results. Therefore, a recommendation is to include schools without a STEM Academy program.

Additionally, this study only included sixth grade students so results are generalizable to other schools with a sixth grade. Other grade levels may produce different findings so a recommendation is to include a variety of grade levels in a study. In addition, this study only included female students in this intermediate school so results are generalizable to using the same gender. Including the males in a study may produce different results so it is recommended that future studies include both genders. Then, this study focused on a minority population (ethnicity/race) so results are generalizable to other schools and districts with similar demographics in student population. Including diverse demographics may result in different findings. A recommendation is to use different demographics in future studies.

Next, this study included a small percentage of Special Education and Gifted and Talented students so results are generalizable to other districts that also include a small percentage of this student population. Future recommendations would be to include future studies with more Special Education and Gifted and Talented students. Additionally, this study involved a high percentage of Economically Disadvantaged students so results are generalizable to other schools with similar demographics. A school or district with a low percentage of Economically Disadvantaged students may produce different results. As a result, it is recommended that future studies include schools or districts with a low percentage of Economically Disadvantaged students.

Finally, a future study should include tracking these students for a longer period of time. If students are tracked for over two years, perhaps more data can be collected on their STEM self-efficacy. It would be interesting to see if they have a higher self-efficacy if they remain in the STEM Academy for several years. These are recommendations that should be taken into consideration for future related studies.

Conclusion

There is plenty of research on girls' self-efficacy in the literature, yet few studies exist related to girls' self-efficacy in a STEM Academy program. Researchers suggest that STEM programs designed for girls will help increase their self-efficacy in mathematics, science, engineering, and technology (Chatman et al., 2008; Gomoll, Hmelo-Silver, Sabanovic, and Francisco, 2016; and Hizieak-Clark et al., 2015). Girls tend to have a lower self-efficacy than boys in mathematics and science, so it is imperative to provide opportunities for girls to increase their self-efficacy in STEM to ensure they are just as motivated to consider and possibly pursue STEM careers as their male counterparts. This current study could potentially provide districts and schools a way to better support, grow, and promote more girls in STEM, thus increasing the number of women who enter STEM related fields.

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APPENDIX A:

AUGUST STUDENT INTERVIEW QUESTIONS

Pseudonym Name: ID #:

Date:

Gender Specific Careers

1.

Draw a scientist.	Draw an engineer
Draw someone working with technology.	Draw a mathematician.

2. Tell me about the scientist you drew.
    a. What is the gender of your scientist? Why did you pick that gender?
    b. Why did you or did you not draw yourself?

3. Tell me about the engineer you drew.
    a. What is the gender of your engineer? Why did you pick that gender?
    b. Why did you or did you not draw yourself?

4. Tell me about the technologist you drew.
    a. What is the gender of your technologist? Why did you pick that gender?
    b. Why did you or did you not draw yourself?

5. Tell me about the mathematician you drew.
    a. What is the gender of your mathematician? Why did you pick that gender?
    b. Why did you or did you not draw yourself?

6. Look at the other person's drawings. Describe how you would feel if everyone drew men each of those jobs.

Favorite Subject

7. Tell me about your favorite subject.

8. On a scale from 1 to 10, (1 being the lowest and 10 being the highest), rate how you feel about your performance in your favorite subject.

9. Why did you give it that rating?

Mathematics Self-Efficacy

10. When it is math time, tell me how it makes you feel.

11. Do you feel you are good at math? Why or why not?

12. What do you struggle with the most in math?

13. How do you feel when you get stuck in math learning?

14. Think about your math teachers. Have any of them changed the way you feel about math? Tell me about it.

15. How do you feel about asking your teacher for help if you don't understand the concept?

16. How would you feel if you heard someone say that boys are better at math than girls?

Science Self-Efficacy

17. Tell me how you feel about science.

18. Do you feel you are good at science? Why or why not?

19. What do you struggle with the most in science?

20. How do you feel when you get stuck in science learning?

21. Think about your science teachers. Have any of them changed the way you feel about science? How?

22. How do you feel about asking your teacher for help if you don't understand the concept?

23. How would you feel if you heard someone say that boys make better scientists than girls?

Engineering Self-Efficacy

24. Tell me how you feel about building and designing things like an engineer?

25. What types of things do you like to build and design or have you built and designed?

26. Do you feel like you are good with your hands to build and design things?

27. How do you feel when what you are building doesn't work?

28. How do you feel when what you are building does work?

29. Growing up, were you permitted to build, construct, and design things either at home or at school?

30. How would you feel if you heard someone say that boys are better at building things than girls?

31. On a scale from 1 to 10, (1 being the lowest and 10 being the highest), rate how you feel about your performance in building and designing things with your hands.

32. Why did you give yourself that rating?

Technology Self-Efficacy

33. Tell me about your experiences with working with technology, at home or at school.

34. What types of technology instruction do you prefer?

35. Do you feel you work well with technology? Why?

36. Tell me about your experience with coding.

37. Tell me about your experience with robotics.

38. Tell me about your experience with 3D printing.

39. Tell me your experience with producing a product using a web 2.0 tool or app.

40. How would you feel if you heard someone say that girls don't make good computer programmers?

41. On a scale from 1 to 10, (1 being the lowest and 10 being the highest), rate how you feel about your performance in using technology.

42. Why did you give yourself that rating?

STEM Self-Efficacy

43. This is your first year in the STEM Academy. On a scale from 1 to 10, (1 being the lowest and 10 being the highest), rate how you feel you will do with the coursework in the STEM Academy this year.

44. Why did you give yourself that rating?

45. Tell me about your expectations of what you think it will be like.

46. Do you think it will be different than another classroom not in the STEM Academy? Why or why not?

47. Tell me what you know about STEM?

48. Describe your feelings about learning STEM in your classes.

49. In eighth grade, you have the opportunity to choose STEM as a pathway or track. Would that be something you would like to pursue? Why or why not?

50. Would you be interested in majoring in science, technology, engineering, or mathematics in college? Why or why not?

51. Have you participated in any STEM programs before (after school, during school, summer)?
    a. Describe that experience.
    b. Did those programs help you feel better about math, science, engineering, or technology? Why or why not?
    c. Because you previously participated in a STEM program, do you feel like it changed the way you felt about STEM? Why or why not?

52. What made you decide to apply for the STEM Academy?
    a. How do you feel about being a part of the STEM Academy?
    b. What do you like about it?
    c. What do you struggle with?
    d. If you participated in STEM programs before this, did those STEM programs influence your decision to apply for the STEM Academy? How?

APPENDIX B:

DECEMBER STUDENT INTERVIEW QUESTIONS

Pseudonym Name: ID #:

Date:

Gender Specific Careers

1.

Draw a scientist.	Draw an engineer
Draw someone working with technology.	Draw a mathematician.

Favorite Subject

2. What is your favorite subject? Why?

Mathematics Self-Efficacy

3. Do you feel you are good at math? Why or why not?

4. How do you feel when you get stuck in math learning?

5. How do you feel when your teacher calls on you to answer a question?

Science Self-Efficacy

6. How do you feel when your teacher calls on you to answer a question?

7. Do you feel you are good at science? Why or why not?

8. How do you feel when you get stuck in science learning?

Engineering Self-Efficacy

9. Tell me how you feel about building and designing things like an engineer?

10. What types of things do you like to build and design or have you built and designed?

11. Do you feel like you do a good job building and designing things?

12. How do you feel when what you are building doesn't work?

13. How do you feel when what you are building does work?

Technology Self-Efficacy

14. Do you feel you work well with technology? Why?

15. How do you feel when you have to use an iPad to create a product in class?

16. Tell me about your experience with coding, robotics, and/or 3D printing.

17. Tell me about your experience with using a web 2.0 tool or app.

STEM Self-Efficacy

18. This is your first year in the STEM Academy. How do you feel you are doing in the subjects?

19. Describe your feelings about learning STEM in your classes.

20. When you did your PBL, tell me how it made you feel during the whole learning process?

21. Do you think you would like to choose STEM as a pathway in 8^{th} grade? Why or why not?

22. Would you be interested in majoring in science, technology, engineering, or mathematics in college? Why or why not?

APPENDIX C:

PARENT CONSENT/STUDENT ASSENT (AGES 7-12)

ASSENT OF MINOR TO PARTICIPATE IN EDUCATION RESEARCH

Student Researcher:
Betty George
School of Education

Faculty Sponsor:
Dr. Michelle Peters,
College of Education

You are being asked to help in a research project called "STEM Academy: A Case Study of Girls' STEM Self-Efficacy" and the project is part of my doctorate dissertation at the University of Houston-Clear Lake. The purpose of this study is to determine if participating in a STEM Academy influences girls' STEM self-efficacy. You will be asked to complete a survey and participate in a focus group twice during the fall semester (August and December). You do not have to help if you do not want, and you may stop at any time even after you have started, and it will be okay. You can just let the researcher know if you want to stop or if you have questions. If you do want to do the project, it will help us a lot. Please keep the upper part of this page for your information. Thank you for your assistance.

* *

_______ Yes, I agree to (allow my child to) participate in the study "STEM Academy: A Case Study of Girls' STEM Self-Efficacy"

_______ No, I do not wish to (allow my child to) participate in the study "STEM Academy: A Case Study of Girls' STEM Self-Efficacy"

___________________________________ ___________________________________

Printed Name of Assenting Child Signature of Assenting Child

___________________________________ ___________________________________

Printed Name of Parent or Guardian Signature of Parent or Guardian

___________________________________ ___________________________________

Printed Name of Witness of Child's assent Signature of Witness of Child's assent

____

Date

THE UNIVERSITY OF HOUSTON-CLEAR LAKE (UHCL) COMMITTEE FOR PROTECTION OF HUMAN SUBJECTS HAS REVIEWED AND APPROVED THIS PROJECT. ANY QUESTIONS REGARDING YOUR RIGHTS AS A RESEARCH SUBJECT MAY BE ADDRESSED TO THE UHCL COMMITTEE FOR THE PROTECTION OF HUMAN SUBJECTS (281-283-3015). ALL RESEARCH PROJECTS THAT ARE CARRIED OUT BY INVESTIGATORS AT UHCL ARE GOVERNED BY REQUIREMENTS OF THE UNIVERSITY AND THE FEDERAL GOVERNMENT. (FEDERALWIDE ASSURANCE # FWA00004068)

APPENDIX D:

PARENT CONSENT/STUDENT ASSENT (AGES 7-12) (SPANISH)

CONCENTIMIENTO PARA PARTICIPAR EN UNA INVESTIGACIÓN EDUCATIVA (MENORES DE EDAD)

Estudiante Investigador:
Betty George
School of Education

Patrocinador de la facultad:
Dr. Michelle Peters,
College of Education

Se le pide que ayude en un proyecto de investigación llamado "Academia STEM: Un estudio de caso de autoeficacia STEM de las niñas" y el proyecto forma parte de mi tesis de doctorado en la Universidad de Houston-Clear Lake. El propósito de este estudio es determinar si participar en una Academia STEM influye en la autoeficacia STEM de las niñas. Se le pedirá que complete una encuesta y participe en un grupo de enfoque dos veces durante el semestre de otoño (agosto y diciembre). No tiene que ayudar si no quiere, y puede detenerse en cualquier momento incluso después de haber comenzado, y estará bien. Simplemente puede informar al investigador si desea detenerse o si tiene preguntas. Si quieres hacer el proyecto, nos ayudará mucho. Por favor, mantenga la parte superior de esta página para su información. Gracias por su asistencia.
* *

_______ Sí, acepto (permitir que mi hijo) participe en el estudio "Academia STEM: Un estudio de caso sobre la autoeficacia STEM de las niñas"

_______ No, no deseo (permitir que mi hijo) participe en el estudio "Academia STEM: Un estudio de caso sobre la autoeficacia STEM de las niñas"

___________________________________ ___________________________________

Nombre impreso del niño asintiendo — Firma del niño que asiente

___________________________________ ___________________________________

Nombre impreso del padre o tutor — Firma del padre o tutor

___________________________________ ___________________________________

Nombre impreso del testigo del niño — Firma del testigo del consentimiento del niño

____

Fecha