College major choice: exploring the perspectives of expectancy and value placed on stem fields by female high school students

Diane O'Connell

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ABSTRACT

COLLEGE MAJOR CHOICE: EXPLORING THE PERSPECTIVES OF EXPECTANCY AND VALUE PLACED ON STEM FIELDS BY FEMALE HIGH SCHOOL STUDENTS

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This qualitative case study examined the expectancy beliefs and value placed on science, technology, engineering, and mathematics (STEM)-fields by female high school students as they relate to college major choice. Nineteen female high school seniors in a STEM-focused academic program from a large suburban high school in the Midwest identified their intended college major choice and explained their career goals along with their educational experiences that were helpful in the decision-making process. Through reflective essays, focus group discussions, and interviews, perspectives emerged that played a role in choosing a college major.

The findings suggested that expectancy to be successful, along with attainment, intrinsic, and utility value placed on STEM fields, relate to the choice to major or not major in a STEM-related field. Moreover, these perceptions do not independently determine the choice of college major; however, they may holistically relate to the decision-making process. The findings of this study suggest that educational institutions can provide experiences that develop positive expectancy and value perceptions for STEM fields in order to increase the number of students who choose to enter STEM majors and careers.
ACKNOWLEDGEMENTS

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I would like to express the deepest appreciation to my family. To my husband, Dan O’Connell, I will be forever grateful for your support and encouragement in all my educational pursuits. I wonder what is next.

To my children, Patrick and Elizabeth, thank you for understanding why I seemed to be always working. Thank you for telling me that I am smart and you are proud of me. Each of you inspires me to want and need to do better.

To my sister, my twin, Debbie Manzella, thank you for talking me off the ledge on many occasions and your constant words of encouragement.

Finally, to my mom, Jewel Hall, thank you for asking the question that was instrumental in shaping who I would become: “What is your plan now?” Thank you for never doubting me.
DEDICATION

To my family:

Your love, support, and sacrifice made the impossible possible.
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CHAPTER 1

INTRODUCTION

Individuals in science, technology, engineering, and mathematics (STEM)-related fields drive the nation’s innovation and competitiveness by generating new ideas, new technologies, and new industries. Over the past 10 years, growth in STEM-related jobs was three times as fast as growth in non-STEM jobs (Atkinson & Mayo, 2006; Hossain & Robinson, 2012; Langdon, McKittrick, Beede, Khan, & Doms, 2011). The workforce in STEM positions plays a key role in the sustained growth and stability of the United States’ economy and is a critical component to the future success of the U.S. (Langdon, et al., 2011). However, there are concerns over who will fill these positions.

While more students are taking STEM-related courses in high school, fewer students, especially females, are continuing on to major in STEM areas post high school. Females outnumber males in the life and social sciences fields; however, they are underrepresented in mathematics, physics, chemistry, and engineering (Chen, Henk, & Rotermund, 2014). Despite decades of work and programs promoting gender equality, many young women in U.S. public school systems do not view themselves as having equal ability in areas of STEM as their male peers (Dentith, 2008). Females seem to lack confidence in their abilities to be successful, which could be discouraging them from choosing STEM-related college majors (Aronson, Fried, & Good, 2002).
In many school districts across the country, educational initiatives have been developed and implemented in an attempt to close the gap between male and female students taking STEM courses and pursuing STEM-related degrees (Honey, Pearson, & Schweingruber, 2014). However, numerous individuals do not have an interdisciplinary understanding of STEM education, creating a significant knowledge and communication gap between prominent stakeholders (Breiner, Johnson, Harkness, & Koehler, 2012). Increasing STEM participation requires communicating the value of STEM education for all students, especially underrepresented groups including female students.

As a society, we need to educationally invest in the entire potential workforce (Labaree, 1997), including females who are underrepresented in STEM areas. The shortage of females in STEM-related fields is a great disadvantage for the advancement of tomorrow’s world as these disciplines are responsible for many of the societal innovations that improve our way of life (Adkins, 2012). Therefore, set in a STEM-focused academic program, this study focuses on the relationship between female students’ perceptions of expectancy and value placed on a STEM fields, and their college major choice.

Problem Statement

In the United States, the number of students pursuing a post-high school degree in STEM is behind other nations, resulting in lack of talent required to fill the growing number of STEM-based jobs (Hossain & Robinson, 2012). Meeting the demands of the 21st-century workforce requires increasing the number of college graduates with majors in STEM areas. However, even with legislative support, the U.S. is continuing to fall further behind other nations in STEM education (Hossain & Robinson, 2012) as evident in low numbers of STEM college graduates.
Furthermore, women continue to be underrepresented in STEM (Chen et al., 2014; Duran, Hoft, Lawson, Medjahed, & Orady, 2014; Hernandez, Woodcock, Schultz, Estrada, & Chance, 2013). Cultural stereotypes concerning gender roles influence students’ attitudes for the expectation for success and value placed on STEM-related educational experiences (van Aalderen-Smeets & Walma van der Molen, 2016). According to Bembenutty (2008), one of the main reasons women do not go into engineering and physical sciences is due to their perception of the fields. These attitudes may discourage females from choosing to pursue STEM-based majors and entering STEM-related fields. Consequently, there are fewer females than males in more advanced STEM courses at the secondary and post high school level.

Despite significant funding of STEM-related youth programs over the past two decades, females still remain underrepresented in STEM-based fields (Duran et al., 2014). Therefore, understanding common perspectives and attitudes that play a role in college major choice can aid in the development of future programs to increase the number female students choosing STEM-based college majors.

The majority of the current research has focused on the relationship between females’ expectancy and value beliefs from participation in outreach programs and choice to participate in only one STEM domain, for example, participation in only engineering. The immense amount of current research has illustrated that experiences in domain specific outreach programs have the ability to positively influence females’ choice to participate in science, technology, engineering, or mathematics (Almarode, et al., 2014; Battle & Wigfield, 2003; Crombie, Walsh, & Trinneer, 2003; Desy, Peterson, & Brockmann, 2011; DiLisi, McMillin & Virosek, 2011; Dubetz & Wilson, 2013; Duran, et al., 2014; Eccles & Wigfield, 1995; Gaspard et al., 2014; Hernandez et al., 2013; Knezek, Christensen, Tofel-Grehl & Callahan, 2014; Tyler-Wood, & Periathiruvadi,
While outreach programs are prevalent (Clewell & Fortenberry, 2009; Duran et al., 2014; Dyer, 2004), according to Forman et al. (2015), the number of STEM-focused academic programs designed to integrate science, technology, engineering, and mathematics collectively within the curriculum are limited across the country. There is also limited research as to how experiences STEM fields offered by STEM-focused academic programs relate to choosing to continue in STEM domains. Therefore, the gap in the research includes the relationship between expectancy beliefs and value perceptions of female high school seniors in a STEM-focused academic program and their college major choice.

Purpose Statement

The purpose of this research was to study the female high school seniors in a STEM-focused academic program. The focuses of this research are how their expectancy to succeed in STEM fields as well as attainment, intrinsic and utility values they placed on STEM fields relate to their college major choice.

Significance of Study

STEM-related jobs are increasing in demand; therefore, in preparing students for these fields, there is a greater demand for STEM-focused academic programs which are being developed and implemented across the country (Honey et al., 2014). The findings of this study may provide curriculum administrators with information on participants’ perspectives of expectancy and value beliefs placed on STEM fields related to future college major choice. Thus,
the study may offer program creators with the specific program components which are the most influential in determining future goals such as college major choice.

The findings of this study may provide the insights from the STEM-focused academic program participants found most influential in creating attainments, intrinsic, and utility value along with expectancy for success. Thus, curriculum administrators may implement aspects of the STEM-focused academic program participants found most significant to provide prospective students with a program that supports their future goals.

Additionally, the findings of this study may add to current literature pertaining to opinions and perceptions of underrepresented females in STEM-related domains. Furthermore, this study fills the gap in the research by exploring the relationship between female perceptions of expectancy of success and value placed on STEM fields, and their college major choice through Eccles and colleagues’ (1983) expectancy-value lens.

Conceptual Framework

The study investigates the relationship between perceptions of expectancy and value of female students who participated in a STEM-focused academic program at a large suburban high school, and their college major choice. This study examines this relationship utilizing Eccles and colleagues’ (1983) expectancy-value model of achievement performance and task choice as a conceptual framework.

Wigfield and Eccles (2000) explained that students appear to have confidence in areas they value and excel in. Bembenutty (2008) posited that students are most likely to choose activities they think they can succeed in and situations they value. Academic choice and performance can be explained by students’ perceptions of how well they can do on a particular
task, along with how much value they place on the task (Eccles et al., 1983; Wigfield & Eccles, 2000). Competency and value tend to be directly proportional as students who believe they are less competent, tend to place less value on those activities.

The expectancy-value theoretical framework combines a student’s expectations for success and the value or importance the student attaches to the various available task choices (Eccles, Wigfield, & Schiefele, 1998). Jacquelynne Eccles and colleagues (1983) studied the factors influencing school-related goals including behaviors affecting grades and course choice. Student’s expectancies and values beliefs can be molded by individual perceptions of competence, goals, and past achievement. Furthermore, family members’, teachers’, and peers’ attitudes and beliefs can be projected onto students, influencing the development of their expectancy and value perceptions for specific tasks (Eccles et al., 1983; Eccles & Wigfield, 2002; Wigfield, Tonks, & Eccles, 2004; Wigfield, Tonks, & Klauda, 2009).

Expectancy and value are the two main constructs for the expectancy-value theory. Expectancy is the specific views for achieving success in completion of a certain task. Additionally, expectancy is the student’s belief in having the required ability to be successful at the specific task.

The value component can be explained through attainment, intrinsic, utility value constructs, and cost (Eccles et al., 1983; Wigfield, 1994; Wigfield & Eccles, 2000; 2002; Wigfield et al., 2009). First, the attainment value represents the importance students give to completing and doing well on a task. Second, the enjoyment the student has for completing the task can be illustrated by the student's intrinsic value placed on the goal. Third, the usefulness the individual places on the task to reach future goals explains the utility value. Finally, the cost refers to the effort required to complete the task or how the activity limits the ability to complete
other activities (Eccles et al., 1983; Wigfield, 1994; Wigfield et al., 2004; Wigfield & Eccles, 2000; 2002; Wigfield et al., 2009).

While there are many studies that have illustrated that either positive expectancy beliefs or value placed on a task influence the choice making process, current studies have illustrated that the expectancy and value constructs may influence one another and holistically influence task choice. Guo, Parker, Marsh, and Morin (2015) and Hulleman, Godes, Hendricks, and Harackiewicz (2010) concluded that high utility value is related to intrinsic value for mathematics which collectively influences expectancy beliefs. Additionally, Nagengast et al. (2011) argued that value perceptions also influence expectancy beliefs; which collectively determine academic choices. Moreover, according to Ball, Huang, Cotton, and Rikard (2017), expectancy beliefs and utility value positively influences attainment value placed on STEM-fields.

Educational choices can be explained by expectancy for success and value placed on completing the task; therefore, utilizing the expectancy-value model as the theoretical lens may result in further understanding of how female students’ perceptions of expectancy and value of a STEM-focused academic program relate to their college major choice.

Research Questions

This study of female high school seniors and STEM-focused academic programs is based on the overarching goal of understanding female high school students’ college major choices from an expectancy-value theoretical framework. The research questions include:
1. How does the expectancy to succeed in STEM fields of the female high school seniors in a STEM-focused academic program relate to their college major choice?

2. How does the attainment value that female high school seniors in a STEM-focused academic program place on STEM fields relate to their college major choice?

3. How does the intrinsic value that female high school seniors in a STEM-focused academic program place on STEM fields relate to their college major choice?

4. How does the utility value that female high school seniors in a STEM-focused academic program place on STEM fields relate to their college major choice?

5. How do the expectancy and value constructs collectively affect female high school seniors in a STEM-focused academic program college major choice?

Questions 1-4 focuses on each construct of the expectancy-value theoretical framework as they relate to college major choice. Research question 5 holistics relates the constructs and choice of college major. This final research question was added after data analysis to create a greater understanding of task choice.

Methodology

This research study focused on expectancy to succeed in STEM fields as well as attainment, intrinsic, and utility values placed on STEM fields relate to college major choice. The research design for the study used a qualitative case study design to answer the research questions. This qualitative research design is used to better understand human behaviors and experiences (Bogdan & Biklen, 2007; Creswell, 2013). Furthermore, Yin (2003) explained that a case study is designed to investigate a phenomenon within a real-life context.
This case study was defined by female high school seniors, while the setting for the study was a STEM-focused academic program housed within a large suburban high school in the Midwest. There were 19 participants in this study. All the female seniors from the STEM-focused academic program were invited to participate in the study and all agreed to participate.

To answer the research questions, data was collected and analyzed; the three types of data collection strategies included: 1) a reflective essay response, 2) a focus group, and 3) an interview. All 19 female study participants were invited to complete a reflective essay to identify their intended college major choice and explain their career goals along with their educational experiences that were helpful in the decision-making process (See Appendix A).

Participants that indicated an intended college major in a STEM-related field in their reflective essay were invited to participate in one of three focus groups. Bogdan and Biklen (2007) explained that participants in focus groups can stimulate each other to articulate their perspectives allowing the researcher gained an understanding of the range of views of those who may have shared similar experiences. The focus group prompts centered on participants’ reasons for choosing STEM fields as their intended college major based on expectancy and value perspectives (See Appendix B).

Based on the response to intended college major in the reflective essay, the participants’ that indicated that they are intending to major in an area outside of STEM fields were invited to participate in an interview. The interview prompts were centered on expectancy and value related to their intended college major choices as well as STEM fields; however, the questions were not specific to choosing STEM as an intended college major (See Appendix C).

Bogdan and Biklen (2007) and Zohrabi (2013) argued that open questions offer a greater level of discovery. Therefore, the reflective essay, focus group, and interview provided further
insight of female high school seniors’ in a STEM-focused academic program perceptions of expectancy and value placed on STEM fields and college major choice.

The focus groups and interview were transcribed by the researcher. Each focus group and interview participant was provided with their transcript to ensure their responses were captured accurately. The focus groups transcripts, the interview transcript, and reflective essays were first coded using the following provisional codes: expectancy, attainment value, intrinsic value, and utility value constructs, and college major choice which were developed prior to data analysis based on existing knowledge. In Vivo coding was then used then by the researcher upon completion of the first round, using the participants’ own words (Saldaña, 2016) (See Appendix D). Following coding, participants’ perspectives emerged from data analysis which was then used to develop key findings related to the perception of expectancy for success in STEM fields and value placed on STEM fields as they relate to college major choice. The findings developed from the data analysis were peer reviewed by a fellow member of the doctoral program to ensure the accuracy of the data analysis.

According to Bamberger (2012), Bogdan and Biklen (2007), Creswell (2013), Golafshani (2003), and Mertens (2015) analyzing different methodologies to address the same problem, an opportunity to triangulate the data improves dependability and credibility to the results. Therefore, data analysis of multiple data sources together may offer further support in determining if there is a relationship between females’ perceptions of expectancy for success and value placed on STEM fields related to their choice of college major.
Delimitations

The delimitations of this study include the participant pool comprising only female senior level students from one STEM-focused academic program from one high school in the Midwest. While STEM-focused academic programs exist throughout the area, the study was confined to a specific program in a large suburban high school. Each STEM-focused academic program has different course requirements; therefore, only one program from one high school is being investigated as all participants will have experienced the same STEM-courses outlined by the program. All study participants would likely be from middle schools across the district, thus meeting the same standards for admittance into the program. Therefore, the study is limited to participants who experienced the same academic curriculum.

Eccles and colleagues’ (1983) expectancy value model includes the expectancy beliefs, attainment, intrinsic, and utility value, along with cost constructs. However, this research focuses on the expectancy to be successful and value placed on STEM fields as they relate to female high seniors’ intended choice of college major. The cost construct would address what female high school seniors’ would be willing to give up or sacrifice related to college major choice. This study is limited solely to expectancy and value beliefs; therefore, cost factors were not investigated.

Definitions

The following terms are defined to provide clarity.

1. Expectancy: Defined by Eccles et al. (1983) as students’ perception of success on specific tasks.
2. STEM education: Defined by Tsupros, Kohler, and Hallinen (2009) as an interdisciplinary, real-world application approach to learning science, technology, engineering, and mathematics.

3. STEM-focused academic program: Defined by the study site (n.d.) as integration of the academic areas of science and mathematics with high technology (Project Lead the Way) focusing on career paths in engineering and high technology; development of a team approach to learning by both teachers and students; and the use of mentoring and internships with professionals from the area.

4. STEM Outreach Programs: Refers to in science, technology, engineering, and mathematics domains explored as enrichment programs offered outside the regular academic school day.

5. Value: Defined by Eccles and colleagues (1983) as the usefulness of completing a task. Value is further defined as:
   a. Attainment value: Defined by Eccles and colleagues (1983) as the importance of completing a task.
   b. Cost: Defined by Eccles and colleagues (1983) as the cost refers to the amount of time or effort required to be successful at the task.
   c. Intrinsic Value: Defined by Eccles and colleagues (1983) as the enjoyment found from completing a task.
   d. Utility Value: Defined by Eccles and colleagues (1983) as the future usefulness of completing a task.
Organization of the Study

This study is organized into five chapters. Chapter one provides the problem, the purpose, and the significance of the study. This chapter also provides a summary of the methodology and conceptual framework utilized to explore the research questions. Chapter two includes a review of the literature about STEM education, including the history of STEM education, the challenges with STEM education, and STEM intervention programs. Chapter two also describes the expectancy-value model as a conceptual framework. Chapter three describes the qualitative case study research design used in this study. Data will be collected and analyzed from the following data sources: 1) reflective essay 2) focus group 3) and interview. Chapter four includes the findings from the coded reflective essays and focus groups and interview transcripts. The findings are presented first, according to each research question, and then as the research questions relate to each other. Finally, chapter five includes a discussion of the finding as they connect to current literature. Additionally, the limitations and recommendations are presented.
CHAPTER 2

REVIEW OF THE LITERATURE

STEM-related jobs have grown three times as fast as non-STEM jobs; furthermore, they play a key role in the sustained growth and stability of the United States economy (Atkinson & Mayo, 2006; Hossain & Robinson, 2012; Langdon et al., 2011). As these jobs are a critical component to the economic well-being of the United States (Labaree, 1997), students need to be prepared to participate in the evolving workforce. Consequently, to be productive and innovative, higher education attainment has become an important component for economic success.

While economic roles can be found in STEM-based careers, there are concerns over who will have the required skills to fill these positions. The number of people armed with the knowledge and skills required to fill positions in the 21st-century workplace is decreasing (Beatty, 2011; Sanders, 2009); thus, fewer females are going into STEM fields than their male counterparts (Beede, et al., 2011). According to the National Research Council (2012), STEM experiences should be integrated throughout the educational system to assist in addressing STEM labor shortage. This includes females who are underrepresented in STEM areas. The shortage of females in STEM-related fields is a great disadvantage for the advancement of tomorrow’s world. This study focuses on female’s experiences from participation in a STEM-focused academic program in relationship to college major choice.
STEM

Definition

The acronym STEM is associated with science, technology, engineering, and mathematics; however, defining STEM as it is applied to various areas is more challenging. Hemmingway (2016) explained that to some, STEM simply refers to each individual disciplines, such as science, while others describe STEM as an integration of two or more disciplines, and STEM can include both the integration and real-world application of two or more disciplines. In this study, STEM is defined as both the integration and application of science, technology, engineering, and mathematics.

STEM Education

STEM education is more than the curriculum taught in an individual science, technology, engineering, or mathematics course. Sanders (2009) along with Tsupros et al. (2009) further explained that STEM education is an interdisciplinary approach to learning where students apply science, technology, engineering, and mathematical concepts in preparation for utilization in real world contexts. Mathematicians, engineers, and scientists integrate STEM skills and content in their professions; for example, a chemist requires an in-depth understanding of other science disciplines along with technology and mathematics to be successful as a chemist.

From an educational perspective, STEM replaces teaching strategies using a traditional lecture approach with more inquiry and project-based lessons. However, most Kindergarten through 12th-grade educators do not teach in this manner because disciplines are compartmentalized into individual courses (Breiner et al., 2012). By developing curriculum
incorporating science, technology, engineering, and mathematics, students gain 21st-century skills and content knowledge reflecting the work of professionals in the field. To increase participation in STEM-related fields, STEM education programs may be found in both formal (e.g., inside the classroom) and informal (e.g., afterschool programs) educational settings (Gandara, 2001).

**History of STEM Education**

America has had a long-standing involvement with STEM education that dates back to the establishment of West Point Military Academy in 1802. West Point graduated professionals with the vital skills necessary to engineer the country’s early expansion infrastructure including railroads, bridges, and roads (Jolly, 2009). Another important early American school founded in 1865, Worcester Technical Institute in Massachusetts, combined the theory and practice of engineering through scientific reasoning and shop experience (Kelley, 2012). These schools were the pioneers in education reform for the late 1800’s. The educational reform included the advancement of technological skills essential to prepare graduates for the industrial revolution workforce (Bevins, 2012). In supporting the advancing world post classroom, Abraham Lincoln signed the Morrill Act of 1862, which shifted higher education from classical to more applied mechanical and agricultural studies. Additionally, the Morrill Act provided governmental financial support for higher educational intuitions in every state (U.S. Department of Education, 2016).

Historically, workers in the U. S. have been the best educated and most skilled in the world driving scientific discovery (Schmidt, Burroughs, & Cogan, 2013). However, in the mid-1900s, interest in science, technology, engineering, and mathematics increased momentum,
sparked by the Soviet Union’s launch the first man-made rocket in 1957. This momentous event brought the global importance of STEM disciplines to the forefront in the United States. Russia’s ability to launch this rocket into space brought into question the United States’ ability to be competitive in science and industry (Bamberger, 2012; Donahue, 1993; Thomas & Williams, 2010; Wissehr, Barrow, & Concannon, 2011).

Government officials, politicians, scientists, and educators in the U. S. needed to take swift action to close the gap left by the space race. To keep up with the scientific and technological advancements illustrated by the space program, students required new skill set to prepare for future endeavors. In supporting the need for education reform, in 1958, Congress passed the National Defense Education Act (NDEA) to encourage the development of rigorous science and mathematics curriculum for students in preparation for these essential technology-based careers (Jolly, 2009; Wissehr, et al., 2011). The NDEA also provided funding to identify and counsel academically talented students in STEM areas, whereby providing the STEM workforce with a steady stream of participants (Jolly, 2009).

Almost 50 years after the NDEA, in 2007, the America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science (COMPETES) Act was designed to support the development of STEM education (Thomas & Williams, 2010; Tofel-Grehl & Callahan, 2014). One focus of the 2007 American COMPETES Act was to strengthen educational opportunities in STEM from elementary through graduate school (Thomas & Williams, 2010). Educational practices have changed due to technological advances which assist in answering questions posed by the demands of innovation. The American COMPETES Act provides assistance to ensure 21st-century innovation. The development of interdisciplinary classrooms that encourage creativity as students tackle problems from different
perspectives sparks innovation (Roberts, 2015), illustrating successful application of the COMPETES Act to prepare students for the 21st-century workplace.

Education in the United States has changed greatly over time due to the quest for local and global understanding, the advancements in technology, and the competitive nature of the country. Chen, Hall, Rotermund and Bersudskaya (2012) explained that the predominant high school graduation requirement was two years of both mathematics and science during the mid-1980s. By 2008, more than half of states required three years of both mathematics and science to fulfill their graduation requirements (Achieve, 2012). As more states have increased the number of mathematics and science courses required to earn a high school diploma, more students are taking higher-level courses. Moreover, the number of mathematics and science Advanced Placement (AP) exams taken doubled from 2002 to 2012 (Falkenheim & Hale, 2013).

Challenges within STEM Education

While progress has been made, one challenge that may impact quality educational experiences is that teachers themselves may lack a background in STEM. Effective educators are essential for inspiring STEM educational value along with the opportunity for success in STEM domains to all students. However, the amount of knowledge essential to be an effective STEM educator requires pedagogies, curriculum, content, and research expertise in all STEM domains (Sanders, 2009). Many educators in elementary and secondary education programs do not have the proficient STEM knowledge to be an effective STEM educator. Kuenzi (2008) explained among high school teachers, 14.5% of those who taught mathematics, and 11.2% of those who taught science did not have a college major or minor in these subject areas. At the middle school level (classified as grades 5-8), 40.0% of science and 51.5% of mathematics teachers lacked an
undergraduate major or minor in the subjects they taught. Thus, female students may not have access to qualified teachers to act as STEM mentors or role models in the educational setting.

This leads to another challenge that teachers may not be encouraging students into STEM domains. Gandara (2001) explained teachers may harbor doubts about students’ abilities to be successful in STEM, especially underrepresented students. Therefore, these students may be provided less encouragement which could contribute to a self-fulfilling prophecy of underachievement. Consequently, too many students lose interest in STEM domains at an early age (Sanders, 2009). As a percentage of this discrimination can be attributed to cultural, economic, and gender stereotypes, to promote equality in STEM, for all students, especially female students, should be provided an opportunity to achieve success in STEM-courses (Grossman & Porche, 2014).

While the number of STEM-related courses has increased, there is a concern as to the disparity between male and female students in STEM-related courses. Falkenheim and Hale (2013) explained that male students are more likely to take AP exams in subjects including Calculus, Physics, Chemistry and Computer Science while female students are more likely to take AP exams in Biology and Environmental Science. Rozek et al. (2015) concluded that large gender gaps exist in areas of physics and engineering.

Even though more students are taking STEM-related courses in high school, few students, especially females, are continuing on to major in STEM-related areas in college. For example, the number of students attaining STEM baccalaureate degrees from United States colleges and universities has more than doubled between 1960 and 2000. However, a survey conducted by the Higher Educational Research Institute confirmed the low number of female college freshmen declaring STEM majors with the following breakdown: 14.3 % Biology, 3.9 %
Engineering, 1.4 % Math and 1.9 % Chemistry or Physics (Falkenheim & Hale, 2013). The low number of females in STEM–related majors could be due to gender stereotypes in which female students view themselves as inferior in ability to males in STEM-related fields (Dentith, 2008; Grossman & Porche, 2014).

Gender-based discrimination during adolescence includes gender bias or stereotypes in a variety of settings including academic contexts (Leaper & Brown, 2008). Hill, Corbett, and St. Rose (2014) argued that stereotypes for gender roles in areas of STEM exist as many people associate science and math fields with males, and humanities and arts fields with females. These gender roles may be influenced and reinforced by social systems such as family, teachers, and peers influence (Bembenutty, 2008; Grossman & Porche, 2014). Many girls face a systemic message that STEM success is incompatible with female gender roles (Hill, et. al, 2014). Smith and Postmes (2011) argued perceptions of associated behaviors dictate the extent to which group members’ behavior conforms to the stereotype. For example, if the gender stereotype dictates that males are better than females in math, girls may experience decreased confidence in their expectancy to perform well in math courses.

Gender and culture stereotypes influence students’ portrayal of STEM professionals, where they work, and what they do. Stereotypes that describe females as incompetent in STEM-related fields influence girls to underestimate their own perception of ability in mathematics and sciences thus may be hesitant to pursue these areas (Grossman & Porche, 2014; Wender, 2004). According to Farland-Smith (2009), 4th and 5th graders students from the United States and China had different perceptions of the physical characteristics of a scientist; however, there was an agreement in perceptions of what a scientist does across groups. There may be multiple influences which could contribute to students’ perception of scientists including typical
classroom science education. All children have preconceived notions of what a “scientist” looks like: both male and female students depict males as the gender of a scientist (Farland-Smith, 2009). Female students given opportunities to see female scientists at work may dispel gender stereotypes. Additionally, offering different experiences in science content areas may increase female’s confidence in their ability to explore many STEM-related fields (Dyer, 2004).

Students’ attitudes towards science were also included in Desy and colleagues’ (2011) questionnaire. The results of the study suggested students recognized the value of science in today’s technologically advanced world (Desy et al., 2011). However, the study also concluded, “Females scored lower than males on the ‘enjoyment of science,’ ‘motivation in science,’ ‘attitude towards science in school,’ and ‘self-concept in science’ scales” (Desy et al., 2011, p. 28). This study illustrated the need for changing female students’ expectancy and value towards science, along with other STEM domains, which can be facilitated by intervention programs and in support networks. While these studies focused on science, the lack of females in other areas of STEM can be related to perceived stereotypes influencing behavioral choices.

In summary, STEM-education faces many challenges. Teachers may be unprepared to meet the demands required to provide quality STEM education for all students, especially underrepresented students (Sanders, 2009). Furthermore, there is a gender gap between male and female students pursuing STEM-related courses and college majors (Falkenheim & Hale, 2009). This may be due to preconceived notions females have about their ability to achieve success in STEM (Dentith, 2008; Farland-Smith, 2009; Wender, 2004); additionally, female students may hold different viewpoints on the value for STEM education as their male counterparts (Wender, 2004), thus, influencing college major choice.
STEM Intervention Programs

Intervention programs have been implemented in a variety of formal and informal settings providing assistance in supporting participants in reaching goals by helping them build self-esteem, develop confidence, and feel empowered to achieve and succeed in their academic careers (Gandara, 2001). Educational intervention programs are found across all age groups from pre-Kindergarten through college; furthermore, programs are typically designed to service specific needs of diverse populations including academic, ethnic, and socioeconomic (Maton, Pollard, McDougall, & Hrabowski, 2012).

Strategies gained through intervention programs have fostered increased engagement and content knowledge in STEM-related disciplines. Consequently, intervention programs targeting underrepresented students are being implemented as early as elementary school with continuation through high school in order to increase the number of participants in STEM disciplines (Constan & Spicer, 2015; Schmidt et al., 2013). Exclusively female only programs recognize the potential value of providing informal and formal learning experiences in achieving gender equity. Dyer (2004) argued to ensure gender equity state and national standards should provide opportunities to integrate gender sensitivity into all educational settings.

STEM intervention programs can play a critical role in providing students with opportunities to experience STEM disciplines. These programs offer exploration in STEM careers, experience with STEM curricular content, and development of 21st-century skills. Bryan and Henry (2008) further explained that participants “gain the necessary skills and knowledge to succeed, feel valued and included in the school, and develop a sense of purpose and confidence in their ability to succeed, accomplish their dreams, and affect their world” (p. 149).
Intervention programs can provide participants with role models and social networks of support in STEM domains. In practice, many programs are designed to offer participants a multitude of services including academic experiences in STEM, encouraging social networks of support, and creating meaningful relationships with a mentor (Duran et al., 2014; Dyer, 2004; Gorman, Durmowicz, Roskes, & Slattery, 2010; Knezek et al., 2013).

**STEM Outreach Programs**

Outreach programs offer informal learning experiences after school, Saturdays, and during summer break to increase interest, engagement, and achievement in STEM domains (Clewell & Fortenberry, 2009; Duran et al., 2014; Dyer, 2004). Outreach programs have been designed to introduce underrepresented groups to STEM, offer a safe place to experience success in STEM content, and to increase the overall value for STEM-based curriculum for elementary, middle, and high school students. Thus, outreach programs have an opportunity to influence female perceptions of expectancy and value in STEM domains which may encourage behavioral choices.

Participants in outreach programs, including Girls in Engineering, Mathematics, and Science (GEMS), Girls Night Out, Middle Schoolers Out to Save the World (MSOSW), Project WISE: Working in Informal Science Education, and Fostering Interest in Informational Technologies (FI³T), explore hands-on activities to increase interest, content knowledge, and skills in STEM-related areas utilizing real-world situations. Current research has concluded participants in outreach programs had a significant gain in STEM content knowledge and interest towards STEM-related fields (Crombie, et al., 2003; DiLisi et al., 2011; Dubetz & Wilson, 2013;

STEM-focused outreach programs inspire a sense of intrinsic motivation along with persistence, allow participants to become confident, despite gender stereotypes, in their abilities to apply this determination in academic settings to enhance individual success. Crombie and colleagues (2003) described how positive experiences promote positive attitudes and confidence in STEM areas. Outreach program participants develop an understanding of STEM expectations, their capabilities in STEM, and what they can expect from themselves, thus influencing academic career choice (Stolle-McAllister, 2011).

**STEM-Focused Academic Programs**

STEM education is accessible at almost every high school across the country offering science, technology, engineering, and mathematics courses. These schools are categorized by the National Research Council (NCR) as comprehensive high schools with access to AP courses for highly motivated students (Beatty, 2011). STEM-focused academic programs are designed to expose students to advanced STEM content, provide students with opportunities for exploration and discovery, connect students to real-world STEM workplaces, and provide role models from STEM professions. (Almarode et al., 2014; Clewell & Forenberry, 2009; Executive Report to the President, 2010; Thomas & Williams, 2010).

STEM-focused academic programs are categorized as elite (or selective), inclusive, and career and technical schools (NCR, 2012). Elite (or selective) schools can further be classified as a school-within-a-school program, pullout program, stand-alone program, residential program, or university-based program (Scott, 2012; Tofel-Grehl & Callahan, 2014). Elite (or selective) and
inclusive programs focus on preparing participants for college majors and STEM careers, while career and technical education schools offer STEM career training for at-risk students (Beatty, 2011). In this study, the participants are from an elite (or selective) STEM-focused academic program in a school-within-a-school setting.

**Advantages of STEM-focused academic programs**

STEM-focused academic programs offer extended time during the school day in which to move students from STEM interest, to competency, and finally to expertise (Scott, 2012). Most STEM-focused academic programs provide support and assistance from a network of teachers and peers. Furthermore, these relationships play a key role in attitudes towards STEM-related areas (Dyer, 2004).

**Role models.** STEM-focused academic programs empower female students by providing role models to foster academic confidence while dispelling gender stereotypes (Dubetz & Wilson, 2013; Gorman et al., 2010; Isaac, Kaatz, Lee, & Carnes, 2012; Wender, 2004). Women facilitating STEM-focused academic programs act as STEM mentors, enabling females to envision themselves in post high school education and in STEM careers by empowering more women to engage and be successful in STEM disciplines (Drury, Siy, Cheryan; 2011; Dubetz & Wilson, 2013; Gorman et al., 2010; Mosatche et al., 2013).

Teachers can act as mentors and role models by offering students unique visions of themselves, motivate them to grow as individuals and act as supporters (Fancsali & Froschl, 2006; Heilbronner, 2009). Female STEM teachers who may have struggled and overcome initial difficulties in STEM courses have an opportunity to become a role model for female students who are struggling with STEM content; whereby, females learn their own academic skills can
improve (Mosatche et al., 2013), leading to positive expectancy for success. Female students may be more willing to take on higher level STEM-related courses when they value and experience success in STEM-related content.

**Teacher support.** Teachers can play an important role in influencing student attitudes towards STEM-related subjects. As the educational level increases, textbooks in these courses become more abstract and disconnected from the practical uses in STEM disciplines (Zhu, 2007). Regardless of how content is presented by textbooks, the curriculum is shaped by teachers (Donahue, 1993). The ability of a teacher to make content interesting and bring difficult concepts to life with real-world applications can increase students’ confidence in their ability to be successful in STEM courses (Dentith, 2008; Desy et al., 2011; Tofel-Grehl & Callahan, 2014). Research conducted by Dentith (2008), Desy et al. (2011), and Fancsali and Froschl (2006) concluded that teacher skill and support were important factors influencing female student’s interest in STEM. Dentith (2008) further argued that female student’s decision to take AP courses was heavily influenced by the relationship students had with their teachers as well as teacher skills.

Teachers can create a culture for learning by providing an identity-safe environment where students can inquire and receive valuable feedback. Furthermore, teachers can allow students to control their own learning (Isaac et al., 2012; Sevinc, Ozmen, & Yigit., 2011). Within a STEM class setting, teachers placing females together in cooperative groups offer girls an opportunity to learn without worrying about gender pressures (Heilbronner, 2009). In STEM-focused academic programs, teachers provide a rigorous level of instruction to challenge students as they collaborate with their peers in a safe learning atmosphere (Zhu, 2007).
Peer support. Students spend approximately eight hours a day in an educational setting. During this time, strong bonds are formed creating an influential peer support network. Peer networks can serve as an important incentive for students’ performance inside and outside of the classroom and can play a significant role in students’ educational experiences and outcomes (Chen, 1997; Robnett, 2013). Peer networks within STEM-based settings build a sense of belonging while promoting and enforcing acceptable norms and values (Stolle-McAllister, 2011). High school, in particular, is an important time as students are making decisions about course choice and future educational and career plans.

Tofel-Grehl and Callahan (2014) explored the experiences and perspectives of students participating in a STEM-focused academic program and concluded the community culture allowed students to be accepted as they shared the same interests, values, and eccentricities while experiencing research opportunities and exploring solutions to real-world problems. Stolle-McAllister’s (2001) research further supported the benefits of cohort structured academic settings participants of a STEM-focused academic program experienced increased self-confidence and sense of achievement and expectancy of success through common experiences and expectations. Therefore, supportive peer networks emphasizing STEM achievement and the extent the participants valued STEM, influenced the next educational choice in STEM (i.e., majoring in a STEM-related field) as women pursue STEM careers (McAllister, 2011; Robnet, 2013).

Challenges of STEM-focused academic programs

Currently, in the United States, there are only about 900 unique STEM-focused schools that integrate multiple STEM domains. Furthermore, only approximately 47,000 students are
enrolled in a STEM-focused school, most at the high school level (Executive Report to the
President, 2010). As Forman et al. (2015) explained, a limited number of these schools have
existed for many decades encouraging talented STEM students to pursue STEM careers.

Common features of many STEM-focused academic programs include a variety of
STEM-related courses along with research opportunities; however, there are no curricular
guidelines or requirements for academic programs to be designated as STEM-focused
(Almarode, et al., 2014; Tofel-Grehl & Callahan, 2014). While there are no standards to be
labeled as STEM-focused, Betty (2011) argued that elite (or selective) schools have been very
competitive and serve only highly motivated students. Consequently, as the majority of the
American student population does not have access to STEM-focused academic programs; thus,
their STEM experiences are limited to the curriculum found in the comprehensive schools
(Beatty, 2011).

In conclusion, even though there are a limited number of competitive STEM-focused
academic programs, the students who do have access to these programs may have an opportunity
to develop influential relationships with teachers and peers while cultivating STEM content
knowledge. STEM-focused academic programs may also provide an opportunity to experience
success and value which may influence future choice. The framework for this current study is
based on Eccles and colleagues (1983) expectancy-value model.

Conceptual Framework: Expectancy-Value Theory

The expectancy-value theoretical framework combines students’ expectations for success
and the perceived value the student places on completing various available task choices (Eccle et
framework brings the importance of expectancy and value constructs in explaining achievement behavior in educational contexts by studying the factors influencing school related goals along with behaviors affecting grades and course choice. It also highlighted two critical aspects of motivation that are necessary for students to be optimally engaged. First, students need to believe that they can succeed (i.e., they need to have positive expectancies). Second, students need to perceive an important reason to engage in the behavior (i.e., they need to have positive values). Behavior is the interaction between action expectancies outcomes and the value placed on those outcomes (Jennet, 2008; Wigfield & Eccles, 2000, 2002; Wigfield et al., 2009).

**Expectancy Construct**

Expectancy is one of the main constructs of the Eccles and colleagues’ (1983) expectancy-value theory, which influences task choice. Expectancy for success is specific beliefs that students have regarding their projected success on certain tasks (Wigfield, 1994; Wigfield & Eccles, 2000, 2002; Wigfield et al., 2009). For example, a woman who chooses a science or engineering related field has an expectancy to succeed in tasks related to her profession. In the classroom, students need to believe they can succeed to have a positive outcome on a specific task. For example, why a student chooses to take an advanced mathematics course can be influenced by the students’ belief that they have the capability to succeed in that particular class.

**Value Constructs**

Value is the other main construct of Eccles and colleagues’ (1983) expectancy-value theory, which also influences task choice. Eccles (1994) along with Eccles et al. (1998) explained task-related value beliefs are influenced by cultural expectation, social experiences,
aptitudes, and prior experiences in a specific domain. As Wigfield et al. (2004) have argued, students place greater importance for tasks consistent with their cultural beliefs. Furthermore, cultural beliefs may include the importance or value placed on education. These subjective perceptions of task value influences academic choice (Eccles, 1983; Wigfield & Eccles, 2000, 2002; Wigfield et al., 2009). For example, in an educational setting, the perceived value students’ gain from their experiences in a mathematics course affects future course choices.

There are four task value constructs of Eccles and colleagues’ (1983) model. These task values can be explained through attainment value, intrinsic value, utility value, and cost. Attainment value represents the importance that the student gives completing a task and doing well on or being proficient at said task. The enjoyment that the student has for completing the task can be illustrated by the student’s intrinsic value placed on the task. The usefulness the student places on the task in fulfilling future goals explains the utility value. Finally, cost refers to the amount of time or effort required to be successful at the task. (Eccles et al., 1983; Wigfield, 1994; Wigfield et al., 2004; Wigfield & Eccles, 2000, 2002; Wigfield et al., 2009). For example, a woman majoring in engineering may not enjoy physics courses (i.e., intrinsic value); however, learning physics content may be valuable in assisting the student understanding the key concepts (i.e., utility value) required to build better bridges. Thus, students need to perceive an important reason to engage in the behavior to have a positive outcome on a specific task (Hulleman, et al., 2016).

**Task Choice**

The task choice may be influenced by the expectancy and the value placed on the task along with cost as illustrated in Figure 1. Student task choice accompanied by the rationale
behind these choices can be determined by behavior motivation. Behavior is the interaction between students’ expectancies about the outcomes of their effort and the value they place on those outcomes (Wigfield & Eccles, 2000; Jennet, 2008). The focuses of this current study include expectancy to be successful in STEM fields and the value placed on STEM fields as they relate to choice of college major. While the cost construct influence task choice (Eccles et al., 1983), female high school seniors’ perspectives of time, effort, and other sacrifices that would be required to be successful in STEM fields as they related to choice of college major was not a focus of the research question; therefore, it was not investigated in this study.

Figure 1 illustrates that task choice is predicted independently and exclusively by that expectancy and task values. However, the value perceptions interaction with expectancy beliefs influences academic choices (Ball et al., 2017; Guo et al., 2015; Hulleman et al, 2010; Nagengast...
et al., 2011). In this current research, the cost construct was not a focus of the research question; therefore, it was not investigated in this study.

Some students believe their performance ability may never improve even with increased effort; therefore, they would not be able to be successful in reaching their goals (Wigfield et al., 2004). Thus, some students modify their outcome expectation for a specific task. However, research has shown that students who exhibit autonomous academic motivation, study more, have higher academic achievement, and put forth a greater effort for learning (Deci & Ryan, 1985; Mih, 2013); thus, their outcome expectancy is related to effort. Students may develop an increase in motivation when they have confidence that they can successfully complete a task while also placing value on the outcome of the task completion.

Students’ beliefs, along with teacher and peer beliefs, play a role in influencing expectancy and value. At a very young age, students appear to have confidence in what they excel at and what they value in different achievement areas (Wigfield & Eccles, 2000; Gao, Lee, & Harrison, 2008). Teachers and peers have an opportunity to dispel gender and cultural stereotypes within the educational setting; therefore, students may develop an expectancy and value for a specific task outside of the stereotypical norm.

Societal stereotypes can influence the development of competence belief, their expectations for success, and the perception of values in various gender specific activities. These stereotypes have encouraged both boys and girls to behave in a way that will satisfy the expectations of society (Grossman & Porche, 2014). Therefore, the value is placed on activities perceived gender-specific (Gao et al., 2008). Typically, social norms dictate girls excel at reading and writing while boys excel at mathematics and science (Hill, et al., 2014). There is an expectation for success in subjects based on gender. As described by Gao et al. (2008), “gender
differences in children’s motivational beliefs (e.g., expectancy beliefs, task values) are found most often in gender-role stereotyped activities” (p. 245).

The constructs of the expectancy-value theory, the individual's expectations for success and the value the individual attaches to the various tasks vary based on gender and culture. Current research has focused on the value placed on STEM, more specifically mathematics related knowledge and the effect of STEM task choices of ethnicity and gender diverse participants. Additionally, gender and cultural stereotypes have been studied as influences in expectancy of success and value for STEM-related courses in academic settings.

Research Using Expectancy-Value Constructs in STEM

The expectancy-value model outlined by Eccles and colleagues (1983) has been utilized as a theoretical framework in research related to STEM fields. Eccles and colleagues studied the relationship between achievement and value attitudes and choice in enrolling in advanced mathematics courses. The results of the study supported the constructs outlined in the expectancy-value model. Eccles et al., (1983) concluded:

Achievement-related behaviors are related to self-concepts of abilities, expectancies, perceptions of task difficulty, perceptions of task value, personal goals and self-schemata, perceptions of parental and teachers’ beliefs, and attitudes, parents’ and teachers’ actual behaviors, beliefs, and attitudes, and perceptions of the cultural stereotypes associated with particular activities. (p. 135)

The higher expectancy and value beliefs of male students than female students in Eccles and colleagues’ study supported previous research conclusions (Crombie, et al., 2003; Desy, et al., 2011; DiLisi et al., 2011; Dubetz & Wilson, 2013; Duran et al., 2014; Farland-Smith, 2009; Gorman et al., 2010; Knezek, et al., 2013; Stolle-McAllister, 2011; Weber, 2011; Wender, 2004). Crombie et al. (2003) expectancy-value study further supported Eccles and colleagues’
(1983) conclusions as female participants reported increased expectancy for science achievement in their science classes the following academic year after participating in a summer outreach program. Furthermore, instructors acting as role models, were successful in encouraging participants to recognize the value of taking elective STEM courses, thus influencing behavior choice (Crombie, et al., 2003).

Gaspard and colleagues’ (2015) study expanded on previous expectancy-value model research by surveying high school students’ value beliefs in the mathematics domain and assessing the value constructs in more detail. Gaspard et al. concluded a lower intrinsic value for mathematics in girls than boys. Girls also perceived mathematics to be less important and less useful for future goals than boys. Girls perceived a higher emotional cost and effort than boys did. Therefore, the more effort associated with success in math may have influenced the value female student’s placed on mathematics education ultimately influencing behavioral choice.

Almarode et al. (2014) explained that talent development programs in STEM areas provide an essential setting for students to gain expertise in those domains by practicing the skills required for the expectancy of success. While there is limited research in focusing on the importance of practice make perfect, music programs have illustrated this practice for perfection model (Burak, 2014). Burak argued that music students who wanted to be viewed as good musicians by their peers illustrated attainment value for practicing their instruments. Additionally, students who practiced their instruments for longer periods of time showed intrinsic value and enjoyment from playing. The results of Burak’s research may be transferable to STEM-related areas as the rigorous content of the STEM curriculum usually requires practice via homework sets to become proficient in the content. Proficiency may lead to expectancy for success along with value for completing the specific task, thus influencing future task choice.
While the aforementioned research demonstrated the independent relationship between expectancy and value constructs and task choice, several studies have illustrated the interaction between expectancy and value constructs collectively affecting task choice. For example, a study conducted by Hulleman et al. (2010) illustrated that the relationship between utility value of a new math technique and intrinsic value for mathematics along with the relationship between expectancy and value. The study found that the participants that had increased utility value for the mathematics had a greater interest in the subject; furthermore, the study illustrated that positive utility value increased participant’s performance in the course. Another study conducted by Gao et al. (2015) confirmed a positive interaction between expectancy beliefs and the intrinsic value placed on mathematics positively predicts the choice of advanced mathematics courses.

Although the research conducted by Hulleman et al. (2010) and Guo et al. (2015) focused on integrating expectancy and value constructs to a specific domain in STEM, Ball and colleagues’ (2017) study integrated the constructs as they relate to changes in perceptions towards STEM fields. The results of this research concluded that intrinsic and utility values positively influenced attitudes towards STEM fields; furthermore, expectancy beliefs and utility value positively influenced attainment value placed on STEM fields. However, the data did not support expectancy beliefs as a sole predictor of STEM affinity. Therefore, task choice, including choice of college major, may be predicted by integration of both value constructs and expectancy beliefs.

Conclusion

This literature review explores the history of STEM education, the challenges in STEM education, and STEM intervention programs. Much of the current research conducted to explain
the relationship between these intervention programs and females’ attitudes towards one STEM domain. However, there is limited research that examines the perceptions of expectancy for success and value placed on STEM fields and college major choice of females in a STEM-focused academic program.

As the world’s job market is evolving into a more technological based society, the students of today will be the innovators of tomorrow. Therefore, attracting students to consider a STEM college major may continue to fulfill the STEM “pipeline”. The relationships among female high school seniors’ perceptions placed on a STEM-focused academic program, and their college major choice, may provide insight for designing programs with the components most influential on future task choice such as college major.

In the following chapter, a description of the research design including participants, data gathering methods, and data analysis techniques to be used in this study.
CHAPTER 3

METHODOLOGY

Introduction

The research focuses on expectancy to be successful in science, technology, engineering, and mathematics (STEM)-fields as well as the attainment, intrinsic, and utility value placed on STEM fields as they relate to female high school seniors’ in a STEM-focused academic program intended college major choice. This chapter includes the description of the research design, participants, data gathering methods, and data analysis techniques to be used in the study.

Research Questions

This study of female high school seniors in a STEM-focused academic program is based on the overarching goal of understanding female high school students’ intended college major choices from an expectancy-value theoretical framework.

The research questions included:

1. How does the expectancy to succeed in STEM fields of the female high school seniors in a STEM-focused academic program relate to their college major choice?

2. How does the attainment value that female high school seniors in a STEM-focused academic program place on STEM fields relate to their college major choice?
3. How does the intrinsic value that female high school seniors in a STEM-focused academic program place on STEM fields relate to their college major choice?

4. How does the utility value that female high school seniors in a STEM-focused academic program place on STEM fields relate to their college major choice?

5. How do the expectancy and value constructs collectively affect female high school seniors in a STEM-focused academic program college major choice?

The final research question was included following the analysis of the data to gain a greater understanding about how each expectancy and value construct collectively affect college major choice. Figure 2 depicts the research questions through the lens of the expectancy value theoretical framework.

![Figure 2](image)

Figure 2. Research questions related to expectancy and value constructs and task choice. Adapted from Eccles et al. (1983), Wigfield (1994), Wigfield et al. (2004), Wigfield & Eccles (2000, 2002), and Wigfield et al. (2009) expectancy and value model.
Research Design

A qualitative case study design was used to answer the research questions. Bogdan and Biklen (2007), and Creswell (2013) explained that the goal of qualitative research is to better understand human behavior and experience. To accomplish this understanding, the researcher was the key instrument in data collection and analysis; furthermore, the data was collected in multiple forms to be organized into themes for inductive data analysis (Creswell, 2013; Merriam, 2001).

A case study was designed to investigate a phenomenon within a real-life context (Yin, 2003). The case can include a person such as a student; a program; a group such as a class or a school (Merriam, 2001; Mertens, 2015; Yin, 2003). According to Yin (2003), a case study research design is prevalent when the following conditions are met: 1) when the focus of the study is to answer “how”, 2) the contextual conditions may be relevant to the phenomenon being studied, or 3) there may be no clear boundaries between the phenomenon and context. Moreover, in a case study, the researcher is the instrument (Patton, 2001) that gathers data with the intent of analyzing to illustrate, support, or challenge theoretical assumptions held prior to data collection (Merriam, 2001).

A case study was chosen for this research because the study focuses on “how” the expectancy for success in STEM fields and value placed on STEM fields of female high seniors in a particular STEM-focused academic program relate to choice of college major. Consequently, the case for this research is defined by the group of female high school seniors. Furthermore, the case required context for this decision of college major choice which is the STEM-focused academic program.
Researcher Background

The researcher has an undergraduate and graduate degree in a STEM major and has used her STEM education background to teach science courses at Arlington Estates High School (pseudonym). The researcher has worked at the study site, Arlington Estates High School, since it opened in 1997; therefore, she has intimate knowledge of the culture and curriculum of both the science department and the elite (or selective) STEM-focused academic program which is housed within the school. Through her tenure at the study site, she has taught a plethora of science courses to all levels of students. Currently, her role is that of junior-level Advanced Placement Physics 1 and senior-level Advanced Placement Biology teacher.

While the researcher does not teach a required science class in the STEM-focused academic program, she does teach Advanced Placement Biology which is an elective science course offered to all senior-level students, including those in the STEM-focused academic program. Additionally, she is the sponsor of Biology Club and the Science Olympiad team that are open to all Arlington Estates’ students. Biology Club provides scientific knowledge and activities related to biology that is not attainable in the classroom setting. Science Olympiad is an academic team in which students compete in 24 cross-curricular events including earth science, biology and anatomy, physics, astronomy, chemistry, technology, and engineering. As the researcher has dedicated her career to teaching and coaching in STEM-related fields to young people, she embraces the attainment, intrinsic, and utility value of STEM fields for all students.

The students participating in the study may have had the researcher as their instructor for their senior-level elective science class or as a sponsor of one of their extracurricular activities. Therefore, the researcher may have had expressed her opinions of the practicality and transferability of the skills gained in STEM-related fields. Consequently, some of the participants
may have been hesitant to respond negatively to the posed questions; therefore, the researcher has assured participants their responses to all questions were based on their own perspectives.

The researcher had experienced success in STEM areas through her personal educational experiences and professional experiences. As a STEM educator, the researcher had also experienced the challenges students may have found in these courses. Therefore, the researcher was mindful of personal perspectives that may have impacted data analysis and development of emerging themes and findings.

The Case

The Setting: Academy of Science, Mathematics, Engineering, and Technology

The District

Arlington Estates High School is one of five high schools in a large suburban K-12 school district in the Midwest. According to the district’s website (2016), the school district serves 39,963 students in 40 elementary schools, 8 middle schools, and 5 high schools from 11 communities. The demographics of this district student population include 28.5% White, 6.3% Black/African-American, 52.3% Hispanic, 8.3% Asian, 0.9% American Indian, and 3.7% two or more races. Additionally, 57.8% of the district’s population is from low-income families, thereby qualified for the Free/Reduced lunch program (Illinois Board of Education, 2016).

The mission statement of the district is “to be a great place for all students to learn, all teachers to teach, and all employees to work. All means all”. (District website, 2016) To meet the needs of students who want to get a head start on higher education, each high school houses a school-within-a-school curriculum specific program. The programs offered include Broadcast,
Education, and Communication Networks, Gifted and Talented, Science, Technology, Engineering, and Mathematics, Visual and Performing Arts, and World Languages and International Studies. In each of these programs, students work in dedicated facilities to tackle intensive curriculum using state-of-the-art equipment related specifically to each the program’s focus.

The School

The mission of Arlington Estates High School is to promote academic and personal success for all while fostering and understanding individual uniqueness. The school also encourages the development of mind, body, and character to become responsible, contributing members of society (School website, 2016). Arlington Estates High School is unique in offering an elite (or selective) STEM-focused academic program to a cohort of students annually for the past 20 years.

Arlington Estates High School has a population of 2,533 students. The school is located in a more affluent area of the district. The school’s self-reported ethnic demographics include 48.9 % White, 5.5% Black/African-American, 29.2% Hispanic, 13.6% Asian, 0.4 % American Indian, and 2.4 % two or more races. Low-income families make up 39.1% of the school’s population (Illinois Board of Education, 2015).

The STEM-Focused Academic Program

History

In 1997, Arlington Estates High School opened its doors to the educational community to meet the need of the district’s growing student population. The first year open, Arlington Estates
High School had only underclassmen students that were now in the newly drawn attendance boundaries. The upperclassmen that would have called Arlington Estates High School their new home school were allowed to complete their education at the school they had been currently attending. However, over the following two academic years, the student population at Arlington Estates High School grew as a new class of incoming freshmen was added.

Each high school in the district houses a unique school-within-a-school academic program in which student could apply for admittance into the program of their choice. From its inception, Arlington Estates housed the STEM-focused academic program available for incoming freshmen student. The students must apply to the program in 8th grade for the upcoming school year. If accepted, the students were required to commit their four years of high school to the program.

Throughout their four-year STEM-focused academic experience, students remain in a cohort as they fulfill the rigorous academic courses in STEM-related fields. These courses required by the STEM-focused academic program are available solely to students admitted to the program. Due to the focus of the program, STEM-focused academic program participants have very little flexibility to take elective courses. Therefore, the only opportunity to collaborate with their peers outside of the program is typically during their extra-curricular activities.

The administration strives to staff the STEM-focused academic program with professionals in STEM fields as the courses in STEM fields are taught from academic and technical disciplines; furthermore, many of the staff members hold an advanced degree within STEM fields. Depending on the qualifications of the staff member, he or she may solely teach in courses required by the STEM-focused academic program. These teachers are typically the Project Lead the Way (PLTW) courses. However, many staff members teach courses required by
the program and also teach courses outside of the program to ensure full-time teaching status. For example, the STEM-focused academic program required chemistry course, which is taken junior year by all students in the program, is taught by an instructor who also teaches honors chemistry to sophomores outside of the program.

**Admission and Retention**

Educators and administrators from the STEM-focused academic program select students who are high achieving and have an interest in STEM-related areas. The admission criteria consist of the following: 1) academic performance, 2) exam scores from the Watson and Glaser exam and the Cogat exam which focus on critical thinking and problem-solving exams, 3) a spontaneous essay responding to a prompt that is developed by the STEM-focused academic program director, 4) teachers letters of support, 5) and standardized academic test scores including the MAP test and the ACT Explore test. The students admitted to the program must be a resident of the district; however, the program may not be the student’s home school outlined by the district’s geographical boundaries.

The application process was developed to ensure the most qualified students are accepted into the program to meet the goals outlined by the program. The program requires students to maintain a C average in the required STEM-academic coursework. Those students who do not meet the academic standards or program goals go through remediation and a probation process. Students who may still be unsuccessful exit the program and return to their home school (Study site, n.d.).
The Curriculum

Students accepted to the STEM-focused academic program are presented a unique learning opportunity in the areas of science, technology, engineering, and mathematics. The curriculum designed for the program connects challenging mathematics and science courses integrated with the technical courses to meet the demands of an evolving technological society. The STEM-focused academic program consists of the science, mathematics, engineering, and technology courses (see Table 1). All required and elective courses are at the honors or Advanced Placement level (Study site, n.d.).

Table 1

| STEM-Focused Academic Program Required and Elective Course by Year (Study site, n.d.) |
|---------------------------------|---------------------------------|-----------------|-----------------|-----------------|
| **Freshmen Level** | **Sophomore Level** | **Junior Level** | **Senior Level** |
| Academy Advanced Honors Biology 1-2 | Academy Honors Physics 1-2 | Academy Honors Chemistry 1-2 | AP science course (Elective) |
| Academy Honors Integrated Mathematics I, | Academy Honors Integrated Mathematics II, | Honors Trigonometry/Analysis/ Calculus | Advanced Placement Calculus BC |
| Honors PLTW Introduction to Engineering Design | Honors PLTW Principles of Engineering | Honors PLTW Engineering Design and Development | Honors PLTW Design and Technology |
| Integrated Technology | Honors PLTW Digital Electronics | Honors PLTW Biotechnical Engineering (Elective) | Honors PLTW Biotechnical Engineering (Elective) |
| | | Honors PLTW Principles of Biomedical Science (Elective) | Honors PLTW Principles of Biomedical Science (Elective) |

The curriculum designed for the program utilizes cross-curricular project-based learning. Students integrate the skills and content knowledge from their mathematics and science courses into their PLTW courses (Study site, n.d.). For example, freshmen year students in PLTW Introduction to Engineering and Design course collaborate to design and engineer a gel.
electrophoresis chamber. This complements the curriculum in their honors biology course during the DNA technology unit in which the participants utilize their chamber to separate DNA strands. Throughout their four years in the STEM-focused academic program, students are exposed to a variety of STEM-related curricula which is showcased in their final senior technology project. According to the senior-level technology project protocol, the students have a strong STEM knowledge base and skill set coming out of the STEM-focused academic program. Therefore, their culminating project design utilizes their current knowledge and skill set while fostering personal growth.

In addition to the STEM-related problem-based learning projects, according to the Study site’s website (n.d.), students participating in the program are required to meet the following goals set forth by the program:

- Partake in an environment that applies and integrates skills acquired through Academy experiences with activity-based, project-based, and problem-based learning.
- Develop an understanding of the nature of science by incorporating the theoretical aspects of the discipline into the real life experiences of the student by exposing the students to a variety of courses using a lab-oriented format that engages them in experimentation, problem-solving and problem-based learning.
- Develop skills in observation, investigation, problem solving, communication and the use of diverse technologies.
- Demonstrate effective oral and written communication in problem-solving, critical thinking, computational and research skills.
- Work cooperatively and effectively with others while demonstrating respect for diversity.
- Demonstrate moral and ethical responsibility when making decisions.
- Demonstrate the habit of life-long learning while exploring future educational and career opportunities. (p. 1)

Many of the classrooms that are dedicated to the STEM–focused academic program are segregated from the rest of the building. One wing of one floor of the school houses the courses in STEM fields along with an Instructional Technology Center which includes a technical laboratory, a project design room, and a prototype laboratory; therefore, the resources required to support the integrated curriculum outlined by the program are available in one area.
Additionally, all lockers in the STEM-focused academic wing are for students in the program; therefore, the students rarely need to leave the confines of the STEM-focused academic program.

The Participants

The STEM-focused academic program is an elite (or selective) program offered to students at the high school level is a school-within-a-school at Arlington Estates High School. The student population of Arlington Estates High School belongs to either the general education program, open to all students who reside within the school’s boundaries or the STEM-focused academic program, requiring admittance to the program via an application process. Therefore, this case study has been bound by the STEM-focused academic program. According to the admission administrators, the participants in the STEM-focused academic program are considered high achieving students who also have an interest in STEM-related areas. Therefore, the students in the general education population were excluded from the case due to lack of interest in the STEM-focused academic program or not meeting the acceptance standards for the program. Furthermore, this case study focused on the perspectives of female high school seniors in the STEM-focused academic program; consequently, male students in the program were also excluded from the study.

The participants were selected using a criterion sampling method, which is a type of purposive sampling technique. Purposive sampling techniques may be defined as selecting participants based on specific purposes associated with answering a study’s research questions (Creswell, 2013; Merriam, 2001; Mertens, 2015; Teddlie & Yu, 2007). Purposive sampling techniques are primarily used in studies with a qualitative component. The data required to answer the posed research questions required a specific participant population; therefore,
purposive sampling was utilized to ensure the contribution of targeted research subjects. As the research questions of this study required data from participants with certain criteria set, this sampling method was instrumental to the study.

For this STEM-focused academic program cohort of students, only about one-third of the applicants were female students; additionally, approximately one-fifth of the accepted students were also female. There were 19 female high school seniors in the STEM-focused academic program. The demographics of the case study participants included 55 % White, 0 % Black/African-American, 10 % Hispanic, and 35 % Asian. Low-income families made up 10 % of the program’s population (See Table 2). Therefore, the female population accepted to the STEM-focused academic program does not represent that of school or the district.

Table 2

Participants’ Demographics, Intended College Major Choice, and Data Gathering Method

<table>
<thead>
<tr>
<th>Participant (Pseudonym)</th>
<th>Ethnicity</th>
<th>Intended College Major Choice</th>
<th>Reflective Essay</th>
<th>Focus Group-a</th>
<th>Focus Group-b</th>
<th>Focus Group-c</th>
<th>Interview</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aru</td>
<td>Asian/Pacific Islander</td>
<td>Engineering/Architecture</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cecilia</td>
<td>Asian/Pacific Islander</td>
<td>Pre-Med</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emilia</td>
<td>White</td>
<td>Pre-Engineering</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emma</td>
<td>White</td>
<td>Chemistry/Pre-Pharmacy</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faith</td>
<td>White</td>
<td>Optical Engineering</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gianna</td>
<td>White</td>
<td>Biomedical Engineering, Molecular Biology/Neuroscience</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jessie</td>
<td>Asian/White</td>
<td>Bioengineering</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Julie</td>
<td>Hispanic</td>
<td>Agricultural and Biological Engineering (concentration in Soil and Water Engineering)</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Continued on the next page)
The study was proposed to and then approved by the principal of the study site that oversees the high school and also the STEM-focused academic program where the study participants attended. Study participation information was disseminated in the STEM-focused academic program’s technology course required for all senior level students in the program. All female students in the STEM-focused academic program received a parent/guardian consent along with a student assent form to participate in the study. Parents and guardians were asked to give consent for their children to participate in the study. All consent and assent forms were returned prior to study participation. Participant confidentiality was honored by assigning pseudonyms to ensure the privacy of the participants. Participants were offered an opportunity to
select their own pseudonym; however, for those who did not select a pseudonym; one was assigned by the researcher.

Data Collection

In this case study, seeking to understand the female high school seniors’ expectancy in STEM fields, as well as value placed on STEM fields in relation to college major choice, three types of data collection strategies were used: 1) a reflective essay response, 2) a focus group, and 3) an interview. Bamberger (2012), Bogdan and Biklen (2007), Creswell (2013), Golafshani (2003), and Mertens (2015) explained that utilizing overlapping methods such as reflective essays, focus groups and individual interviews to address the same problem provides an opportunity to triangulate the data, adding both credibility and dependability to the data.

Reflective Essay

The qualitative approach using a reflective essay offered the case study participants an opportunity to respond in detail about their intended college major choice and their future goals and ambitions. McLeod (2014) explained that open-ended responses in an unstructured setting allow participants time to reflect and elaborate upon their responses, thus providing a greater level of detail to explore the problem (Bogdan & Biklen, 2007; Zohrabi, 2013).

All 19 female participants were invited to participate in the reflective essay; additionally, all 19 participants chose to complete a reflective essay. Participants were instructed to identify their college major choice and explain their career goals along with their educational experiences that were helpful in the decision-making process (See Appendix A). The prompts were developed for the participants to explain the rationale behind their choice of college major
exposing both the expectancy and the value aspects related to STEM fields. The participants were asked to provide as much explanation and detail as they wish; additionally, they were instructed to write at least a page or a few paragraphs for their response. Nonetheless, their reflective essays varied from 413 to 1012 words with an average response of approximately 650 words.

Focus Group

According to Bogdan and Biklen (2007), Mertens (2015), and Morgan (1998), focus groups are group interviews that rely on interactions within the group. Furthermore, Krueger and Casey (2009) explained that focus groups are often times less threatening than interviews for many participants; consequently, this setting may be more conducive for participants to discuss perceptions, ideas, opinions, and thoughts without the researcher dominating the interview (Mertens, 2015). Therefore, for this study, a focus group was used to collect data because the participants can stimulate each other to articulate their perspectives; thus, the researcher gained an understanding of the range of views of those who have shared similar experiences (Bogdan & Biklen, 2007).

Three focus groups were conducted with 5-7 participants intending on majoring in various STEM fields. The researcher placed 18 participants in one of three focus groups based first on their STEM majors with the hope that the college majors of the focus group participants are as diverse as possible and second based on schedule availability (See Table 2). According to Krueger and Casey (2009), focus groups should consist of 6 to 12 participants to create a small, intimate environment where participants are comfortable to share their experience and perspectives; however, the group must also be large enough to yield diverse responses. The
remaining respondent, which was a non-STEM major, was invited to participate in an interview to share opinions and perspectives in a one-on-one setting.

A script was read to the members of each the focus group to ensure the understanding that the session would be audio and video recorded; nonetheless, each participant was provided an opportunity to self-select a pseudonym to ensure that their identity will remain confidential. Those participants that did not choose a pseudonym, one was selected for her by the researcher. Participants were instructed that the goal of the focus group was to gain an understanding of participants intending on majoring in a STEM-related field perceptions, experiences, and opinions through their conversations. The researcher encouraged participants to speak freely; however, the participants were instructed to respect the viewpoints of each focus group member.

The focus group prompts centered on participants’ reasons for choosing STEM fields as their college major based on expectancy and value perspective. The focus group protocol consisted of 10 questions (See Appendix B) modeled after Krueger and Casey’s (2009) question categories which included: 1) opening questions, 2) introductory questions, 3) transition questions, 4) key questions, and 5) ending questions to allow students to explain the expectancy for success and value placed on STEM fields as they relate to choice of STEM college major; thus, exposing both the expectancy and the value aspects related to STEM fields and college major choice. The researcher had a predetermined protocol; however, to gather further insight from the focus group and reflective essay responses, the researcher asked follow-up questions for participants to provide further explanation of their perspectives and opinions.
The qualitative approach using an interview setting offered participants an opportunity to explain their perspectives of expectancy for success and value placed on STEM-related fields as they relate to their college major choice. According to Bogdan and Biklen (2007) and Mertens (2015), the researcher gains an understanding of participants’ viewpoints via their own words. All participants of the STEM-focused academic program share the same academic experience; however, each member may have been influenced by the experience in a different manner. Some of the participants in the STEM-focused academic program may have been undecided on their college major choice or choose not to pursue a STEM-based major. Therefore, an interview setting may allow participants to feel less pressure in expressing their opinions and perspectives in a one-on-one setting (Stake, 2010) without feeling potential biases of those who have chosen a STEM major.

The sole participant that chose a non-STEM major was invited to participate in one 30-40 minute interview. While the interview pool could have consisted of those participants either 1) undecided college major or 2) non-STEM college major students, only one participant chose not to major in a STEM-field; consequently, she was the lone interview participant. A script was read to the interview participant to ensure her understanding the session would be audio recorded; even so, the identity of the interviewee remains confidential via pseudonym assignment. The participant was instructed that the goal of the interview was to gain an understanding of individual perceptions, experiences, and opinions. The interview prompts were centered on expectancy and value related to their intended college major choices as well as STEM fields; however, the questions were not specific to choosing STEM as an intended college
major. The interviewer had a pre-determined protocol consisting of 11 questions with sub-questions for each interview participant (See Appendix C). The use of the interview protocol was to gain an understanding of how student’s expectancy for success and attainment, intrinsic, and utility value perspectives of STEM fields as they relate to their college major choice. Therefore, while specific interview questions were posed, if needed, the researcher provided follow-up questions to provide clarification or more in-depth responses from the reflective essay and interview.

Research Questions and Instrumentation

Table 3 illustrates how the data collecting methods are connected to the individual research questions.

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Reflective essay</th>
<th>Focus Group</th>
<th>Interview</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How does the expectancy to succeed in STEM fields of female high school seniors in a STEM-focused academic program relate to their college major choice?</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2. How does the attainment value that female high school seniors in a STEM-focused academic program place on STEM fields relate to their college major choice?</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3. How does the intrinsic value that female high school seniors in a STEM-focused academic program place on STEM fields relate to their college major choice?</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>4. How does the utility value that female high school seniors in a STEM-focused academic program place on STEM fields relate to their college major choice?</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>5. How do the expectancy and value constructs collectively affect female high school seniors in a STEM-focused academic program college major choice?</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
The goal of the reflective essay, the focus group, and the interview was to examine perceptions of female high school seniors’ in a STEM-focused academic program expectation beliefs STEM and attainment, intrinsic, and utility value placed on STEM fields related to their college major choice. The data collected in this qualitative study consisted of “direct quotations from people about their experiences, opinions, feeling, and knowledge” (Merriam, 2001, p. 69). Therefore to capture the participant’s responses, the focus groups and interview were audio recorded to later be transcribed by the researcher. The focus groups were also video recorded to ensure the responses had been correctly quoted to the participant. Furthermore, the video recording captured the participants’ body language along with nonverbal interactions within the group dynamic resulting in greater comprehension of the data.

After the transcription process, the researcher read through each transcript and reflective essay to develop a general understanding of the data (Saldaña, 2016). Furthermore, the researcher analyzed data simultaneously with the data collection (Bogdan & Biklen, 2007; Merrian, 2001) to generate a list of possible categories that represented the themes or patterns found with the data.

The researcher coded the data using setting/context coding, process coding, and provisional coding. Bogdan and Biklen (2007) explained that setting/context and process coding can be used to organized data in a case study. The case in this study was defined by the STEM-focused academic program; therefore, setting/context codes were used to describe how participants define perceptions of their own academic experiences or their perspectives towards a particular aspect of a setting. Additionally, the process codes were used to categorize sequence of events such as choices of a college major (Bogdan & Biklen, 2007). Saldaña (2016) explained
that provisional codes are developed prior to data analyze based on existing knowledge. Therefore, the provisional codes used to analysis the data included expectancy for success, attainment value, intrinsic value, utility value, and STEM-related field. The second cycle of coding was conducted to further categorize the data with each provisional code. In Vivo coding was used by the researcher using the participants’ own words (Saldaña, 2016) (See Appendix D).

Once the data had been coded, high frequency codes were grouped together into categories in which participants’ perspectives emerged. These perceptions were then used to develop key findings related to the perception of expectancy for success in STEM fields and value placed on STEM fields as they relate to college major choice.

Trustworthiness Assurance

Golafshani (2003) explained that to ensure credibility and dependability in a case study, the examination of trustworthiness is essential. This can be accomplished using a peer reviewer (Merriam, 2001) and triangulation of data (Bamberger, 2012; Bogdan & Biklen; 2007; Creswell 2013; Patton, 2001).

The credibility is affected by the researcher’s perception of credibility in the study and her choice of key assertions (Creswell & Miller, 2000). Once the focus groups and interview were transcribed, the participants in each group had an opportunity to review the transcripts to ensure the accuracy. Furthermore, the data analysis of the focus group transcript, interview transcripts, and reflective essay were peer reviewed by a fellow doctoral candidate, to confirm the credibility and dependability of the data analysis. The peer reviewer was used to offer confirmation the data analysis is accurate and identified with sufficient evidence (Creswell & Miller, 2000, Merriam, 2001). To ensure that the researcher interpreted data and drew
conclusions through an objective lens, she utilized a peer reviewer, who is also a high school science teacher also pursuing her doctoral degree. The peer reviewer examined the analyzed data sets to check if reasonable and appropriate interpretations were made.

Bamberger (2012), Bogdan and Biklen (2007), Creswell (2013), Patton (2001) explained that utilizing different data collection methods to address the same problem provides an opportunity to triangulate the data adding both dependability and credibility of the data. Therefore, the findings were compared across all data sets.

Conclusion

This chapter described the qualitative case study research design that was used in this dissertation study. The chapter included the research questions, research design, setting and sample population, data collection procedure, and data analysis methods. The following chapters will consist of the findings and conclusion of this study.
CHAPTER 4

FINDINGS

This study investigated female high school seniors in a science, technology, engineering, and mathematics (STEM)-focused academic program regarding their expectancies for success and attainment, intrinsic, and utility value perspectives of STEM fields as they relate to their college major choice. The data sources including 1) reflective essays, 2) focus groups, 3) and an interview were analyzed to generated themes. The emergent themes from each data source were interpreted by the researcher to answer each research question. This chapter includes the findings organized first according to research questions 1-4 as they relate to a specific expectancy or value construct and then as the research questions relate to each other. The final research question is overarching and will be explained later.

The Context

A case study is designed to investigate a phenomenon in a real-life context (Yin, 2003). This case study centered around 19 female high school seniors from a STEM-focused academic program at Arlington Estates High School (pseudonym), a large suburban high school in the Midwest. All 19 female high school seniors defining the case were invited to participate in the study. All of them chose to participate. Each participant completed a reflective essay which provided details about their intended college major choice and their future goals (see Table 4).
Each participant’s response to the prompt designed to elicit her intended college major choice was utilized for recruitment for participation in either a focus group or interview. All 19 study participants agreed to participate in either a focus group or an interview. The participants that indicated an intended college major in a STEM fields participated in a focus group while the participants that intended to major in an area outside of STEM participated in an interview. In their reflective essay response, 18 participants disclosed future STEM-related majors and therefore were each divided into one of three focus groups. Only one participant’s college major was not in a STEM-related field and consequently she was the sole interview participant. To protect the identities of the research participants, each was offered an opportunity to choose a pseudonym or give the researcher permission to provide one for them. Of the 19 participants, 10 self-assigned a pseudonym and the remaining 9 pseudonyms were chosen by the researcher.

Table 4
Participants’ College Major Choice and Future Goals

<table>
<thead>
<tr>
<th>Participant (Pseudonym)</th>
<th>Intended College Major</th>
<th>Future Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aru</td>
<td>Engineering/Architecture</td>
<td>Obtaining a license for Architecture and working in an Architecture firm</td>
</tr>
<tr>
<td>Cecilia</td>
<td>Pre-Med</td>
<td>Attending medical school specializing in pediatrics or work in research</td>
</tr>
<tr>
<td>Emilia</td>
<td>Pre-Engineering</td>
<td>Becoming a Bioengineer or Systems (General) Engineer</td>
</tr>
<tr>
<td>Emma</td>
<td>Chemistry/Pre-Pharmacy</td>
<td>Working in a hospital setting, as a pain management pharmacist, or doing research on pharmaceutical medications</td>
</tr>
<tr>
<td>Faith.</td>
<td>Optical Engineering</td>
<td>Making lens for medical devices</td>
</tr>
<tr>
<td>Gianna</td>
<td>Biomedical Engineering, Molecular Biology or Neuroscience</td>
<td>MD and Ph.D. doing both patient care and research</td>
</tr>
<tr>
<td>Jessie</td>
<td>Bioengineering</td>
<td>Developing innovative medical technology</td>
</tr>
<tr>
<td>Julie</td>
<td>Agricultural and Biological Engineering (concentration in Soil and Water Engineering)</td>
<td>Earning a Master’s degree and working with agricultural growing methods to make them more sustainable</td>
</tr>
<tr>
<td>Katy</td>
<td>Exercise Physiology/minor in Biomedical Sciences</td>
<td>Attending medical school specializing in orthopedic, such as physical medicine and rehabilitation or sports medicine</td>
</tr>
<tr>
<td>Kara</td>
<td>Business (Finance)</td>
<td>Attending law school</td>
</tr>
<tr>
<td>Maeve</td>
<td>Biomedical Engineering</td>
<td>Working in a research facility for cell research and development then opening own research center</td>
</tr>
</tbody>
</table>

(Continued on the following page)
Table 4 (continued)

<table>
<thead>
<tr>
<th>Participant (Pseudonym)</th>
<th>Intended College Major</th>
<th>Future Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Michelle</td>
<td>Chemical Engineering</td>
<td>Pre-med to become a practicing physician or research</td>
</tr>
<tr>
<td>Mickey</td>
<td>Biology/Pre-Med</td>
<td>Attending medical school specializing in anesthesiology</td>
</tr>
<tr>
<td>Nikki</td>
<td>Chemical Engineering</td>
<td>Research to be part of the team that discovers new and safer methods of creating certain substances</td>
</tr>
<tr>
<td>Rose</td>
<td>Computer Science (CS)</td>
<td>Attending law school and pursuing a career in the legal/political field</td>
</tr>
<tr>
<td>Sam</td>
<td>Biology and Computer Science</td>
<td>Attending medical school</td>
</tr>
<tr>
<td>Sofia</td>
<td>Biology and Chemistry</td>
<td>Attending medical school</td>
</tr>
<tr>
<td>Summer</td>
<td>Computer Science</td>
<td>Working as a software programmer in an undecided area</td>
</tr>
</tbody>
</table>

Summary of Participants’ Perspectives

After transcribing the three focus groups and interview, transcripts and reflective essays were coded, whereby common themes emerged from the data to answer the following research questions.

1. How does the expectancy to succeed in STEM fields of the female high school seniors in a STEM-focused academic program relate to their college major choice?
2. How does the attainment value that female high school seniors in a STEM-focused academic program place on STEM fields relate to their college major choice?
3. How does the intrinsic value that female high school seniors in a STEM-focused academic program place on STEM fields relate to their college major choice?
4. How does the utility value that female high school seniors in a STEM-focused academic program place on STEM fields relate to their college major choice?
5. How do the expectancy and value constructs collectively affect female high school seniors in a STEM-focused academic program college major choice?
Table 5 illustrates the perceptions of participants as they relate to the first four research questions. Research question five collectively addresses the expectancy and value constructs as they relate to college major choice and will be addressed second. To ensure trustworthiness of the data, study participants were offered an opportunity to access the accuracy of the transcription of their focus group or interview. Additionally, the coded transcripts were peer reviewed by a colleague in the same doctoral program as the researcher.

### Table 5

**Participants’ Perspectives That Address Each Research Question**

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Participants’ Perspectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How does the expectancy to succeed in STEM fields of female high school seniors in a STEM-focused academic program relate to their college major choice?</td>
<td>1. Participants’ prior STEM success increased confidence to be successful in STEM fields and led them to choose STEM fields as their college major.</td>
</tr>
</tbody>
</table>
| 2. How does the attainment value that female high school seniors in a STEM-focused academic program place on STEM fields relate to their college major choice? | 1. Participants value STEM fields because the fields drive innovation and change.  
2. Participants believe that STEM fields can make an impact on people’s lives. |
| 3. How does the intrinsic value that female high school seniors in a STEM-focused academic program place on STEM fields relate to their college major choice? | 1. Participants find STEM fields interesting.  
2. Participants find STEM fields enjoyable.  
3. Participants find STEM fields personally satisfying. |
| 4. How does the utility value that female high school seniors in a STEM-focused academic program place on STEM fields relate to their college major choice? | 1. Participants believe that STEM fields are useful because they provide relevant skills for the future.  
2. Participants find future academic and career opportunities in STEM fields. |

**Research Question 1**

How does the expectancy to succeed in STEM fields of female high school seniors in a STEM-focused academic program relate to their college major choice?

In addressing research question one, the participants responded to the following prompts from the reflective essay: How or why will you be successful in your future career? Explain how your educational experiences helped make your college and/or career decisions. The participants
of each of the focus groups responded to the following: Why do you see yourself being successful in the STEM field you chose? How does your expectation for your success in STEM fields relate to your college major choice? The interview participant was asked the following questions: How did you select your college major? Why do you think you will be successful in that field? Data from each of these sources was coded and the following perspective emerged, Participants’ prior STEM success increased confidence to be successful in STEM fields and led them to choose STEM fields as their college major. Wigfield (1994), Wigfield and Eccles (2000 & 2002), and Wigfield et al. (2009) explained that expectancy for success is specific beliefs that students have regarding their projected success on certain tasks. Female high school seniors in a STEM-focused academic program were given an opportunity to experience success through the specific opportunities offered by the program; moreover, through these successes, participants gain confidence to be successful in STEM fields.

**Perspective 1-1. Participants’ prior STEM success increased confidence to be successful in STEM fields and led them to choose STEM fields as their college major.**

Female participants in a STEM-focused academic program had an opportunity to experience STEM-related fields through their participation in camps, internships, job shadowing, STEM-courses, STEM project challenges, and career exploration. These experiences offered participants a variety of occasions to field test what it would be like working in a STEM-career prior to committing to a specific college major. Study participants described how internships and shadowing professionals in their STEM-field of interest illustrated real-world application of STEM-related curricular content. Kara summarized the power of internships as “they further helps students to explore different fields, experience a real work environment, see STEM in action, and make more educated decisions in regard to a college major” (Reflective essay, May
Mia interned at a Pain Center and supported Kara’s perspective of the benefits of experience real work environment. Mia’s positive experience interning at the Pain Center is why she is considering the field of geriatrics (Reflective essay, May 11, 2017). According to Katy, her experience at two physical therapy clinics was instrumental in “solidifying [her] previous (basic) knowledge of body mechanics, as well as solidifying [her] calling to follow a career in a similar field” (Reflective essay, May 15, 2017). Through their experiences, Kara, Mia, and Katy could envision themselves eventually working in the fields that they field tested, thus influencing their choice of college major.

In addition to field testing STEM-careers, female participants in the STEM-focused academic program gained hands-on experiences through the required STEM-related courses. Summer expressed the impact of being exposed to more advanced technology and engineering courses as she clarified “[they have] helped me form my decision to go into computer science” (Reflective essay, May 15, 2017). Cecilia also reflected that through her experiences in science courses, she just knew she needed to major in science (Reflective essay, May 15, 2017). Furthermore, Michelle explained that being in a STEM-focused academic program provided opportunities over four years in which to experience many different areas within STEM whereby, “has given me more insight into fields that I knew little about before” (Reflective essay, May 15, 2017). In the focus group, several participants including Sofia, Summer, Mia, Vaishnava, Jessie, Michelle, and Emilia described how the experiences they have had in STEM fields will assist them in being successful in college (Focus group-b, May 19, 2017; Focus group-c, May 22, 2017). Mia voiced that

we are a little more prepared because of all the exposure we have gone through but … some people have some kind of sense of what they what to do, but they haven’t really
gotten through these fields that we have. Engineering and technology…is beneficial for us to just have this kind of exposure. (Focus group-c, May 22, 2017)

The focus group participants illustrated their consensus of Mia’s statement by agreeing and nodding. Thus, exposure to a variety of curricular content in STEM fields provided participants with an overview of what they would be learning in a specific STEM-related college major.

While some participants’ experiences solidified their college major choice, for others, their experiences in STEM-contexts sent them on a different STEM-related path. Gianna explained that she thought that she would “be a Biomedical Engineer, but taking courses in Engineering Design actually turned me away from engineering as a career. But it took being in this immersive engineering environment to realize that engineering wasn’t for me” (Focus group-c, May 22, 2017). Kara had a similar experience as she volunteered that “aspects of the engineering stuff in the [STEM-focused academic program] that I absolutely loathed like all of the documentation that we did. I could not see myself doing that [documentation] for the rest of my life” (Interview, May 19, 2017). The diverse experiences across many STEM fields provides participants with flexibility within their college major as Sofia described, “we [female STEM-focused academic program participants] have had exposure to a lot of different topics within STEM so we know that if we choose a major and we don’t like it we can switch it to something else” (Focus group-c, May 22, 2017).

The STEM-focused academic program offered experiences in STEM-related contexts. These opportunities were in a variety of forms including hands on experiences within their STEM-related coursework and career exploration in a STEM-field. Through these experiences, participants had a chance to field test STEM fields prior to choosing a college major.
Consequently, participants explained that these opportunities influenced their decision to pursue specific majors in STEM-related fields or major in areas outside of STEM.

Female high school seniors in a STEM-focused academic program were somewhat successful in the STEM-content areas and this success increased their confidence to be successful in their future STEM-related major. Wigfield and Eccles (2000) and Gao et al. (2008) explained that students have confidence in areas in which they excel. In this study, participants intending on majoring in a STEM field expressed confidence to be successful in STEM-related fields. This confidence may have been developed through prior success in STEM areas. Several participants have found success in STEM-related competitions, including Project Lead the Way (PLTW) and Health Occupations Students of America (HOSA). Mickey referred to her success at the State HOSA competition. Mickey earned medals due to her successful performance in the following events: medical terminology, pathophysiology, and Community Emergency Rescue Team. Moreover, she explained that her success in these events will assist her in the future (Reflective essay, May 13, 2017). Rose was successful in designing an App for Verizon and she also competed at the State level in PLTW State Engineering Design. She explained that “the repeated success in classes/projects that were CS [Computer Science]/STEM focused showed me that a career or at least a major in that field would be viable” (Reflective essay, May 15, 2017).

The curriculum in a STEM-focused academic program offered participants with opportunities to build confidence through rigorous coursework and independent inquiry based projects. Gianna described how the “technology classes [were] designed to mold us through different levels of independent projects from building DNA testers to coding Android Applications, the [STEM-focused academic program] helped me believe in my own abilities” (Reflective essay, May 15, 2017). Sophia is confident that she will be able to perform well in her
Gianna is planning on majoring in biomedical engineering, molecular biology, or neuroscience, each of which she explains integrates engineering, technology, and biology, all areas in which she had a successful outcome. Michelle echoed that tech classes my freshman, junior, and senior year were the most influential to my choice in major [chemical engineering] besides my AP Chemistry course … The confidence I gained from these classes pushed me to think about the best I can give to the world. (Reflective essay, May 15, 2017)

Nikki expressed that educational experiences prior to participating in the STEM-focused academic program did not offer “opportunities to have expressed our confidence” (Focus group-b, May 19, 2017). Julie also explained that her experiences in high school STEM courses were more challenging than her prior educational experiences, yet she excelled in these rigorous courses. She stated that “compared to elementary school and middle school this is the hardest I have ever pushed myself so I'm pretty sure I will succeed in college” (Focus group-b, May 19, 2017). Through their achievements in STEM-related areas, the participants expressed their confidence to be successful in their future college experiences.

Mia, Michelle, and Sofia volunteered that they performed well in the STEM-focused academic program required coursework and that they were not afraid of entering into rigorous STEM-related fields, even though these fields are predominately male (Focus group-a, May 19, 2017; Focus group-c, May 22, 2017). Rose explained that “we already have been successful to an extent [and] I think it’s challenged us to take high-level of STEM classes” (Focus group-b, May 19, 2017) as 18 out of 19 participants have chosen a STEM-related college major. Nonetheless, according to Gianna, “doing well in STEM classes and having that experience under my belt
reminds me that the only thing really ever in the way is my own determination” (Reflective essay, May 15, 2017). Therefore, through prior success in STEM-related areas, Gianna is confident in her ability to be successful in a STEM program at an Ivy-League institution. Sophia is also confident that she will be able to perform well in her double major in biology and chemistry at a competitive university due to being successful in rigorous STEM courses in high school (Reflective essay, May 14, 2017).

The participants who did not experience success in all STEM areas used the experience to steer away from STEM for choice of college major. Through the STEM-focused academic program, Mickey has taken a variety of courses in the engineering field; however, she realized that she simply is not good at engineering and has no desire to pursue a career in engineering (Reflective essay, May 15, 2017). Consequently, Mickey has chosen to go into the medical field due to the success she experienced in her Health Occupation courses and Health Occupations Students of America competitions. Kara struggled through her STEM courses as she explained that “I’m not really good at it [math and science] so I just was worried about … maybe not being good enough to succeed in that field” (Interview, May 19, 2017). Kara’s concern for being able to be successful in a STEM-field resulted in her choosing a college major outside of STEM.

Female high school seniors in a STEM-focused academic program described their success or struggles in their STEM-related fields experiences. Consequently, these experiences influenced their confidence to be successful in future college STEM endeavors. Therefore, the participants who experienced success in specific areas STEM fields expressed their confidence to also be successful in those same STEM-related college majors. However, participants who did not experience success were not confident that they would be able to do well in the field in which they struggle whereby choosing an alternative college major.
Research Question 2

How does the attainment value that female high school seniors in a STEM-focused academic program place on STEM fields relate to their college major choice?

In addressing research question two, the participants were instructed to respond to the following prompt in the reflective essay: Explain how your educational experiences helped you to make your college and/or career decisions. Additionally, participants in the focus groups were asked the following: 1) How important do you think it is to pursue STEM fields for your future?, 2) How does it [STEM fields] play a role in deciding your college major?, 3) Do you feel that being successful in a STEM field would make you feel good about yourself in the future?, and 4) Why? Or why not? The interview participant was asked: 1) How valuable is it to pursue your chosen college major for your future? 2) Do you think that your skills and knowledge about STEM make you feel good about yourself?, and 3) How does it, or does not it play a role in deciding your college major?

The data from the reflective essay, focus groups, and the interview was coded and analyzed resulting in the following participants’ perspectives: 1) Participants value STEM fields because the fields drive innovation and change and 2) Participants believe that STEM fields can make an impact on lives. The attainment value or the importance the individual places on specific tasks also incorporates the participant's identity; whereby, if individuals view a task as central to their personal belief, the importance of the task increases (Eccles et al., 1983; Wigfield & Cambria, 2010).
Perspective 2-1. Participants value STEM fields because the fields drive innovation and change.

Female participants in a STEM-focused academic program explained the importance of STEM-related fields as they drive innovation and change. Through their reflective essay, Maeve, Sam, Nikki, and Julie hope that through research they will be able to develop or discover something that will change the world (Reflective essay, May 14, 2017; May 15, 2017). Sam described how innovation and inventions can integrate the two STEM fields she is passionate about computer science and health care. She further explained that “Whether I become a doctor or a computer scientist, I will be able to take my career plans further to help those in need of medical assistance. (Reflective essay, May 15, 2017). Nikki offered that she “would love to work to research and try to develop new combinations of substances and processes to make better products” (Reflective essay, May 14, 2017). Many of the participants explained how technology is always changing and STEM-related fields provide the setting for these new discoveries.

While not all participants have chosen to major in a STEM-related field, they explained how important it is to keep apprised the advances that are made in STEM areas. Kara was asked if STEM skills and knowledge about STEM would make her feel good about herself, Kara explained that even though she is not majoring in a STEM field just feels really good learning about the different STEM stuff especially because STEM is so important especially now with all the technological advancements and society is going to keep progressing that way and it's going to be such a huge part of our future so I like staying on top of that. It’s really important. (Interview, May 19, 2017)

The focus group participants addressed their perspectives of the importance for pursuing STEM fields for their future. Many described the how diverse STEM fields are and that they are constantly evolving. Katy summed up this concept with “I like careers in STEM fields... because
you can create something that can help change how we use stuff…you could take it in so many
directions” (Focus group-a, May 19, 2017). STEM fields require a different way of thinking and
without STEM fields Aru argued, “You wouldn’t be able to create an innovative design” (Focus
group-b, May 19, 2017) and Emilia offered that STEM “looks at things … in a different way to
…find a new way of doing things” (Focus group-b, May 19, 2017). Faith’s opinion which was
confirmed by many study participants is that “everything is going to keep progressing and
moving forward so I guess the only way to kind of prepare for that is to go into STEM and try to
help that progression” (Focus group-a, May 19, 2017). For many, the importance of having the
opportunity to innovate, discover, or design new ways of doing things influenced their decision
to major in a STEM-related field.

Perspective 2-2. Participants believe that STEM fields can make an impact on people’s lives.

Female participants in a STEM-focused academic program explained the significance of
STEM-related fields for making a substantial impact on people’s lives. Many participants
reflected on their belief that through innovation and change, STEM fields provided them an
opportunity to help people. In her essay, Maeve offered “I believe that there is a lot of progress
that needs to be made with applying science to those suffering. People’s bodies will not always
be perfect … this creates a demand that I can and will fulfill” (Reflective essay, May 15, 2017).
Jessie shared her thoughts that “the ability of biomedical technology to improve human life”
(Reflective essay, May 15, 2017) which has led her to a college major in the field of
bioengineering. Michelle offered that through math and science, the medical field is the “most
straightforward way to help people” (Reflective essay, May 17, 2017). Sam explained how
technology can be utilized to assist doctors in patient care (Reflective essay, May 15, 2017).
Finally, Julie explained how in her future career, she will be able to impact people both locally and globally through the restoration of the environment (Reflective essay, May 15, 2017). For all of the participants, choosing a college major in a field in which they can help people add a sense of purpose to their lives. The participants explained that pursuing STEM fields was important because they were making a difference in the world (Reflective essay, May 15, 2017; May 17, 2017; Focus group-a, May 19, 2017; Focus group-b, May 19, 2017; Focus group-c, May 22, 2017).

When participants were asked if being successful in a STEM field would make them feel good about themselves in the future, Michelle said, “by achieving in STEM fields I can help other people” (Focus group-a, May 19, 2017). Many participants nodded in agreement with Michelle while Gianna provided the following, “STEM [is a] really easy way to do that [helping other people] whether it is one successful research project you finished [and] it could be applied to something if you are working hand-on with a patient” (Focus group-a, May 19, 2017). Mia added, “being able to benefit other people's lives, not changing their lives, but being there for people so even though I may not be doing groundbreaking research or anything at least I am affecting the lives of others” (Focus group-c, May 22, 2017). Sam’s opinion was that “there is much room to help other people and you can see the visible work like right in front of you” (Focus group-c, May 22, 2017).

The female high school seniors in a STEM-focused academic program explained that their future STEM-field fulfills a personal goal of making a difference in people’s lives. This goal is further achieved through innovation and change. Study participants place high attainment value on STEM fields to provide the platform for positively impacting the health and wellness of
others. Therefore, choice of college major allows participants to ultimately enter a career in which they achieve their goal of impacting others in a helpful manner.

Research Question 3

How does the intrinsic value that female high school seniors in a STEM-focused academic program place on STEM fields relate to their college major choice?

In addressing research question three, the participants were instructed to respond to the following prompt in the reflective essay: Explain how your educational experiences helped you to make your decisions college and/or career decisions. Additionally, participants in the focus groups and interview were asked the following: 1) What do you like about the college major you chose? 2) How did you like the STEM-related tasks from your educational experiences?, and 3) How does it, or does not play a role in deciding your college major?

The data from the reflective essay, focus groups, and the interview was coded and analyzed, resulting in the following participant’s perspectives: 1) Participants find STEM fields interesting, 2) Participants find STEM fields enjoyable, and 3) Participants find STEM fields personally satisfying. Eccles and colleagues (1983) explained that intrinsic value is the interest or enjoyment that the individual has for completing a specific task. Therefore, these themes further explained how participants found STEM-related content areas interesting; furthermore, they also enjoyed and experienced satisfaction in STEM-related fields.

Perspective 3-1. Participants find STEM fields interesting.

Female participants in a STEM-focused academic program expressed interested in STEM-related fields. Emma explained how she finds the field of science to be the most
interesting; furthermore, Mia was even more precise in stating that other sciences were not as interesting to her as biology (Reflective essay, May 15, 2017). Sofia described in her essay that

Learning about the living world fascinated me because I could read about photosynthesis in my textbook and then use a microscope in class to view the living plant cells that actually underwent the process. The entire biology course left a lasting impression on me and helped guide me towards studying biology in college. (Reflective essay, May 14, 2017)

Gianna concurred, as she explained that through her educational experiences in her freshmen biology class, her interest in the life sciences peaked and she began developing her goal of studying medicine (Reflective essay, May 15, 2017). Mickey also has an interest in studying medicine due to, as she explained, “I have always been interested in the science aspect of things” (Reflective essay, May 13, 2017). According to Rose, her field of computer programing is extremely interesting because it can be used to support many STEM areas (Reflective essay, May 15, 2017). During a focus group discussion, Emilia and Nikki explained how their college major choice integrated the two STEM-related fields they have an interest in. Nikki explained that, since middle school, she was interested in both math and science so she figured “why not go for engineering?” (Focus group-b, May 19, 2017). Furthermore, Emilia is planning on majoring in bioengineering because her major takes “the medical side of things and … the engineering and technology side and it just puts them together” which she finds intriguing (Focus group-b, May 19, 2017). Gianna’s interest lies in life science; however, she clarified that within the life sciences, the cellular/genetic level of microbiology is the area that is most interesting to her. Both Sofia and Katy found biology and chemistry most interesting (Focus group-a, May 19, 2017; Focus group-c, May 22, 2017). However, Sofia explained that her interest has led her to choose a major in Biology (Focus group-c, May 22, 2017); whereas, Katy
is majoring in Exercise Physiology on her path to medical school (Focus group-a, May 19, 2017).

Through their reflective essay and discussions, the participants described their interest in specific STEM-related areas. Therefore, participants expressed their college major choice and future career path based on current areas of interest.

Perspective 3-2. Participants find STEM fields enjoyable.

Female participants in a STEM-focused academic program enjoyed participating in STEM-related fields. Participants described how they enjoyed their educational experiences in STEM-related fields. Furthermore, they revealed how they envision the enjoyment they would experience from their college major choice. Summer’s opportunities in her Introduction to Engineering Design course allowed her to find her passion is computer aided drafting (Reflective essay, May 15, 2017). Nikki is looking to integrate her enthusiasm for math, science, and engineering to pursue chemical engineering (Reflective essay, May 14, 2017). Maeve and Cecilia both find enjoyment in biology because they appreciate learning about what makes everything in the natural world work the way it does (Reflective essay, May 15, 2017). Cecilia discussed in detail that she “enjoyed learning concepts that explained basically everything about things around me, whether it was the molecular structure of DNA to classification of all kinds of animals” (Reflective essay, May 15, 2017). Emilia also finds enjoyment in biology and the life sciences which is why she explained that she is looking forward to a career in the medical field (Reflective essay, May 15, 2017).

STEM-related courses offer a more hands-on approach to the content. Additionally, students are given an opportunity to collaboratively problem-solve as they tackle projects with
real-world applications. Sofia’s curricular course work included STEM classes that she described required a different way of thinking than non-STEM classes. She clarified that her STEM-classes required that I asked questions to understand the problems presented to us and thought analytically and critically to generate and test the solution. I enjoyed this method of thinking and it led me to pursue a higher education and career in the STEM field. (Reflective essay, May 14, 2017)

Sofia is planning on attending medical school where she believes that she will be able to use this method of problem solving to treat her patients.

During the focus group, Maeve shared that she finds gratification in the form of debate, whereby she enjoys hearing both sides of a story. Within the area of cell research, conflict arises with moral and ethical issues surrounding this field. She offered that she would find enjoyment from applying science and evaluating issues to come up with a “happy median” (Focus group-a, May 19, 2017). Nikki’s enjoyment of solving puzzles which date back to early childhood is the reason she has chosen chemistry as a college major as she described how chemistry is like “solving puzzles” (Focus group-b, May 19, 2017). For Jessie, she prefers designing things and to be able to “integrate solid scientific concepts with more theoretical or like abstract concepts and ideas” which led to her college major (Focus group-b, May 19, 2017). What is interesting about the areas of STEM-field that sparks Sofia, Maeve, Nikki, and Jessie’s enjoyment is not as content specific as with the other study participants. They find enjoyment in finding a solution to a problem; therefore, their college major choice was due to their passion for the processes found within STEM fields. Kara also expressed how her educational experiences in STEM fields were “awesome”; she especially enjoyed designing things, working with tools, and watching projects come together (Interview, May 19, 2017). However, unlike the other study participants, Kara’s
major is not in STEM fields, yet her future career in business will require collaboration on projects (Interview, May 19, 2017). While chose a major outside of STEM, she will still be able to apply the problem solving aspects of STEM, which she enjoyed, to projects in the business world.

The participants found enjoyment from working with others to find solutions to relevant real-world scenarios. Their STEM-related experiences offered an opportunity to tackle inquiry-based projects and solve puzzles, which the participants appreciated. Thus, the participants’ choice of college major and future career may also provide similar experiences through which they can collaborate and problem-solve, two examples in which the participants found enjoyment.

Perspective 3-3. Participants find STEM fields personally satisfying.

Female participants in a STEM-focused academic program found personal satisfaction from participating in STEM-related fields. For example, Maeve explained that she wanted the challenge that comes from majoring in a STEM field, and she believes that it will “be complicated and rigorous but [have a] rewarding outcome” (Focus group-c, May 22, 2017). The driving force for Gianna’s college major is how STEM is more enriching than other majors (Focus group-c, May 22, 2017). Aru finds satisfaction from participating in STEM-related fields because there are few females in STEM; therefore majoring in this area, as she exclaimed, “kind of made me feel like … kind of special” (Focus group-b, May 19, 2017). For Aru, succeeding in a male dominate fields will provide her with personal satisfaction. Emilia views her experience in STEM through the lens of courage, as she finds satisfaction by incorporating her strengths of
technical and medical writing with areas of math and science in which she is trying to improve upon to create something more (Focus group-b, May 19, 2017).

For Rose, satisfaction will come from finishing her STEM degree. She explained that a degree in STEM illustrates your capability “even if you are naturally gifted with STEM stuff it takes a lot of hard work… so I think that it shows you are capable of persevering (Focus group-b, May 19, 2017). However, Sofia envisions the fulfillment that will come from using her degree as she explained, “when I graduate, I want to get a job and I want to do work that I am proud of. So it [personal satisfaction] definitely influenced me” (Focus group-c, May 22, 2017). Catlin and Sam also described the work that they will be able to accomplish with their Computer Science degrees. According to Sam and Summer, they both like the coding component of computer science and the satisfaction of writing the code and seeing what was created actually work. Jessie agreed with the personal satisfaction comes from completing what she thought were impossible projects offered in STEM fields (Focus group-c, May 22, 2017).

The female high school seniors in a STEM-focused academic program described their interest in diverse STEM fields; furthermore, they enjoyed the work that is required for participation in the STEM program. Through these experiences, participants explained that they found personal satisfaction from completing these challenging projects. Consequently, participants aligned their choice of college major to future career goals that may continue to hold their interest, to find enjoyment, and to provide personal satisfaction.
Research Question 4

How does the utility value that female high school seniors in a STEM-focused academic program place on STEM fields relate to their college major choice?

In addressing research question four, the participants were instructed to respond to the following prompts in the reflective essay: How or why do you think you will be successful in your future career? Explain how your educational experiences helped you to make your decisions college and/or career decisions. The focus groups were asked the following questions pertaining to this research question: Do you believe that your college major will provide you with more and better career opportunities? Why? Or why not? The researcher followed up by asking: How do (or do not) you think your experiences in STEM field will help you fulfill your potential, and How does it, or it does not relate to your college major choice? Furthermore, participants in the focus group were also asked the following: Do you believe that your college major will help you fulfill your potential?

The data from the reflective essay, focus groups, and the interview was coded and analyzed resulting in the following participant’s perspectives: 1) Participants believe that STEM fields are useful because they provide relevant skills for the future, and 2) Participants find future academic and career opportunities in STEM fields. Wigfield and Cambria (2010) described how well a task fits into future plans as the utility value.

Perspective 4-1. Participants believe that STEM Fields are useful because they provide relevant skills for the future.

Female participants in a STEM-focused academic program explained that STEM-related fields provide useful and relevant skills for the future. Through the reflective essay, participants
explained how their educational experiences in STEM fields provided skills that are beneficial for their future endeavors. In addition to content specific skills, many participants also discussed the “soft skills” that were developed during their STEM-coursework. Gianna described her skills development through projects in her coursework, “every engineering project was a network of formal business presentations, months of teamwork, and growth of interpersonal skills. It was the soft skills that turned out to matter the most” (Reflective essay, May 15, 2017). Aru expounded on how critical and important collaboration will be in her future career in architecture, “Architects have to be very collaborative, bringing different types of experts, to create and conduct the progress of the construction of a building” (Reflective essay, May 15, 2017). Furthermore, Aru along with Sofia, Cecilia, Emma, Nikki, and Jessie explained that in addition to content knowledge, problem solving skills are essential for their future careers in STEM fields. Jessie clarified that through her STEM-classes she “quickly learned to view my math, physics, and technical knowledge as a toolbox for problem solving, a repertoire for my ability to create innovative and inventive solutions to design projects” (Reflective essay, May 15, 2017).

While the participants in a STEM-focused academic program developed a specific skill set necessary for success in STEM fields, this skill set is transferable to other fields as well. Kara explained that while she is not majoring in a STEM-field, her experiences in STEM provided opportunities for critical thinking, problem solving, and thinking outside the box which she clarified will be helpful in her future in business (Interview, May 19, 2017). Gianna, Faith, and Sofia explained how beneficial STEM is for gaining a specific skill set. Faith offered that by just earning a STEM degree provided a useful skill set (Focus group-c, May 22, 2017), and Sofia agreed in how “there is the same skill set that you use it's the same problem-solving/critical thinking that you use in every STEM field” (Focus group-c, May 22, 2017). Rose focused on the
technological skills cultivated through STEM as “very important in most careers now a days… because technology is literally everywhere you have to have some basic understanding in order to be able to succeed in your career” (Focus group-b, May 19, 2017).

In addition to technology being embedded in all career paths, skills including critical thinking, problem-solving, and collaboration were also useful in diverse fields. STEM fields offer participants with an opportunity to integrate technology in across a variety of contexts as they develop innovative solutions in their future careers.

**Perspective 4-2. Participants find future academic and career opportunities in STEM fields.**

Female participants in a STEM-focused academic program explained that participation in STEM-related fields offers great opportunities in an academic or career setting. Many participants (including Faith, Michelle, Sam, Mickey, Summer, Julie, and Rose) explained that STEM fields offer diverse paths in which they can explore. Katy discussed how she set up her ungraduated program so that she would have many different options and opportunities. With STEM fields, Julie explained that in addition to working in other STEM fields besides her intended agricultural or bioengineering major, she could also go into politics where she could use her STEM content knowledge to change environmental legislation. According to Michelle, individuals in STEM fields problem solve which she believes would make her more marketable for law school if she chooses that path (Reflective essay, May 15, 2017). Even Kara, who is not pursuing a STEM-related major, offered that she is contemplating patent law as it combines her major of business along with high school engineering experience.

Mickey described STEM fields as “the work you have to do can lend itself to so many other different fields too and there are so many different opportunities you could get from that”
Sofia commented that by majoring in biology and chemistry, it “will open the door to countless opportunities” as she explained that she could go into either medicine or research (Reflective essay, May 15, 2017). Faith explained that her area of focus is lens design which is in high demand due to the few qualified individuals who specialize in this area (Focus group-c, May 22, 2017); therefore, her STEM major will provide her with greater career opportunities. Michelle is confident that her education in a STEM-field will open opportunities within the medical community,

there are different things I can do with the education I will receive by completing medical school. For example, I can travel to third world countries to provide aide, conduct medical research, or actually practice medicine with a few tweaks in my education/priorities. There are many different paths in the medical field that I can explore in medical school in order to find the correct one for me. (Reflective essay, May 15, 2017)

Finally, Rose and Summer explained their excitement for the variety of careers they could choose from with their Computer Science (CS) degrees. Rose explained that “CS is the one major in the STEM field that really allows you to explore other subjects, since it’s a subject that’s applied to every single potential career field” (Focus group-b, May 19, 2017). Summer offered, “there are so many applications for computer science that's why I'm still exploring my options within computer science. It's so broad that you can pretty much expand [computer science] into other fields” (Focus group-c, May 22, 2017). The consensus from the participants is that jobs in STEM fields are the fastest growing which offers greater opportunities for STEM-majors.

The female high school seniors in a STEM-focused academic program explained that their experiences in STEM fields provided them with an opportunity to develop a diverse skill set that is applicable to a variety of college majors and future careers. The participants may or
may not have a STEM-related field as their college major choice or future career goal; nevertheless, they described how a background in STEM lends itself to greater opportunities in college and career.

Research Question 5

How do the expectancy and value constructs collectively affect female high school seniors in a STEM-focused academic program college major choice?

Eccles et al. (1983), Eccles et al. (1998), and Hulleman et al. (2016) explained that the expectancy for success and the perceived attainment, intrinsic, and utility value placed on a completing a particular task influences future task choice. Therefore, if a female high school student in a STEM-focused academic program has an expectation that she will achieve or not achieve success in STEM-related fields, then these beliefs will influence her future college major choice. However, each value construct placed on STEM-related fields is also an influential factor for choice of college major. Through the analysis of the focus groups transcripts, interview transcript, and reflective essays, the following findings were developed:

1. Female high school seniors expect success in the STEM fields that they find interesting, enjoyable, and worthwhile.
2. Female high school seniors find pleasure and personal satisfaction using STEM fields to make a difference in the lives of others.
3. Female high school seniors believe that STEM fields provide future career opportunities in which to help people because STEM fields are innovative.

Table 6 illustrates how each finding relates to the expectancy or value construct in each research question.
Table 6

Findings Related to Constructs Represented in Each Research Question

<table>
<thead>
<tr>
<th>Findings</th>
<th>Expectancy for Success</th>
<th>Attainment Value</th>
<th>Intrinsic Value</th>
<th>Utility Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Female high school seniors expect success in the STEM fields that they find interesting, enjoyable, and worthwhile.</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>2. Female high school seniors find interest, enjoyment, and personal satisfaction using STEM fields to make a difference in the lives of others.</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Female high school seniors believe that STEM fields provide future career opportunities in which to help people because STEM fields are innovative.</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

**Finding 1:** Female high school seniors expect success in the STEM fields that they find interesting, enjoyable, and worthwhile.

Female high school seniors in a STEM-focused academic program had the ability to field test STEM fields through job-shadowing, mentorships, and STEM coursework. These opportunities provided a platform to develop their interests in diverse STEM fields, confirming areas in which they have or do not have intrinsic value. Additionally, these opportunities may further develop their identity thus molding their attainment value.

Participants tend to have greater confidence for success in areas in which they find worthwhile, find interest, and enjoy. Maeve who is planning on majoring in biomedical engineering explained how fulfilling it will be to assist others through work in her major of choice; furthermore, she described how the attainment value placed on her biomedical engineering major increased her confidence to be successful in STEM fields. “It's ok to like the
work you do and will eventually prove that you did something great with your time. I guess [helping people] was rewarding and that helped with our confidence” (Focus group-a, May 19, 2017). While Katy described how she enjoyed learning about biomechanics and then interacting with people and applying what she learned to help patients; consequently, she learned how to work harder to be successful because the work is so important (Focus group-a, May 19, 2017). The application of STEM fields represented may be interpreted as value constructs; furthermore, this application relates to expectancy beliefs.

Many participants described how their interest and importance placed on STEM fields relates to their expectancy to be successful in STEM. Maeve liked the idea of choosing a challenging major, as she explained that, “when it’s something you care about you don’t necessarily feel like it’s hard”. Julie is confident that she will succeed her college major because she as a passion for the environment and really enjoys the content; therefore, it was always her focus and drives her to work hard (Focus group-b, May 19, 2017). Kara is choosing not to major in a STEM-field; yet, she explained that she applied to the STEM-focused academic program because she was always interested in STEM and thought she wanted to go into STEM fields (Interview, May 19, 2017). Moreover, her interest also lies in business. She explained:

At first, I thought I wanted to be an architect and then maybe an engineer because I am interested in STEM, but I always have been interested in business. And I don’t know I’m not really good at math and science so I feel like business is a better fit for me… there is still a lot of room in that field for different aspects, so I can still work for an engineering firm even with a business major. (Interview, May 19, 2017)

Therefore, she explained how her college major college major choice is due to both interest and expectancy to be successful in her future career. However, due to her belief in STEM importance, she has the ability to apply her business degree in a STEM context.
Participants described their interest in specific areas of STEM along with their expectancy to be successful in the STEM fields prior to entering high school. The participants’ intrinsic value placed on STEM fields as they relate to positive expectancy beliefs were illustrated as they explained why they choose to apply to the STEM-focused academic program. The participants described that their interest and enjoyment for STEM-related fields along with their expectancy to be successful in STEM fields was their motivation for applying and attending the STEM-focused academic program. Nikki explained how she “was super interested in science and math all through middle school. It was my favorite subject always science and I was good at math so I figured why not go for engineering”. For Nikki, the constructs that influenced her decision to attend a STEM-focused academic program were her interest, enjoyment, and prior success in math and science. While Katy offered, “I like science stuff … I talked to my 7th grade science teacher and she says you should do it you're smart enough … she said I had potential so I went with it [STEM]”. Mickey agreed with Katy as she also described how she “really enjoyed the sciencey classes… and was good at it. I was interested in going into biomedical engineering even in middle school so I thought that this was the best school” (Focus group-a, May 19, 2017). Through their dialogue, the participants illustrated that choosing a STEM-focused academic program was because they found STEM fields to be interesting and enjoyable; additionally, they experienced prior success in those STEM-related areas. The STEM-focused academic program gives participants an opportunity to take diverse courses in STEM fields which may or may not confirm their interest in STEM fields. Furthermore, their experiences in STEM fields provided further opportunities to experience or not experience success.

The participants in the focus group were then prompted with the following question: Why do you see yourself as successful in the STEM field that you chose? Participants may or may not
have revised their value and expectancy beliefs due to their high school experiences. The participants’ perceptions of intrinsic value placed on STEM fields related to their expectation for success in their college major choice. Sofia explained that she has had experiences in a variety of STEM fields and even if her interest changes from one STEM-field to another, she has confidence that she will still be successful.

We're going to be successful because we have had exposure to a lot of different topics within STEM… we know that if we choose a major and we don't like it we can switch it to something else. So if I don't like biology, I can switch to computer science and I know that I have been exposed to it here and I did well. (Focus group-c, May 22, 2017)

Katy also described how she has “a passion for this stuff [STEM] and… I’ve been interested [in] doing medicine for my entire life pretty much…the [STEM-focused academic program] and high school, in general, I've learned how to work harder [to be successful]” (Focus group-a, May 19, 2017). The participants in this study have an interest and passion for a variety of STEM fields. Due to their interest and passion, the participants still had confidence that they will be successful in their STEM related college major choice. However, if their interests change to a different STEM-field, they are confident that they will also be successful in this alternative choice of college major.

By field testing STEM fields, participants had an opportunity to explore areas they were interested in and also areas they had never experienced whereby new interests may have been discovered. Julie and Sofia explained the intrinsic value placed on STEM fields along with their expectancy for success in STEM fields.

Julie: I think that what’s going to make us all successful … we have more engineering experience from just classes we took PLTW [Project Lead the Way] classes and those of us that took the biology classes that were interested in biology and those that took the classes that were medically oriented for me those are going to help me in my major. (Focus group-b, May 19, 2017)
Sofia: I expect myself to do well because I performed well in all my [STEM] classes so that kind of told me I had an inclination towards a STEM field so I wasn’t afraid to choose a field like biology or chemistry … I knew I could do well because of my previous exposure, I took these classes as electives… I find them interesting… [I] have previous success in high school with those topics. (Focus group-c, May 22, 2017)

As described by Julie and Sofia, their choice of a STEM-related college major was influenced by the intrinsic value placed on STEM fields; furthermore, they explained that they were also successful in area that they have interest. Through their experiences in the STEM-focused academic program, the participants had an opportunity to be exposed to a variety of STEM fields in which they can further explore their fields of interests as well are different STEM fields. These experiences can then lead to greater expectancy for success in diverse STEM fields thus influencing college major choice.

Female high school seniors in a STEM-focused academic program chose this program due to positive expectancy beliefs in STEM fields along with intrinsic value placed on STEM fields as 8th graders. Through their high school experience, the STEM-focused academic program offered participants an opportunity to field test STEM-related careers. Thus, those participants that retained their intrinsic value placed on STEM fields led to expectancy for success in STEM fields which relate to a college major choice in a STEM-field.

These findings support Eccles and Wigfield’s (1995) research which argued that positive expectancy beliefs relate to attainment and intrinsic value. College major choice is related to the intrinsic value and attainment value placed the STEM fields. Furthermore, these values placed on STEM fields relates to the expectancy for success in STEM areas.
Finding 2: Female high school seniors find interest, enjoyment, and personal satisfaction using STEM fields to make a difference in the lives of others.

Female high school seniors in a STEM-focused academic program believe that STEM fields provide an opportunity to help others through research and innovation. The participants enjoyed the personal satisfaction offered through STEM fields and look forward to continuing this fulfilling work in their future careers. The participants were asked if being successful in a STEM field will make you feel good about yourself in the future. Through this prompt, many participants suggested that to be a success was driven by doing work in which they deemed important. Helping others fulfilled a need to give back; furthermore, participants explained that they found enjoyment in activities that required innovation, which could then be used that make a difference in people’s lives. Maeve and Michele describe how STEM fields can provide a platform for research and innovations in which they can utilize to help others. For Nikki, “I like solving puzzles… [in a STEM-field], I have solved the puzzle…I am going into research. I want to go into something where I can help people”. While Michelle explained that “STEM-jobs are focused towards helping people and helping the planet…everyone here wants to do something along those lines… it’s the day to day helping people that will also make us feel good”. These comments were confirmed by other participants through aggressive nodding (Focus group-a, May 19, 2017). The participants defined success as the ability to use their college major choice to help others. They found enjoyment through their ability to make a positive influence on someone’s life; additionally, this trait was an important component of their identity. For Michelle, the medical field seems the most aligned with her interests in math and science; furthermore, it is the most straightforward way to help others (Reflective essay, May 15, 2017). Sam enjoys working in a STEM field, as she further explained that within in STEM fields, “there
so much room to help other people and you can see the visible work like right in front of you and so that satisfaction is kind of going to be good” (Focus group-c, May 22, 2017).

Careers in STEM fields provide participants with a means to work with people in a variety of settings. The consensus amongst participants was the importance of attainment value placed on STEM fields. In addition to the satisfaction that comes from positively impacting the lives of others through research and innovation, participants expressed the enjoyment they experience in the process.

Finding 3 Female high school seniors believe that STEM fields provide future career opportunities in which to help people because STEM fields are innovative.

STEM-related fields are growing at a faster rate than non-STEM fields (Atkinson & Mayo, 2006; Hossain & Robinson, 2012; Langdon et al., 2011). The rapid growth in STEM fields is due to the quest for innovation, which is responsible for improving our way of life (Adkins, 2012). Careers in STEM fields are in high demand and offer participants with an opportunity to help people through innovation.

Participants shared their perspectives of their college major choice for the profession they envisioned themselves exploring. Maeve described her goal of helping people through her major in Bioengineering. “I believe that there is a lot of progress that needs to be made with applying science to those suffering. People’s bodies will not always be perfect ... this creates a demand that I can and will fulfill” (Reflective essay, May 15, 2017). Maeve explained that the demand is created through career opportunities, as she explained that “[STEM] is such a growing field. Especially, if you are thinking about engineering and computer science… medicine can [not] be outsourced. They [STEM professionals] are always going to be in need… to create new technology…as the population grows” (Focus group-a, May 19, 2017). According to Michelle,
she is planning on going to medical school after earning her degree in chemical engineering. In describing her future plans she stated, “There are different things I can do with the education I will receive by completing medical school. I can travel to third world countries to provide aide, conduct medical research, or actually practice medicine” (Reflective essay, May 15, 2017). Michelle further explained the variety of opportunities that will be available with her education in STEM fields.

It [STEM] is a growing industry so …there are a lot of opportunities for after college to get a job to do what you want. I just feel like a lot of people are looking for it [STEM careers] right now. Employers are looking for people… who can help people from their knowledge [and] can apply their own knowledge…to problem solve. (Focus group-a, May 19, 2017)

Sam also described how her major in biology and computer science provides a choice of career paths in which to impact the lives of others, “I will be able to take my career plans further to help those in need of medical assistance with a major in STEM, I could become a doctor or a computer scientist” (Reflective essay, May 15, 2017). Maeve, Michelle, and Sam’s choices of college majors are in three different STEM fields; however, they are all planning on going on to medical school which they explained offers a variety of professional opportunities to help others.

As illustrated by Maeve, Michelle, and Sam, the attainment value placed on STEM fields provided an opportunity to help people. Furthermore, there is an increase in demand for innovative STEM-careers which may lend itself to many different career opportunities. Participants hope to use their college major choice to develop new technology that could increase the quality of life for the growing population.
Conclusion

This chapter provided the findings of this qualitative case study. The findings were developed from the themes that emerged from the analysis of the data collected from reflective essays, focus groups, and interview addressed the research questions. The findings were discussed according to research question 1-4 and then as they related to each other.

In addressing the first research question related to expectancy to be successful in STEM fields related to college major choice, female high school seniors in a STEM-focused academic program explained that exposure to experiences in STEM-contexts provides opportunities to experience success in STEM-related fields. Additionally, prior success in STEM-content areas, increased confidence to be successful in STEM-related fields. The second research question addressed attainment value placed on STEM-field related to college major choice. The participants explained that STEM-related fields drive innovation and change; furthermore, STEM-related fields make an impact on lives. The third research question focused on intrinsic value placed on STEM fields related to college major choice. The participants described how STEM-related fields are interesting, offer enjoyment through STEM-context, and provide personal satisfying experiences. The final research question related utility value placed on STEM fields and college major choice. According to the participants, STEM-related fields are useful and relevant skills for the future; moreover, these fields provide future academic and career opportunities.

In addressing the final research question, the constructs of expectancy and attainment, intrinsic, and utility value for STEM fields are integrated and collectively affect choice of college major. Female high school seniors in a STEM-focused academic program expressed confidence to be successful in the STEM fields they find interesting, enjoyable, and worthwhile.
Additionally, when the participants are interested and find enjoyment from participating in STEM fields, they experience greater expectancy for success in these fields. The participants also found enjoyment and satisfaction through the use of research and innovation inspired by STEM-related fields to make a difference in the lives of others. Furthermore, STEM-related fields drive innovation which provides female high school seniors in a STEM-focused academic program increased future career opportunities to impact people’s lives.

In the following chapter, the findings are discussed in connection to the current literature. In addition, the limitations and recommendations are presented.
CHAPTER 5

DISCUSSION, LIMITATIONS, RECOMMENDATIONS, AND CONCLUSION

The purpose of this case study was to examine female high school seniors in a science, technology, engineering, and mathematics (STEM)-focused academic program. The research focused on expectancy beliefs in STEM fields along with the attainment, intrinsic, and utility value placed on STEM fields as they relate to female high school seniors in a STEM-focused academic program intended college major choice. This case study was designed around 19 high school seniors in a STEM-focused academic program at Arlington Estates High School (pseudonym). Through a qualitative research approach, data from three sources including reflective essays, focus groups, and interviews were analyzed to gain an understanding of the participant’s perceptions and to develop key findings to answer the research questions.

This chapter discusses the findings of this study as they relate to the literature. Additionally, this chapter discusses the limitations along with recommendations for teachers, curriculum administrators, district administrators, and future research.

Summary of the Findings

Each of the 19 participants completed a reflective essay in which they identified their intended college major choice, explained their career goals, and described their educational experiences that were helpful in the decision-making process. Utilizing the intended college major choice responses from each reflective essay, the 18 participants who indicated that they
had chosen a college major in a STEM-related field took part in one of three focus groups. The only participant that specified a college major outside of STEM was interviewed. Through the reflective essays, the focus groups and interviews participant’s perceptions of STEM fields, along with key findings, emerged to address each research question. Figure 3 illustrates participants’ perspectives and key findings as they relate to choice of college major.

In addressing the first four research questions, the participants described how exposure to experiences in STEM-contexts provided opportunities to experience success in STEM-related fields; furthermore, their confidence to be successful in STEM-related fields increased due to prior success in these areas. The participants chose a college major in a field they were confident that they would experience future success. In describing the attainment value placed on STEM fields, the participants explained that STEM-related fields drive innovation and change; moreover, STEM-related fields make an impact on lives. The college major that would provide participants with an opportunity to fulfill their personal need to help others was a significant factor in choosing that specific major. Intrinsic value was placed on STEM fields as participants described these fields as interesting, enjoyable, and providing personally satisfying experiences; furthermore, participants had hoped to continue exploring these areas by choosing a major in a STEM field. Finally, STEM-related fields have utility value because they are useful in providing relevant skills for the future; moreover, these fields also offer future academic and career opportunities. Therefore, participants who choose to major in a STEM field because that major will most likely assists in achieving future goals. Each of these constructs are outlined by Eccles and colleagues’ (1983) expectancy value model, including expectancy to be successful in STEM
Female high school seniors expect success in the STEM fields that they find interesting, enjoyable, and worthwhile.

Female high school seniors find pleasure and personal satisfaction using STEM fields to make a difference in the lives of others.

Female high school seniors believe that STEM fields provide future career opportunities in which to help people because STEM fields are innovative.

Figure 3. Summary of participants’ perspectives and key findings. Adapted from Eccles et al. (1983), Wigfield (1994), Wigfield et al. (2004), Wigfield & Eccles (2000, 2002), and Wigfield et al. (2009) expectancy and value model.
fields, the attainment value, the intrinsic value, and the utility value placed on STEM fields relate to college major choice.

The final research question was developed after the analysis of each data instrument to gain a greater understanding of how the constructs of expectancy and attainment, intrinsic, and utility value for STEM fields are integrated and collectively affect choice of a college major. Female high school seniors in a STEM-focused academic program described that the content areas in which they find interesting, enjoyable, and worthwhile, increased their expectancy beliefs to be successful in that content area. This assisted them in their choice of college major. The participants described how STEM-related fields inspire research and innovation which can be used in to make a difference in the lives of others. Moreover, a college major in a STEM-related field offers future career opportunities in which they can help others. Collectively, expectancy beliefs along with attainment, intrinsic, and utility values placed on STEM fields relate to college major choice.

Discussion

Choice of College Major Is Related to Content and Skills Within STEM Fields Rather Than Specific Content Areas

The participants’ college major choices seem to be based on skills and knowledge across many STEM disciplines. Although participants chose a specific college major (i.e. biology or chemistry), STEM-related content and skills are integrated across all STEM fields and not specific to their particular major. For example, professionals in STEM fields, including mathematicians, engineers, and scientists, integrate STEM skills along with STEM content knowledge to be successful in their careers. The study participants have experienced many
STEM fields which have led to the development of skills that are transferable to multiple STEM college majors; consequently, they are not committed to one STEM field. According to Hemmingway (2016), STEM has been defined in the following manner 1) each of the following disciplines: science, technology, engineering, and mathematics, 2) an integration of two or more disciplines, or 3) the integration and real-world application of two or more disciplines. Sanders (2009) along with Tsupsos and colleagues (2009) described STEM instruction to include an interdisciplinary approach to learning in which students apply science, technology, engineering, and mathematical concepts in preparation for utilization in real world contexts. The participants in this study placed value across multiple STEM fields, thus value is not limited to only one STEM discipline. The current research supports Scott (2012) as she explained that through integrated learning experiences, students move from STEM interest, to competency, and finally to expertise which can translate to expertise across many STEM-related fields. Hence, content knowledge in science, technology, engineering, and mathematics along with the development of a skill set can be utilized across all STEM college major choices; whereby, the participants do not seem to be concerned with being committed to one college major choice.

The content knowledge and skill set cultivated by various experiences in areas of STEM were described as a “toolbox” which can be transferable amongst STEM fields. Several participants described how every STEM field uses the same collaboration, problem-solving, and critical-thinking skills which, for many, were practiced daily. Through acquisition of skills and STEM content knowledge with which to stock their “toolbox”, participants had positive expectancy beliefs to be successful in many STEM fields. The participants have the tools in their “toolbox” that can be transferred to any STEM college major; consequently, the participants believe that they can switch their major to another STEM discipline and still experience success.
The intended college majors for 18 of the 19 study participants are in a STEM field including but not limited to bioengineering, chemical engineering, computer science, biology, and exercise physiology. The career goal for many participants is to utilize her degree in a STEM field to make a difference in the lives of others. These attitudes and values are supported by the literature as Bryan and Henry (2008) and Stolle-McAllister (2011) described how participants gain the necessary skills and knowledge to succeed through STEM focused experiences; moreover, participants developed the confidence that they could be successful in accomplishing their goals and have an effective role in the world. The current research illustrates that choosing a STEM college major is due to expectancy beliefs along with attainment value for STEM fields. However, participants are confident that if they switch their major, they will still be successful and have the ability to help others, thus illustrating their belief that choice of STEM fields are interchangeable with a well-equipped “toolbox”.

The 19 female high school seniors’ choice of college major seems to be driven by the ability to help people. For example, many of the participants are planning on using their college major for a future career in the medical field in which they can impact the lives of others; however, their choice of a college major is in diverse STEM fields. Therefore, attainment value seems to be accomplished from a variety of college major choices. The uniform sense of purpose among the participants was to utilize her STEM college major choice to attain a career in a STEM field. Through their further career aspirations, they believe that they could create solutions for real world problems. Even the sole participant that has chosen a college major outside of the STEM hopes to use her major to help others. These attitudes among these participants seemed to be a cultural belief found within the case study. Wigfield et al. (2004) have suggested that students place greater importance for tasks consistent with their cultural
beliefs. Additionally, these cultural beliefs may include the importance or value placed on educational pursuits. The cohort setting of the STEM-focused academic program may provide a culture within STEM in which the perceptions of those that belong are that of needing to assist others. The consensus among the participants is also supported by McAllister (2011) and Robnet (2013) as they suggested that supportive peer networks emphasizing STEM achievement and the extent the participants valued STEM, influenced the next educational choice in STEM (i.e., majoring in a STEM-related field). Moreover, as argued by Hulleman et al. (2016), it is essential that students perceive an importance for completing a task (e.g., STEM college major choice) to have a positive outcome on that task. The primary cultural belief of the participants is to utilize innovation and problem-solving to make a difference in the lives of others. Therefore, if they do not find interest in one specific area of STEM, then they can switch to a different STEM domain and still find success along with having a career platform in which to assist others.

**Choice of College Major Seems to Be Collectively Related to Expectancy Beliefs and Task Value Perceptions.**

Senior year of high school is when many students finalize their future academic choices. While these choices include choosing their college or university, they also include their major of study at that educational intuition. Bembenutty (2008) suggested that students are most likely to choose activities they think they can succeed in and situations they value. Therefore, college major choice is related to expectancy and value beliefs. In this current study, the female high school seniors in a STEM-focused academic program discussed their reasons for choosing or not choosing a college major in a STEM-related field.

In this study, the participants’ expectancies to be successful in STEM fields along with her attainment, intrinsic, and utility value placed on STEM fields seem to play a role her college
major choice. For example, the participants tend to have greater expectancy for success in areas in which they find interesting, enjoyable, and worthwhile. Thus, the intrinsic value and attainment value placed on STEM fields collectively influenced expectancy to be successful in these fields. The utility value placed on STEM fields also influenced the attainment value placed on STEM fields. And finally, the attainment value increased the intrinsic value place on STEM fields.

The participants that placed attainment and intrinsic value on STEM fields had increased expectancy beliefs in these fields thus choose STEM as a college major and future career choice. These conclusions are supported by a study conducted by Ball et al. (2017) which illustrated that intrinsic and utility values positively influenced attitudes towards STEM fields; furthermore, expectancy beliefs and utility value positively influenced attainment value placed on STEM fields. Moreover, the reasons for choosing a college major in a STEM-field is supported by research conducted by Jennet (2008), Wigfield and Eccles (2000; 2002), and Wigfield et al. (2009) as they suggested that behavior (i.e. college major choice) is the interaction between expectancy outcomes and the value placed on those outcomes.

“Field Testing” Provides a Platform to Experience STEM Fields as a College Major and Future Career Choice.

Professionals in STEM fields integrate diverse content knowledge and technical skills to be successful. “Field testing” a STEM career can provide an opportunity to gain an understanding of what it would be like to work in that particular field prior to committing to a specific profession. In this current research, the participants had described their plethora of experiences in diverse STEM fields through the setting of a STEM-focused academic program. The participants completed their rigorous STEM-related courses in a cohort setting; moreover,
the students participated in job shadowing, internships, and career exploration as they gained hands-on, real-world experiences in STEM fields. According to Almarode et al. (2014), Clewell and Forenberry (2009), Executive Report to the President (2010), and Thomas and Williams (2010), educational experiences in a STEM-focused setting expose students to advanced STEM content, provide students with opportunities for exploration and discovery, connect students to real-world STEM workplaces, and provide role models from STEM professions. Collectively, these opportunities offered students a setting to field test what it would be like to work in a STEM fields prior to choosing a college major in a STEM-related field. Through their field test, the female high school participants that experienced success in STEM contexts while also finding interest and enjoyment in these fields have chosen a college major in an area of STEM.

Through exposure to rigorous curriculum comprising of honors and advanced placement courses, including many integrated courses in STEM domains, participants explored project-based learning within a multitude of STEM content areas. Additionally, utilizing an interdisciplinary approach to learning, the participants had the ability to field test STEM fields as they incorporated STEM-concepts for real world application (Sanders, 2009; Tsupros et al., 2009). Therefore, experiencing STEM fields in relevant real world settings illustrates how STEM content is not utilized independently, i.e. a chemical engineer cannot be effective in their career if they simply apply chemistry and engineering. A successful chemical engineer must holistically apply mathematics, technology, along with other sciences in her workplace. Field testing illustrates this interconnectedness; whereby, the participants had a greater understanding how course work in a STEM major is integrated. The participants that found the application of diverse STEM content in her STEM-related field test enjoyable choose to major in a STEM field.
Field testing offered participants with an opportunity to explore a variety STEM fields in real world settings; moreover, participants had the ability to see STEM in action in their future potential career. Through field testing, participants are able to make a more educated decision about how their choice of college major. Previous studies have illustrated that outreach programs that provide informal learning experiences outside of the school day have increased interest, engagement, and achievement in STEM-related domains (Clewell & Fortenberry, 2009; Duran et al., 2014; Dyer, 2004; Scott, 2012). However, these studies are limited to specific fields within STEM (e.g., technology programs or engineering camps). This current study has illustrated that through field testing across all areas of STEM, participants had an opportunity to confirm their field of interest early; furthermore, field testing also increased expectancy to be successful in her field of choice which provided confidence in her choice of college major.

The relationship between expectancy beliefs which had been developed through field testing, thus influencing choice of college major, is supported by current literature. According to Eccles et al. (1983) and Wigfield and Eccles (2000), academic choice (e.g., college major choice) and performance (e.g., expectancy to be successful in STEM fields) can be explained by students' perception of how well they can do on a particular task. Furthermore, Stolle-McAllister’s (2001) research supported increased self-confidence, sense of achievement, and expectancy for success can be achieved from common experiences obtained through a cohort setting. In this current research, the cohort is defined by the study’s case and together they experienced STEM-content, internships, and career exploration, along with the rigorous expectations outlined by the STEM-focused academic program. Crombie et al. (2003), DiLisi et al. (2011), Dubetz and Wilson (2013), Duran et al. (2014), Farland-Smith (2009), Gorman et al. (2010), Knezek et al. (2013), and Weber (2011) also suggested that through participation in
programs focusing on STEM fields, STEM content knowledge and interest towards STEM-related fields increased. Therefore, field testing STEM fields provides participants with an opportunity to experience STEM-related content in real world situations whereby expectancy beliefs may be supported or rejected which then influences the choice of college major.

Limitations

The potential pool of study participants consisted of only 19 students meeting the study participation criteria. While all female high school seniors in the STEM-focused academic program participated in the study, the demographics of this study did not represent the school or the district in which houses the setting for this case study. The majority of the participants in this study were White or Asian; furthermore, there were only two Hispanic students while African American students were not represented in this study (See Table 2). Therefore, the relationship between expectancy and value placed on STEM fields and choice of college major for all ethnic groups may be limited.

This research focuses on Eccles and colleagues’ (1983) expectancy and value placed on STEM fields related to college major choice; however, the choice of college major is the participant’s intended major which was reported prior to entering college. In this study, 18 participants indicated a STEM-related college major and only one participant indicated a non-STEM major. Therefore, the study was limited by the very small sample of students who were in the STEM program but did not anticipate choosing a STEM major.

The researcher in the study is a senior-level science teacher at the study site; therefore, the possibility exists that the participants may have a prior relationship with the researcher. The
interviewees are senior-level students the researcher may have in class; therefore, this dynamic may sway the stories being told by the respondents. As Seidman (2006) pointed out,

The interviewing relationship is fraught with issues of power who controls the direction of the interview, who controls the results, who benefits. To negotiate these variables in developing an equitable interviewing relationship, the interviewer must be acutely aware of his or her own experience with them as well as sensitive to the way these issues may be affecting the participants. (p. 99)

Therefore, the results of the study may have been limited based on the participants’ desire to please the researcher (Bogdan & Biklen, 2007); thus, the responses may not have been the participants’ true perspectives or opinions.

Recommendations

In this research, the case study was defined by the female high school participants in a setting that was a STEM-focused academic program at Arlington Estates High School. While the data in this study was confined to the 19 participants, the findings from this study may offer recommendations for teachers, curriculum administrators, district administrators, and future research.

Teachers

The recommendations for teachers include first, providing learning experiences that integrate diverse STEM content areas to solve real world problems. The experiences provided by the setting of this study including integrated STEM curriculum, inquiry and problem-based lessons, and career exploration in STEM fields were instrumental in providing a platform for students to field test what it would be like to work in a STEM career. However, the learning experiences provided by the STEM-focused academic program setting are not commonly
practiced. In many kindergarten through 12th-grade classrooms, educators do not teach in this manner because disciplines are segregated into individual courses (Breiner et al., 2012) even though the America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science (COMPETES) Act was designed to support the development of STEM education including implementation of STEM educational opportunities (Thomas & Williams, 2010).

Second, provide educational opportunities for skill development that can be utilized in a variety of academic settings. In this study, participants described the skills including problem-solving, critical-thinking, communication, and collaboration that made up their “toolbox” which are transferable to a variety of settings. The participants had positive expectancy beliefs to be successful through the acquisition of a skill set that can be used in a multitude of college majors and careers.

Third, provide opportunities in which students can cultivate their interests. In research conducted by Desy et al. (2011) concerning attitudes of male and female students towards science, the females scored lower than their male counterparts in areas of apparent ‘enjoyment of science,’ ‘motivation in science,’ ‘attitude towards science in school,’ and ‘self-concept in science’ scales. However, in this current study, participants explained that they had a variety of opportunities through internships, job exploration, and course work across all STEM domains to determine if a particular career would be interesting prior to making choices based on perceived interest.

Finally, provide multiple opportunities for students to experience success. This current study focuses on the participants’ perspectives of STEM fields as they relate to college major choice. The perceptions of the participants illustrated that exposure to experiences within STEM
fields provides students with an opportunity to experience success in these fields. In this study, participants choose a major that they believed that would experience success. These expectancy beliefs were developed through success in their projects, internships, competitions, and course work.

Teachers have the ability to increase participation in STEM fields by providing meaningful experiences to increase intrinsic value in these fields. However, teachers have harbored doubts about students’ abilities to be successful in STEM-areas (Gandara, 2001). Consequently, teachers may be less encouraging which could result in lower expectancy beliefs and may result in loss of interest in STEM domains at an early age (Sanders, 2009). However, the findings of this study suggest that when female high school seniors are interested and find enjoyment from participating in STEM fields, they experience greater expectancies for success in these fields.

**Curriculum Administrators**

It is recommended that curriculum administrators strive to create programs in which students have the ability to explore careers in STEM fields through mentorship and job shadowing opportunities. In this current research, participants had an opportunity to experience what it would be like to work in a STEM-related career. Through career exploration, participants either solidified or changed their intended choice of college major. Additionally, curriculum administrators can create curriculum in which STEM courses replicate real world applications. This case study along with research conducted by Desy and colleagues (2011) illustrates the need for changing expectancy beliefs and perceived values towards STEM domains which can be facilitated through program development. Furthermore, the setting for this case study is a STEM-
focused academic program which is an elite (or selective) program in which the STEM curriculum is integrated across all STEM domains. In this case study, participants had an opportunity for career exploration, job shadowing, problem-based learning, and real-world application in STEM-domains. Through the education experiences offered by the STEM-focused academic program, participants experienced success in STEM domains while developing a “toolbox” of content knowledge and skills that can be utilized across all STEM fields. Furthermore, through field testing participants gained a greater understanding of what STEM professions do in the field prior to choosing a college major.

District Administrators

District administrators should make efforts to hire educators who have a passion and commitment for the subject areas in which they teach. In this current study, participants described the success they experience in the rigorous course work required by the STEM-focused academic program. In order to inspire educational values and opportunities for success in STEM fields, effective educators in the classroom are essential for delivery of integrated STEM curricular content that can be applied to real world situations. Therefore, educators that are dedicated to continued professional growth to provide students with educational opportunities that cultivate interest, develop skills, and promote understanding of content knowledge should recruited by educational institutions.

While future efforts can be made to staff elementary and secondary classroom with personnel that having extensive content and technical knowledge in STEM fields, it is recommended that district administrators provide professional development opportunities and support continuing education in STEM for those educators in STEM related classrooms. In this
study, participants described how their experiences in their Project Lead the Way and STEM classes integrated content knowledge and skills from diverse STEM fields. Through these learning experiences, participants gained expectancy beliefs and value for STEM fields, which related to future academic choices. Therefore, through professional development, teachers at all levels can gain content knowledge and strategies for implementation of integrated real world STEM-related lessons. Sanders (2009) explained that effective STEM educators require pedagogies, curriculum, content, and research expertise in all STEM fields. Therefore, educators need to be supported in areas of STEM in order to increase opportunities for students to experience STEM fields.

It is also recommended that district administrators implement and support intervention programs, especially at the elementary level, to increase opportunities to experience STEM fields outside of the regular school day. In this current study, the participants described the value of internships, job shadowing, and STEM-related competitions. Each of these events occurred during the summer, after school, or on a Saturday. Through these informal learning experiences, participants gained confidence to be successful in their future college major and career choice. Wilson (2013), Gorman et al. (2010), Isaac et al. (2012), and Wender (2004) argued that intervention programs in STEM-related fields have the potential to foster academic confidence in STEM fields, which can lead to increase value perspectives in STEM. Through these informal learning experiences, participants that gain value perspective and confidence in their ability to be successful in STEM fields whereby they may elect to take more courses in STEM fields throughout their educational career.
Future Research

Further research is recommended to gain a greater understanding of the development of both male and female expectancy beliefs and value perceptions placed on STEM fields as they relate to future choices. This case study focused on the expectancy and value perspectives that female high school seniors in a STEM-focused academic program placed on STEM fields as they relate to college major choice. The findings from this study are limited to females immersed in a cohort program that integrated STEM content and experiences throughout the participant’s school day for their entire high school experience. It would be interesting to compare the male and female experience.

A longitudinal study is also recommended to focus on participants in the STEM-focused academic program expectancy beliefs and attitudes placed on STEM fields along with college major choice. Data related to expectancy beliefs and value placed on STEM fields along with intended college major choice could be collected annually after completion of each academic high school year. The results of this study could provide researchers with information on program development to be integrated at the middle school and high school level. Furthermore, students outside of the STEM-focused academic program could also be surveyed to compare perspectives of those students exposed to integrated STEM experiences and those whose courses in STEM are independent of one another.

While this current research was qualitative, the perspectives of the participants that relate to choice of college major could be quantified in a regression model as a predictor of college major choice in future research studies. The number of expectancy and value attributes possessed by a participant may act as a predictor for future choice of college major. Furthermore, future research in determining if the significance of each of the expectancy and value constructs is
weighted equally or differently may determine which constructs are more important in predicting choice of college major.

Future research is recommended to include the cost construct of Eccles and colleagues’ (1983) expectancy value model related to choice of college major. Cost may contribute to expectancy and value beliefs as increased effort or time commitment may be needed to be successful in STEM fields. Therefore, choosing a STEM college major may be influenced by willingness to make the sacrifice.

Because Arlington Estates is a high school in which the participants in the program spend four years immersed in STEM-related experiences, future research could be conducted at the elementary and middle school levels that have programs similar to the one offered by Arlington Estates High School. It would be beneficial for researchers to study younger aged students when their competence-related beliefs are beginning to develop. Eccles and colleagues (1983) have suggested that as early as six, children can assess their abilities in various domains. Therefore, gaining a greater understanding of how STEM-focused academic programs or co-curricular could influence program development at the elementary level.

This current research was limited to the demographics of the female high school seniors in the STEM-focused academic program at Arlington Estates High School. Consequently, the perspectives of expectancy and value placed on STEM fields as they relate to choice of college major of Hispanic students were underrepresented and African American students were not represented. Therefore, it is recommended that an in-depth study be conducted to include the voices of all ethnic groups to gain a greater understanding of the decision making processes for college major of all groups of students as they relate to expectancy beliefs and value placed on STEM fields.
Finally, future research could investigate the cultural beliefs of participants in a cohort setting. In this current research, the participants had a common sense of wanting to help others using their choice of college major for their future career goals. Further investigation could determine if these cultural beliefs were common amongst participants prior to entering the cohort setting or if their beliefs were cultivated by the program.

Conclusion

According to Honey et al. (2014), educational initiatives have been developed and implemented to increase the number of students enrolled in higher level STEM courses and pursuing degrees in STEM-field. While current research has explored attitudes and outcomes from participation in these initiatives there is limited research within the setting of a STEM-focused academic program. Therefore, this study addressed the gap in the research on the subject of the relationship between expectancy beliefs and value perceptions of female high school seniors in a STEM-focused academic program and their college major choice.

In completing this research study, the researcher gained a greater understanding of the importance that educational experiences in a variety of STEM fields can offer students. An integrated approach to STEM education provides students an opportunity to experience success in STEM fields while gaining expertise in content knowledge and developing a specific skill set that made up their STEM “toolbox” which can be utilized across all STEM fields. The participants had an opportunity to field test STEM fields which further increased perceptions of attainment, intrinsic, and utility value placed on STEM fields. Collectively, these expectancy beliefs and value perceptions influenced choice of college major. The participants that had positive expectancy for success in STEM fields along with high attainment, intrinsic, and utility
value placed on STEM fields have indicated that they are intending on majoring in a STEM-related college major and pursuing a career in a STEM field.

The findings of this research are encouraging as the number of jobs in STEM fields is increasing while there is a concern as to who is going to fill these positions (Atkinson & Mayo, 2006; Hossain & Robinson, 2012; Langdon et al., 2011). In this research, the female high school seniors participating in a STEM-focused academic program have experienced success and value the potential from participating in STEM fields, which may have assisted in their decision to major in a STEM-field and pursuing a career in these growing fields.
REFERENCES


APPENDICES
APPENDIX A

STEM-FOCUSED ACADEMIC PROGRAM PARTICIPANTS’ FUTURE PLANS REFLECTIVE ESSAY
STEM-Focused Academic Program and Future Plans

Reflective Essay

In at least one page, or in a few paragraphs, write a reflective essay that addresses the following prompts.

If you have decided on a college major, what do you plan on majoring in? What profession do you see yourself working in 5 years from now? How or why will you be successful in your future career? Explain how your educational experiences helped you to make your decisions college and/or career decisions.
APPENDIX B

STEM-FOCUSED ACADEMIC PROGRAM PARTICIPANTS’
FOCUS GROUP PROTOCOL
Focus Group Questions-STEM Majors

1. Please introduce yourself and explain why you decided to apply to the STEM-focused academic program in high school. (Introduction)

2. Describe your college major and what type of career do you envision yourself exploring. (Introduction)

3. What do you like about the college major you chose? (Intrinsic Value)

4. Why do you see yourself being successful in STEM field you chose? (Expectancy)

5. How does your expectation for your success in STEM fields relate to your college major choice? (Expectancy)

6. How important do you think it is to pursue a STEM field for your future? How does the importance of a STEM field play a role in your college major choice? (Attainment Value)

7. Do you feel that being successful in a STEM fields would make you feel good about yourself in the future? Why? Or why not? (Attainment Value)

8. Do you believe that pursuing a STEM field is important because it will provide you with better career opportunities? Why? Or why not? (Utility Value)

9. Do you believe that your college major will help you fulfill your potential? (Utility Value)

10. Imagine you’ve graduated with a degree in a STEM area. (Conclusion)
    a. What’s next for you?
    b. What do you imagine yourself doing on a day-to-day basis?
    c. What would you say it takes to be good at your profession?
APPENDIX C

STEM-FOCUSED ACADEMIC PROGRAM PARTICIPANTS’ INTERVIEW PROTOCOL
Interview Questions – Non STEM Majors

1. Please introduce yourself and explain why you decided to apply to the STEM-focused academic program in high school. (Introduction)

2. Describe your college major and what type of career do you envision yourself exploring. (Introduction)

3. How did you select your college major? Why do you think you will be successful in that field? (Expectancy)

4. What do you like about the college major you chose? (Intrinsic Value)

5. How did you like or the STEM-related tasks from you educational experiences? How does it, or does not it play a role in deciding your college major? (Intrinsic Value)

6. How valuable is it to pursue your chosen college major for your future? (Attainment Value)

7. Do you think that your skills and knowledge about STEM make you feel good about yourself? How does it, or does not it play a role in deciding your college major? (Attainment Value)

8. Do you believe that your college major will provide you with more and better career opportunities? Why? Or why not? (Utility Value)

9. How do (or do not) you think your experiences in STEM field will help you fulfill your potential? How does it, or it does not relate to your college major choice? (Utility Value)

10. Imagine you’ve graduated with a degree in ______________. (Conclusion)

   a. What’s next for you?

   b. What do you imagine yourself doing on a day-to-day basis?

   c. What would you say it takes to be a good ______________
APPENDIX D

SAMPLE CODES OF PARTICIPANTS’ PERSPECTIVES AND KEY FINDINGS EXTRAPOLATED FROM THE DATA
Sample Codes of Participants’ Perspectives and Key Findings Extrapolated from the Data

<table>
<thead>
<tr>
<th>Provisional Coding</th>
<th>In Vivo Coding</th>
<th>Perceptions</th>
<th>Findings (Construct)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expectancy Beliefs</td>
<td>• be exposed to more advanced technologies and engineering principles</td>
<td>• prior STEM success and confidence to be successful in STEM fields</td>
<td>expect success in the STEM fields that they find interesting, enjoyable, and worthwhile</td>
</tr>
<tr>
<td></td>
<td>• projects has helped and also the internships and job explorations</td>
<td>• help me believe in my own abilities.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• to be successful because we have had exposure to a lot of different topics within STEM</td>
<td>• have confidence knowing that we figure it out and if we can't then we know there is someone there to help</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• can do this</td>
<td>• successful in my future career because of the way the STEM program has taught me</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• more confidence in what I am doing</td>
<td>• really improving me academically in confidence</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• not good at math and science</td>
<td>• be going into it with a solid background in engineering</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• a solid background</td>
<td>• so much more confidence in what I am doing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• not really good at it</td>
<td>• been successful to an extent</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• performed well</td>
<td>• STEM academy has given me more insight into fields</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• not afraid to choose a field like biology or chemistry</td>
<td>• had experience in the actual real world live jobs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• can do what's next I can keep up</td>
<td>• going into college we have more engineering experience</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• doing well in STEM classes</td>
<td>• intern at a software-oriented business company</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• of the rigor of the STEM classes that I took in high school. helped me believe in my own abilities.</td>
<td>• experienced in CAD Digital Electronics and making circuits</td>
<td></td>
</tr>
<tr>
<td>Provisional Coding</td>
<td>In Vivo Coding</td>
<td>Perceptions</td>
<td>Findings (Construct)</td>
</tr>
<tr>
<td>--------------------</td>
<td>----------------</td>
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<td>----------------------</td>
</tr>
</tbody>
</table>
| Attainment Value   | • One was a watch that allowed doctors to track their medical conditions  
• real world applications of computer science… where I created medical innovations.  
• biomedical technology  
• make some breakthrough discoveries  
• more direct path for like inventing things  
• technological advancements and society is going to keep progressing  
• develop new combinations of substances and processes to make better products  
• doctor or a computer scientist in the pathway toward innovations and inventions  
• technology that could like renewable energy  
• new inventions or innovations and they are all geared towards STEM fields  
• new combination of chemicals that will hopefully help solve problems  
• progressing and moving forwards  
• fields in STEM because you if you want to chemical engineering because you can create something  
• be looking for new solutions and new ways of doing things  
• STEM as extremely relevant to today’s world, what with its perpetually changing and advancing technology  
• pursue a career that I truly care about  
• job in turn will also the day to day helping people  
• applying science to those suffering.  
• working hand-on with a patient  
• science and engineering being able to better people's live  
• Ag and Bio engineering to make a positive impact on the environment  
• STEM jobs are focuses towards others helping the planet  
• being able to benefiting other people's lives  
• I was to just help one person later one with my career  
• improve people like health or their quality of life | | | expect success in the STEM fields that they find interesting, enjoyable, and worthwhile  
find pleasure and personal satisfaction using STEM fields to make a difference in the lives of others.  
STEM fields can make an impact on lives  
STEM fields provide future career opportunities in which to help people because STEM fields are innovative |
<table>
<thead>
<tr>
<th>Provisional Coding</th>
<th>In Vivo Coding</th>
<th>Perceptions</th>
<th>Findings (Construct)</th>
</tr>
</thead>
</table>
| • medical field seems the most aligned with my interests in math and science  
• optical engineering degrees …US government working on national defense. Work in that area interests me  
• science field remained to be the most interesting  
• always really into science and that kind of thing  
• material [Biology] felt compelling  
• other science classes did not interest me as much as Biology did.  
• Learning about the living world fascinated me  
• content of the class was fascinating and I knew that I could see myself studying chemistry  
• my interest in Life Sciences peaked and the goal of Medicine started to develop  
• I have a strong interest in global methods of growing produce  
• I have always shown an interest in science, technology, engineering, and math. | | STEM fields interesting | expect success in the STEM fields that they find interesting, enjoyable, and worthwhile |
| • I very much like learning about body mechanics and the apply it and interacting with people  
• aspects of the engineering stuff that I absolutely loathed  
• I do enjoy trying to think of things in different ways and creating solutions to problems  
• really enjoyed biology and the life-sciences  
• I know that orthopedics is something that I would very much enjoy  
• like to be in the middle of conflicts and stuff but I like to hear both sides of stories  
• loved all my experiences in the [STEM]  
• questions to understand the problems presented to us and thought analytically and critically to generate and test the solution. I enjoyed this method of thinking  
• enjoy the kind of like that area [STEM]  
• like solving a puzzle and as a little kid I was always solving puzzles  
• like designing things being able to integrate solid scientific concepts with like more theoretical  
• enjoyed biology previously as a freshman  
• I loved the opportunity I had to perform labs and learn all of the skills related to labs: writing lab reports, following procedures, using lab equipment, etc. Although the course was AP biology, there were elements of chemistry within the course, which I enjoyed  
• enjoyed learning concepts that explained basically everything about things around me | | Enjoy STEM fields | enjoy the kind of like that area [STEM] |

Intrinsic Value
- the satisfaction from computer science I just like it to write the code and see something come out of it
- challenge and so I think that putting me in a situation that is going to be complicated and rigorous but rewarding outcome
- It [STEM] was more of enriching so I think that is what drove me to choose STEM major
- the ideas about picking a harder major because when it's something you care about you don't necessarily feel like it hard
- like I'm going to finish this and it's going to be good and we have to get this done together and it's going to be great
- accomplishing things in the STEM field will make you feel like you have confidence in yourself
- STEM not having a lot of girls I feel like that also like kind of
- Having the courage to try and improve upon your weaknesses so like you may not be the best at math or science but wanting to be better
- with STEM stuff it takes a lot of hard … so I think that it shows you are capable of persevering
- and I want to do work that I am proud of so I definitely that um like it influence me
Provisional Coding

- STEM field that really allows you to explore other subjects, since it’s a subject that’s applied to every single potential career field.
- STEM field it kind of integrated like with STEM you could just do so much you have the scope to go so far
- Learning all I have through the different STEM classes has proven to be some of the most relevant and helpful information
- STEM classes that I have taken has also taught me how to problem solve and find new ways to get things done
- engineering project was a network of formal business presentations, months of teamwork, and growth of interpersonal skills. It was the soft skills that turned out to matter the most
- experiences have taught me that collaborating with others is critical and important.
- these classes [STEM], I was able to learn how to find solutions to a variety of problems
- STEM for at least and undergrad is a really good way to teach yourself how to think more effectively
- just the skill set for STEM like what you have to do to get the degree
- The 12-Step PLTW process that was used in my engineering classes were very helpful in documentation and creating a solution.
- besides establishing a strong foundation in STEM skills, STEM provides rigorous development of skills that can be applied to any career
- I will have the education and skills necessary to thrive in my workplace
- concepts and creative problem solving methods
- math, physics, and technical knowledge as a toolbox for problem solving, a repertoire for my ability to create innovative and inventive solutions to design projects
- technology is literally everywhere you have to have some basic understanding in order to be able to succeed in your career
- me skill set that you use it’s the same problem solving critical thinking that you use in every STEM field
- I just bio and stuff you could take in so many directions
- CS extremely interesting, specifically in terms of its versatility.
- very few individuals who specialize in lens design in the USA and people qualified in that area are in high demand

In Vivo Coding

- Utility Value

- STEM fields are useful they provide relevant skills for the future

Perceptions

- future academic and career opportunities in STEM fields

Findings (Construct)
and I know that majoring in these fields [biology and chemistry] will open the door to countless opportunities
different things I can if I hadn't thought STEM wasn't applicable everywhere that like there really is a future do with the education I will receive by completing medical school.
many different jobs like you have all the different aspects working together to create like new things and keep things going with technology
least for biomed I feel that what I am expecting that it is an everlasting field
STEM like a good way go for college major because you could do so much it like for like lawyers if you're applying to law school
work you have to do can lend itself to so many other different fields too and there is so many different opportunities
[STEM] is a growing industry so I Mean there are a lot of opportunities for after college to get a job to do what you want
set up my education for my undergrad so I have different opportunities or options
A lot of jobs in the STEM field are like increasing at higher rates than other jobs and also a lot of new jobs are being created … working in the STEM field because there is a very prosperous future
STEM field connects to so many other fields that you can just go to another field
if you have a degree in a STEM field you can apply it to so many different places
in terms of job growth [STEM] they are the fastest growing ones