

**VALUES AND EXPERIENCES OF YOUNG WOMEN WHO COMPLETE AN
ARCHITECTURE, ENGINEERING OR COMPUTER SCIENCE PATHWAY IN
SECONDARY EDUCATION**

by

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(Under the Direction of Jay Rojewski)

ABSTRACT

Women are underrepresented in the STEM workforce areas of architecture, engineering, and computer science. The STEM workforce is a reflection of the STEM education system. A solution for increasing the number of women in the STEM workforce is increasing the number of STEM education students. Research explains why women do not pursue STEM in education and as a career but not why some do.

The purpose of this qualitative study was to describe and explain the experiences and perceptions of young women who have graduated high school about their participation in and completion of architecture, engineering, or computer science program. The research question used to guide this study was how young women explain what influenced their entry into and completion of the Engineering, Architecture, or Computer Science Pathway? Vroom's expectancy theory was used as a theoretical lens to predict and classify the research findings. The primary data source was semi-structured interviews conducted with three former students who recently completed the pathway. The participants described themselves as academically gifted and influenced their family members who worked in a STEM field. The young women who

participated in the study entered the pathway without prior knowledge of the pathway. They decided to stay and complete the pathway because they enjoyed the work and found their presence as young women in the class empowering.

The findings from this study can be used as a guide to provide opportunities for students to develop an understanding of architecture, engineering, and computer science. More efforts need to be channeled toward recruiting young women to participate in nontraditional STEM areas in secondary education. Recommendations for further research are explained.

INDEX WORDS: Young women, STEM, Pathway completer.

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CHAPTER 1

INTRODUCTION

Background

Science, technology, engineering, and math (STEM) occupations are crucial for generating and capitalizing on new ideas, and is a vital part of our economy. STEM jobs in 2015 represented 5.7% of U.S. occupations (Noonan & Economics and Statistics Administration, 2017) and are the fastest growing category of occupations in the U.S. (Jones et al., 2018). Occupations in STEM grew 9% from 19.1 million workers in 2016 to 20.9 million workers in 2019. Prior to the pandemic, STEM employment growth was expected to increase another 9.2% between 2019 and 2029 (Fry et al., 2021).

The STEM workforce is comprised of occupations in the areas of life, physical, and earth sciences; engineering and architecture; computer and math; and healthcare providers. Women make up 50% of the total STEM workforce but only 25% of computer workers and 15% of engineers and architects (Fry et al., 2021). Women are needed in the STEM workforce to meet growing demands but continue to be underrepresented in architecture, engineering, and computer science fields despite efforts made by educational institutions and employers to attract their participation (Campbell et al., 2012). Women are more likely to work in the areas of education and healthcare (U.S. Bureau of Labor and Statistics, 2018).

STEM occupations typically pay higher wages than other occupations (Fry et al., 2021). The average salary for a female worker age 35 and older in 2018 ranged only between 75%-80% of a man's salary (U.S. Bureau of Labor and Statistics, 2018). Careers in STEM, and engineering

in particular, offer higher salaries than many traditional occupations for women. Four of the 10 fastest growing STEM occupations that do not require a four-year degree are for drafters and engineering technicians (Fayer et al., 2017).

The STEM workforce is a reflection of the STEM educational system (Gottfried and Plasman, 2018). Sixty-seven percent of STEM workers have earned at least a bachelor's degree, and 75% of those with a degree have earned it in a STEM field (Fry et al., 2021). Despite an increasing demand in STEM-related occupations, only 14% of students surveyed during their junior year in high school expect to be working in a STEM-related occupation in adulthood (National Center for Educational Statistics [NCES], 2020). Improved engagement in STEM education is critical for the U.S. to meet growing occupational demands (Jones et al., 2018).

A solution for increasing the number of women in the STEM workforce is to increase the number of women completing secondary and post-secondary STEM education coursework (Gottfried & Plasman, 2018). While women receiving bachelor in engineering degrees increased to 22% in 2018, those receiving computer science degrees declined from 27% to 20% during the same period (National Center for Science and Engineering Statistics, 2021). Young women are less likely than young men to participate in architecture, engineering and computer science classes in secondary education. On average, 14% of students enrolled in high school engineering courses are young women (Riegle-Crumb & Moore, 2013).

Architectural, engineering or computer science pathways prepare students for careers that are in high demand and careers that contribute to solving some of the world's biggest problems (Madara & Namango, 2016). Young women in high school may not elect to pursue courses in architecture, engineering and computer science because they may see them as an inappropriate fit for their gender. Campbell et al. (2012) posited that many occupations are seen by society as

appropriate for young men or young women students' skills and abilities. Therefore, because of these biased ideas some students are not matched with courses that yield opportunity to explore new or different career interests. Young women may believe the stereotypes and not elect to pursue a career in architecture, engineering or computer science because they see themselves incapable of success. They may also not pursue a non-traditional career in fear of negative social identity (O'Brien et al., 2015). Many people do not have a true understanding of what engineers do and perceive engineering as masculine, doing manual work and requiring superior intellectual abilities (Madara & Namango, 2016).

Gender based discrimination and gender bias is prevalent in education and the workplace and takes many forms through spotlighting and macroaggression which is a subtle form of bias (Corbett et al., 2015; Yang & Carroll, 2018). Adolescent girls and women who are successful in STEM may be viewed as unlikable and can have a difficult time working with their peers (Hill et al., 2010). Additionally, women currently in the workplace find some STEM positions male dominated and the situation unwelcoming (Corbett et al., 2015). Women who work in a setting dominated by men report that being a women is more of an obstacle than an advantage and 50% report that they have been discriminated against at work (Pew, 2018).

Girls are less likely than boys to be interested in a STEM major (NCES, 2020) and these majors are often seen by adolescent girls as uninteresting and irrelevant to their life-expectations. Engineering introductory courses do not provide a broad overview of engineering and students do not relate to the content (Hill et al., 2010). Inquiry and hands-on learning techniques are appropriate to engage and increase personal confidence and understanding of concepts for students (Cagle et al., 2018).

Diversity in gender experiences can bring richness to the development of ideas used to solve engineering related problems. Engineering is about being creative and innovative. The increase of young women participating in STEM will increase diverse perspectives to solving technical problems (Cagle et al., 2018). There is a vast array of STEM related jobs that students should be made aware of. This knowledge will allow students to gain a better understanding of how their interests may be associated to STEM careers (Madara & Namango, 2016).

Support is an important component in education and the workplace. Management is a key component to creating and maintaining an environment that better supports women and adolescent girls in an engineering environment (Holl, 2017). Women in engineering jobs have reported low job satisfaction, unfair hiring practices and unfair treatment (Buse, 2013). These components may contribute to the underrepresentation of women currently in STEM careers. Diversity management support is a strategy used to create an environment that is inclusive for a diverse group.

Campbell et al. (2012) found that peer support motivated young women in math and science academic achievement more than parental support. Feminism, the belief in equality for men and women, is another support for young women who considered STEM as a career. Learning about feminism had a positive correlation to math and science participation in adolescent girls. Mau (2016) stated that young women in the pursuit of a STEM career benefit from financial and academic assistance and encouragement.

There have been longstanding efforts to increase STEM participation among women in education and in industry without much success (Fry et al., 2021). Research has been found explaining why adolescent girls do not pursue STEM in education and why women leave STEM

careers (Cagel et al., 2018; Holl, 2017). However, there is little research about the reasons young women choose to persist in these types of educational programs.

Purpose of the Study

The purpose of this qualitative study was to describe and explain the experiences and perceptions of young women who have graduated high school pertaining to their participation in and completion of an architecture, engineering, or computer science program. A secondary purpose is to elicit experiences and perceptions that supported or challenged their perseverance to pathway completion. A pathway completer is a high school student who successfully completes three classes in the same field of study (Georgia Department of Education, 2020). I interviewed young women who have completed their secondary education in a public high school in the metro Atlanta area.

Research Question

The research question used to guide this study was how do young women explain what influenced their entry into and completion of the Engineering, Architecture, or Computer Science Career Pathway?

Theoretical Framework

A theoretical framework provided a scheme for classifying data, predicting research outcomes, and interpreting research findings (Farmer & Rojewski, 2001). For this study, young women's decision to enroll and persist in the Architecture, Engineering or Computer Science Career pathway was viewed through the lens of Vroom's (1995) expectancy theory. Expectancy theory explains motivation as a result of an individual's perceived abilities related to a task, effort estimated to complete the task, and the attractiveness of the goal. This study sought to

explain the decision making process of young women in high school who complete a pathway related to STEM career interests in architecture, engineering, or computer science.

Vroom's (1964) expectancy theory suggests that people choose to act based on their beliefs, perceptions, and attitudes in order to enhance pleasure and/or avoid pain. A person's motivation to act is based on a combination of their expectations and the value placed on outcomes (Isaac et al., 2001). The importance of this theory is expressed through three variables—expectancy, instrumentality, and valence—that hold unique meaning to an individual. The motivation for the young women to enter and remain in the program was shown through each of the variables.

Expectancy is the belief that effort will result in a certain level of performance. In this study, the participants and I discussed the young women's efforts relative to their level of performance in the pathway. I asked them if the class was easy or difficult for them and why. Based on Vroom's (1964) expectancy theory, the young women should have been motivated to continue in the pathway if they believed that their efforts led to a high level of performance and would help them receive their expected reward. Outcome expectations are acquired through learning experiences and can be in the form of the reaction of others or the sense of well-being during task performances (Brown, 2002).

Instrumentality is the belief that a reward will be received when a certain performance expectation is met. The young women were asked to recall their perceptions and describe the benefits they expected to realize for completing the pathway. I asked the young women to describe the reward and to share if the efforts required for completion were worth what they expected as their reward. I also asked the participants to describe the performance level that was required to complete the pathway.

Valence refers to whether or not a particular reward or outcome is important to an individual. I examined the young women's description of the importance they placed on completing the program. I listened as they reflected and discussed goals that were important to them. Vroom (1964) presents his theory as an equation with three variables: expectancy, instrumentality, and valence. Each of the three variables has a multiplier effect and can be expressed as

$$\text{Motivation} = \text{Expectancy} * \text{Instrumentality} * \text{Valence}.$$

As each variable increases, there is a significant increase in motivation (Lunenburg, 2011). This theory was developed to demonstrate the potential for organizing empirical research for the relationship between people and their work. This theory was designed to be useful in providing a language for formulating context driven questions related to behavioral choices (Vroom, 1995).

Importance of the Study

The results of the proposed research will possibly improve the educational experiences of young women who are considering a career in engineering or a related STEM field. Foremost, a better understanding of current participants' experiences may help to increase the participation of young women in secondary education classes related to STEM by removing possible barriers, making needed curriculum revisions or offering academic supports. The words of these young women may help instructors and policy makers create a more supportive environment to attract and retain more young women into the pathways. This research was aimed to uncover any unknown barriers or incentives that influence young women's participation in the pathways.

This study focused on reducing a gap in the literature as to why so few young women elect to complete the engineering, architecture or computing pathway in secondary education. Literature has significantly addressed why young women may not find it relevant and why they

may leak from the STEM pipeline but, not on why they may choose to stay (Corbett et al., 2015; Nix et al., 2015; Shapiro et al., 2015). It is important to recognize, describe and give meaning to the experiences of young women who enter and complete the engineering, architecture and computing pathways because it is through their voice improvements can be made for future participants (Creswell & Poth, 2018).

The purpose of the research is to inform action, for example change in policy and curriculum (Harding, 2019). Learning about young women's experiences in STEM-related pathways may be used to implement new recruitment strategies designed to increase the number of young women who enroll in these types of programs. Increasing the number of young women in engineering related classes may increase the number of young women who select a career in an engineering related field (Rundgren et al., 2019). Individuals who hold STEM jobs typically earn 70% more than the national average (Ball et al., 2017). Increased wages for women will increase their financial positions and promote positive social change (Turanli et al., 2015).

The words that these young women use to give meaning to their experiences may describe factors, e.g., interest level or pedagogy that will inform teaching practices and remove barriers that impede others to enter and complete the pathway. Young women's insights may also suggest ways to modify curriculum to include a clearer understanding of what engineering is, how it is relatable to young women, and how it has a valuable impact on society. The insights and experiences of adolescent girls may identify ways to provide additional academic support needed to strengthen women's math and science skills (Mau, 2016).

CHAPTER 2

LITERATURE REVIEW

Women earn the majority of undergraduate and advanced college degrees but, remain significantly underrepresented in the completion of degrees in the areas of architecture, engineering, and computer science. Diversity in these STEM workforce areas are unlikely to increase until more women pursue these degrees. STEM workers are more likely to hold a degree in a STEM field (Fry et al., 2021).

The purpose of this qualitative study is to describe and explain the experiences and perceptions of young women who have graduated high school pertaining to their participation in and completion of an architecture, engineering, or computer science program. A secondary purpose is to elicit experiences and perceptions that supported or challenged their perseverance to pathway completion. A pathway completer is a high school student who successfully completes three classes in the same field of study (Georgia Department of Education, 2020). I interviewed young women who have completed their secondary education in a public high school in the metro Atlanta area.

Research Question

The research question used to guide this study was how do young women explain what influenced their entry into and completion of the Engineering, Architecture, or Computer Science Career Pathway?

In this chapter I will explain the background of STEM and how it is defined in the literature. I will describe the gender gap in STEM and possible reasons why it exists. I will address the benefits of increasing women's participation in STEM and how that is being

addressed. I will also discuss the relationship of CTE and young women in STEM. The last section of chapter 2 is dedicated to the discussion of how the theoretical lens of Vroom's Expectancy theory was used to engage in dialog with young women who have completed a STEM pathway in secondary education.

Background and Definition of STEM

The United States' desire to remain a world leader in technology has forced many social and economic changes over the past several decades, forcing the evolution of educational policy, curriculum and pedagogy. Gender and minority equity issues, technological advancements, and an increase in the number of students who plan to attend college have all brought attention to needed changes in education to make the United States more prepared to compete in a global market.

The desire of the United States to remain a world leader in innovation and technology brought about what is now called STEM. The Soviet Union's launch of Sputnik in 1957 brought about great anxiety to the American people and created a lack of confidence in American values, politics, military, and technology. A desire to lead spurred the great space race with Russia and forced the United States to reprioritize research science. The new emphasis on scientific developments brought about many of the micro technologies still used today. Realizing the lack of progress of keeping in step with space travel, the United States placed a renewed emphasis on math, science, and engineering education (Steeves et al., 2009). The nation's new priorities brought about the *Vocational Act of 1963*, which replaced the *Smith-Hughes Act (1917)*.

The *Vocational Act of 1963* was passed to strengthen and expand vocational education to create an improved vocational training capacity. The demands of a growing labor market, automation, and new technologies created a need for a new type of training (Dugger, 1965).

Secondary and technical schools were held accountable for meeting all persons' educational needs, women and even those with disabilities, preparing them for occupations that did not require a college degree (Peralta et al., 2018).

A growing labor market and more women entering the workforce brought about competition for jobs in the 70s. Thirty-four percent of women held a high school diploma, and 11% held a bachelor's degree. Women earned 62% of what men earned according to States News Service (2017). Gender equity changes in education began with the Title IX Education Amendments Act of 1972, declaring that no person in the United States shall be excluded from participation or discriminated against based on gender under any educational program or activity receiving federal funding. This new law significantly impacted women's collegiate sports but did little to negate the gender divide in most career and technical education (CTE) occupational training areas (Toglia, 2013). Other acts, *Women's Education Equity Act* passed in 1974 and the *Education Amendments* of 1976, were policy attempts to improve women's societal position. However, there was little financial support and no enforcement of the policies (Stromquist, 1993).

In another attempt to reform education, United States Secretary of Education, Terrel Bell, released a report in 1983 titled *A Nation at Risk* that stated education in America needed urgent improvement. The report's recommendation was for schools to raise the expectations for students in academics and their conduct. The goal was to develop the ideal citizen through an educational curriculum. This curriculum change was in response to the United States' inability to compete economically in the late 1970s. The government's goal was to improve equitable delivery of math, science, technology, and foreign language to all students (Johanningmeier, 2010).

The Carl D. Perkins Vocational Education Act (1984) was created to replace the Vocational Act (1963). The purpose of this act was to expand the economic base, develop human resources and strengthen the United States defense capacity by assisting the individual states in expanding and strengthening vocational-technical education (Carl D. Perkins Act, 1984). The Perkins Act has been amended and reauthorized many times since increasing equity, academic, and technical educational goals reflecting changes in workplace demands and research data (Plasman et al., 2020).

The 1990s created a demand in the workplace that shed light on the need for advancements in education. These changes emphasized moving away from teaching content in silos and connected to real-world problems. More technology was brought into the vocational education classroom through Perkin's grants and was used to teach collaboration and critical thinking using academics and technical skills. The number of women earning a STEM-related degree in the United States has gradually increased since the early 1990s (Reinking & Martin, 2018).

The early 21st-century brought about many changes to technology and education. The STEM acronym was introduced in 2001 by the National Science Foundation (NSF), replacing the previous acronym of SMET. The term vocational education was replaced with Career and Technical education to remove the stigma of vocational education. Changing the name did not remove the fear of sorting students based on students' abilities (Hodge et al., 2020). A committee of experts was asked to identify gaps and make recommendations for educational improvements. This publication was titled *Rising above the gathering storm* and stated that students' interest and abilities in science, technology, engineering and, mathematics (STEM) education, if not remedied would prove to cause a problem for the United States to remain a leader in the world

economy. The committee recommended more science scholarships, research funding, additional training for teachers and, an increase in foreign science students' admissions (National Academies, 2007).

The president's Council of Advisors on STEM recommended that to be an internationally competitive country, the United States needed to provide individuals with stronger STEM-related skills (Reinking & Martin, 2018). In the 2011 State of the Union address, President Obama called for the United States to ramp up technological innovation to stay internationally competitive. He stated that this was our generation's Sputnik. He challenged educators to prioritize 21st-century skills and learning (Obama, 2011).

There is some controversy in how STEM is defined in education and the labor market. The Census defines STEM differently than some professional groups. There is also debate over the supply and demand of skilled STEM workers.

Importance of Science, Technology, Engineering, and Math

The current emphasis on STEM preparation is essential for individuals and the workforce because there is a demand for these skills. These jobs usually pay higher wages than other workforce areas (Zheng et al., 2016). The industry realizes a shortage of qualified applicants in the technical areas, and diverse perspectives are needed to solve challenging issues. Adding diversity in the workforce increases creativity, innovation, and productivity (Jones et al., 2018). The U.S. Bureau of Labor Statistics (2014) announced that STEM workers' need was expected to increase to more than 9 million before 2022. According to the National Science Foundation (2019), the science and engineering workforce between 1960 and 2017 grew faster than the overall workforce. STEM careers are a vital part of our world economy and essential to individuals earning potential. Individuals who hold STEM jobs earn 70% more than the national

average (Ball et al., 2017). Increased wages for women will increase their financial positions and promote positive social change (Turanli et al., 2015).

Gender Gap in STEM

Women have historically been underrepresented in the STEM classroom. More boys elect to participate in math and science-related activities beyond what is required in compulsory education than girls (Reinking & Martin, 2018). Young women in high school make up approximately 20% of STEM-related classes (National Coalition of Women and Girls in Education, 2017). A Maryland study found an increase in the number of STEM degrees earned in Maryland between 2008 and 2012. The majority of these degrees were awarded to white males. Women and minorities are historically underrepresented in STEM in secondary education and the workforce (Zheng et al., 2016). The majority of the postsecondary degrees in STEM were earned by white males, with women earning only 20% of the STEM bachelor's degrees (Catalyst, 2020).

Approximately 5% of the U.S. workforce are in STEM-related occupations (Smith, 2017). Most of the STEM workforce is male and White (Jones et al., 2018). In this research, the literature review questioned if there was a shortage of STEM workers or if this claim is an excuse for exporting manufacturing jobs to China (Zheng et al., 2016).

Factors Creating Inequalities of Participation

There are many reasons hypothesized as to why there are inequalities in participation for women in STEM-related education and careers. This section will highlight some of the reasons discussed in the literature: (a) lack of knowledge, (b) lack of interest and ability, (c) biased and unwelcome environmental conditions, and a lack of support (Swafford & Anderson, 2020).

Swafford and Anderson (2020) found in a national study using a Delphi method that girls are not aware of educational and career opportunities in STEM. Studies suggested that girls do not make the connections that a STEM career allows a person to contribute to a society that can make a difference (Boe et al., 2011). Providing an overview of STEM courses and providing practical applications to how these career choices contribute to society may help attract and retain more girls in the pipeline (Hill et al., 2010). Information on how engineers solve society's most challenging problems should be shared with girls at a young age (Bossart & Bharti, 2017).

Girls want a career that is seen as relevant, rewarding, and has impact and a decent salary (Sinkele & Mupinga, 2011). High school girls often see engineering as uninteresting because it appears irrelevant to their life expectations (Hill et al., 2010). According to a study examining middle school students' career interests, girls' top goals were making the world a better place and helping others (Shapiro et al., 2015). Another study examining the participation of high school students in science and technology found that girls were more interested in taking care of the body and animals. Girls are more interested in topics that help them relate with themselves and others (Boe et al., 2011).

The lack of students trained in STEM may be due to students' lack of interest in physical sciences and advanced math in secondary education. Boe et al. (2011) noted in their research that there is an international trend of students, young women in particular, who are reluctant to elect science and math courses beyond what is compulsory. This reluctance to participate in advanced math courses is more evident in modernized parts of the world. This study associated the lack of STEM participation with social and cultural characteristics of a generation and their lack of technological need. Math abilities were an obstacle for women and minority students in a study at UVA School of Engineering and Applied Sciences (Jones et al., 2018). The conclusion was

that girls tended to associate the study of math and science with a higher perceived cost and lowered expectation of success (Boe et al., 2011).

Women and girls may not choose to participate in STEM areas that men dominate because they feel that they do not fit in. Some of the reasons for not fitting in are gender bias, stereotypes, unwelcome environments, and a lack of support. Gender bias against women in STEM is prevalent in education and the workplace (Corbett et al., 2015). Students, parents, and educators may have cultural beliefs and values that influence gender roles. Most people view STEM occupations through a gender lens. For example, many believe that computer science is a domain for men (Michell et al., 2017). Leaper et al. (2012) posit that in the United States, many occupations are seen as appropriate for young men's or women's skills and abilities. These biases can be conscious or unconscious and occur more often in advanced industrial countries because there is more freedom or individual choice.

Biased self-concept is also believed to lead to segregating career choices, given that studies of young adult's science and math abilities are shown to be equivalent. Young women do not see themselves as having the ability to succeed in careers dominated by men (Sikora & Pokropek, 2012). Some students are not matched with courses that allow them to explore new or different career interests because of these social biases (Leaper et al., 2012). These biases or gender schemas limit girls' and women's potential by lowering their self-confidence, earnings and often leading to discrimination (Easterly & Ricard, 2011).

There are also biases in the STEM curriculum and the learning environment. Computer-mediated communication (CMC) was once seen as a possible solution for gender parity in the learning environment. Li (2006) concluded that there are differences in the way men and women relate through CMC, and these communication differences can create an uncomfortable

environment for some girls and women. Boys tend to be more aggressive through their CMC by using inappropriate language.

Stereotypes also exist in society around the area of STEM. Girls who show an early interest in science prefer employment in biology, agriculture, health, and boys like careers in engineering, computing, and math. This preference is observed in all countries (Sikora & Pokropek, 2012). These ideas are learned at a young age and are a part of the culture. These stereotypes are often taught through children's fiction. An examination of children's fiction titles related to science and engineering as a career is portrayed as dominated by men and nerdy. These negative impressions influence young children's early career preferences (Holbrook et al., 2008). Many adults do not understand what engineers do in their profession, and information in children's fiction does not offer accurate or positive occupational insight. A lack of accurate information contributes to the perpetuation of occupational gender stereotyping among youth. Stereotypes also cause participants to lower their STEM-related work expectations of girls and women and overlook sexual harassment (Sikora & Pokropek, 2012).

Factors Supporting STEM-related enrollment.

There are ways to create and support girls' interests in STEM. Reinking and Martin (2018) conducted a qualitative content analysis and compiled strategies that may be used to increase girls' participation in STEM-related areas. These findings included creating engaging opportunities designed to change girls' mindsets away from socialized stereotypes implying that STEM activities are for boys. There are many movements created by businesses and organizations designed to develop STEM enthusiasm for girls. A few of the organizations are Girls, Inc., Girls Who Code, STEM Like a girl, Engineer Girl and Girlstart. The goal of these resources is to educate and create a sense of belonging for girls in STEM. Hill et al. (2010)

concluded that social and environmental factors contribute to girls' interest in math and science. An association with these movements helps girls create a social connection. It was concluded that support from peers motivated math and science participation more than parental support (Campbell et al., 2012).

While movements can positively impact girls' STEM participation, educators must realize their impact in spurring interest in motivating girls to consider STEM as an interest. Teachers can be positive role models by introducing STEM movements, using STEM concepts, and creating positive hands-on experiences for all students in a non-biased environment. Schools and teachers can host career fairs where men and women in STEM careers are invited to explain their profession (Reinking & Martin, 2018).

Mentoring is a meaningful way to create a personal, supportive connection between a student and STEM information. This connection can be accomplished through STEM after-school and summer programs to allow mentors to share their personal experiences with girls and share that engineering can be exciting and relevant. Students need to learn proper knowledge about the profession and how it can be relevant to their personal goals (Sinkele & Mupinga, 2011). Learning about feminism has a positive correlation to math and science participation. According to Campbell et al. (2012) peer support motivated girls in math and science more than parental support.

Extracurricular, informal learning environments are ideally suited to promote active learning and promote interest in STEM careers. Summer camps and after-school programs allow youth to explore math and science creatively through STEM-related activities (Nugent et al., 2015). According to Sinkele and Mupinga (2011), girls developed a better understanding of

engineering and expressed an interest in pursuing engineering as a career after participating in an all-girl hands-on workshop.

Girls and boys develop an idea of gender roles at an early age; according to Eccles and Wigfield (2002), it is essential to expose students and engage them in STEM-related activities to spark their interest in STEM fields. A positive learning environment, quality instruction, appropriate materials and equipment are proven strategies that can encourage greater participation in STEM activities. Early exposure to STEM programs is likely to directly impact young women's decision-making to enter high-demand STEM careers and level the gender playing field.

Workplace factors

Women in the workplace find some STEM positions male-dominated, and the situation unwelcoming (Corbett et al., 2015). Low job satisfaction, unfair hiring practices, and unfair treatment has been reported (Buse et al., 2013). Instances of bias were indicated in Holl's (2017) study of why women were underrepresented in engineering. In his qualitative study, he found five of the eight participants, surveyed indicated poor treatment of women engineers at times. It was determined that the organization's culture can sometimes be hostile toward women in engineering, although its existence might not always be apparent. Discrimination is often glossed over and more tolerated because of ingrained societal biases and stereotypes (Michell et al., 2017). It was also stated that some people in the work environment are more rigid on women than men. Participants agreed that women typically must work harder than men to prove their value and negate stereotypes about women in engineering (Holl, 2017).

Men in STEM fields are moved up the ranks while leaving women behind (Reinking & Martin, 2018). Fouad et al. (2016) concluded in a qualitative study that women left their

engineering jobs because of a culmination of multiple role stressors and micro-aggressive behaviors. In comparing a group of women who stayed in an engineering career and a group who did not stay, it was determined that they did not differ in self-confidence, a change in career interests, or outcome expectations.

Support is an essential component in education and the workplace. The work environment and support for women were shown to determine who stays and leaves engineering jobs (Fouad et al., 2016). It is vital to acknowledge that barriers exist and educate all workers on recognizing and reducing gender inequalities (Swafford & Anderson, 2020). Diversity management support is a strategy used to create an environment that is inclusive for a diverse group. Management is a crucial component to creating and maintaining an environment that better supports women and girls in an engineering environment (Holl, 2017). A more flexible work schedule can support women in STEM careers with work and life balance. Mentors who share commonalities may be used to create supportive networks through professional or women associations (Buse et al., 2013). An example is the National Association of Women in Construction (NAWIC) who offers membership to women in the construction industry. This organization also provides learning opportunities for women who want to advance in a career related to construction (NAWIC, n.d.). Internships are essential for assisting women in finding a work environment that allows them to match their skills and experiences with job demands (Smith & Gayles, 2017).

Women in STEM related to Career and Technical Education

Career and technical education (CTE) is continually evolving to meet students' educational and career needs. Policies have been written and funding provided to encourage the participation of nontraditional students in CTE. Nontraditional occupations are defined as an occupation that is comprised less than 25% male or female. The Carl Perkins Act of 1984

required that each state assign a sex equity coordinator who was responsible for directing efforts to overcome gender bias and stereotyping in vocational education. But in 1990 Perkins funding was reauthorized to require only 3% of the funding to be allocated to gender equity programs. The equity coordinator was eliminated and gender equity activities were reduced again in the 1998 reauthorization known as Perkins III (Toglia, 2013).

The 1990's started the transformation of Vocational Education into what is now CTE. The term Vocational Education was replaced with CTE as a rebranding strategy. Historically, vocational education was provided to students who were not capable or had the means to continue their formal education in college (Hodge et al., 2020). Because the term vocation was associated with manual labor, the term was replaced with career and technical to remove the stigma associated with past educational preparation for students who were not preparing for a four year university. Vocational education for young women was typically geared toward preparing the student to be a homemaker or a career in education or nursing. Young women's career aspirations were greatly influenced by their mothers and most mother's did not work outside the home (Toglia, 2013). Course name changes continued as a rebranding of education designed to prepare all students for a career related to the job market, demanding a more technologically trained workforce.

CTE has continued to evolve through new initiatives, curriculum, and pedagogy. (Heyward et al., 2019). Unceasing advancements in technology have been a driving force in education (Hutton, 2019). The introduction of new technologies brought about the need for new curricula (Morra et al., 1993; Plasman et al., 2020). Typing courses were replaced with computer courses, Industrial Arts or shop class was replaced with Introduction to Technology and drafting tables were replaced with computers and CAD. These changes in technology and the job market

brought about a need to reorganize the goals of education. A demand for a larger and more prepared workforce in the area of STEM required CTE to recruit and educate more young women to the STEM classroom. The Perkins Act of 2006 encouraged progress toward gender equity by requiring increased nontraditional participation or the threat of decreasing funding (Toglia, 2013).

The secondary education curriculum is divided into academics and elective courses. CTE programs are offered along with fine arts, modern language, and physical education courses as electives to allow students an opportunity to experience how academics are applied to careers. CTE programs and courses focus on the knowledge and skills required for a particular field of work. CTE courses are designed to help students connect what they learn in the classroom to what happens in the workplace. CTE courses in Georgia are organized into 17 clusters, with each cluster including multiple pathways. A career cluster is a broad group of careers or industries developed by the United States Department of Education. The clusters are based on the 16 National Cluster Model (Georgia Department of Education, 2020).

There are many different Career Pathways within a Career Clusters. Over 130 pathways are represented in Georgia's 17 occupational clusters. Georgia includes an additional Energy cluster that is not represented on the national cluster model. A career pathway is a route to obtain the necessary knowledge, skills, attitude, and credentials to obtain employment in a particular career area. This path includes the academic and elective course options at the secondary and postsecondary education levels. A career pathway also includes participation in an internship and work-based learning opportunities along with specific credentialing requirements (Georgia Department of Education, 2020).

Students select a pathway offered at their school and related to their career interests. Career pathways are based on shifts in the local and global economy (Hodge et al., 2020). Only select clusters and pathways are offered in each school district based on local economic demands. The curriculum for each course in the pathway is designed to show students the relevance of what they are learning and how the information is applied to real-life situations, regardless of whether a student plans to attend postsecondary education or go straight to work (Georgia Department of Education, 2020). The three Career Pathways addressed in this study will be Architecture and Construction, Information Technology, and STEM.

Theoretical Framework

A theoretical framework provides a scheme for classifying data and can help predict research outcomes (Farmer & Rojewski, 2001). It is vital to propose an academic perspective to guide the inquiry and scope of the study. The theoretical lens influences the purpose, goals, questions, and methods used to carry out the research process (Creswell & Poth, 2018). Collins and Stockton (2018) states that a theoretical framework provides organization and helps to identify strengths and weaknesses to a study. Theories also play an essential part as a guide to understanding the complex process of learning (Gopalan et al., 2017). Well-constructed ideas should incorporate the smallest number of constructs to explain the phenomena addressed yet comprehensive enough to explain decisions for all people. Good theories facilitate understanding the past, present, and future of what happened and why it happened (Brown, 2002).

There are many theories aimed at explaining human motivation as it relates to education and career choice. I have discovered several theories that have been successfully used as a lens to learn more about girls and women who explore STEM related activities: (a) Expectancy-Value

Theory (Eccles & Wigfield, 2002), (b) Personality Career Choice Theory (Holland, 1985), (c) Social Cognitive Career Theory (Lent et al., 2018), and (d) Vroom's (1964) expectancy theory.

The expectancy-value model (Eccles & Wigfield, 2002) was developed to explain achievement-focused behaviors and motivation in an educational setting such as a girl choosing to participate and engage in learning activities in a STEM class. According to Eccles and Wigfield (2002), individuals are motivated to excel in subjects in which they are expected to and that they value. Subjective task value is based on interests, attainment value, utility value and the relative cost associated with a particular subject. This model of motivation is very comprehensive and specifies many area of influences that affect a child's reactions and memories.

Holland's (1995) theory is based on a person's personality traits as determining their career interests. Dr. Holland believed that a person resembled a combination of six different personality types. These personality types are realistic, investigative, artistic, social, enterprising, and conventional (RIASEC). A person with a realistic personality type is described as productive, practical, and having concrete values. Realistic people enjoy working with tools and machines. Investigative personality types are defined as intellectual thinkers and enjoy solving problems. Artistic personality types are categorized as being innovative and creative and enjoy working with different art forms. Social personality types work well with other people and enjoy training or enlightening others. Enterprising personality types value money, power, and status and enjoy situations where they control and influence others. Conventional personality types are considered efficient and organized and enjoy data management activities (Kemboi et al., 2016). People find more enjoyment and achieve better performances when matched with a career that allows them to utilize their strengths and values (Nauta, 2010).

Social cognitive career theory (SCCT) (Lent et al., 1994) is intended to explain career choices' development and success. SCCT is based on Albert Bandura's (1986) social cognitive theory that states learning is a social construct and is a dynamic interaction of the learner, environment, and behavior. SCCT explains career development using personal and environmental factors internalized by the individual. The personal factors are an individual's predispositions, attitudes, personality, gender, race and health. The environmental factors are the person's background and affordances. Both the personal and environmental factors influence the person's learning experiences and thus effects self-efficacy and outcome expectations. Self-efficacy and expectations are domain specific. All of the factors contribute to a person's interests, goals, and actions.

The theoretical lens influences the purpose, goals, questions, and methods used to carry out the research process (Creswell & Poth, 2018). Collins and Stockton (2018) states that a theoretical framework provides organization and helps to identify strengths and weaknesses to a study. Well-constructed ideas should incorporate the smallest number of constructs to explain the phenomena addressed yet comprehensive enough to explain decisions for all people. Good theories facilitate understanding the past, present, and future of what happened and why it happened (Brown, 2002). In my attempt to understand and explain the motivation and decision making process of young women who completed a pathway related to STEM in secondary education, I will listen to their words using the lens of Victor Vroom's expectancy theory (1964).

Vroom's (1964) expectancy theory is a simple approach and the model suggests that individuals act through self-interest by adopting courses of action that are perceived as maximizing the probability of desirable outcomes (Isaac et al., 2001). The importance of using this theory as a foundation for the research is in the power of expectancy, instrumentality, and

valence. These components have heuristic value in supporting the participants and me to determine why these girls persist in completing a STEM pathway (Vroom, 1995). I employed Vroom's expectancy theory (1964) as a lens to organize the words used by the participants to explain their decisions related to their choices.

Victor Vroom developed expectancy theory in 1964 as an ambitious attempt to establish a theoretical structure to guide and be guided by empirical research in industrial and organizational psychology (Vroom, 1995). He identified his ideology with logical positivism, meaning only problems that can be solved using logical analysis are meaningful. His theory started taking shape while at the University of Michigan in the early 1960s. The idea was conceptualized as a response to explain the results of his dissertation research. He was influenced by Helen Peak and Jack Atkinson's seminars in the psychology of motivation (Vroom, 1995).

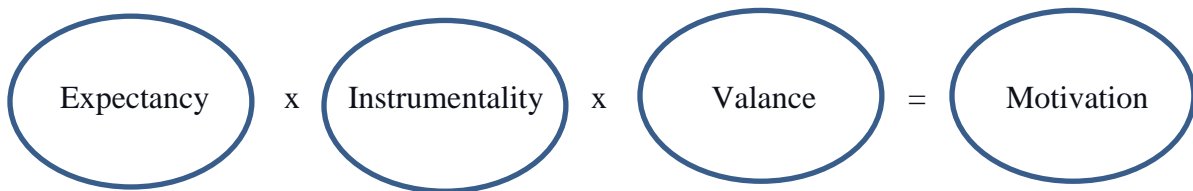
Hedonism is the guiding principle of motivation, and it assumes that behavior is directed toward pleasure or away from pain. People select between alternate choices based on these two directions. There are, however, unclear assumptions on how pleasure and pain are defined. More refined models state that people behave in ways that will maximize their rewards and minimize adverse outcomes (Vroom, 1995). The expectancy theory model suggests that people feel motivated when three conditions are met: 1) Personal effort will result in an acceptable performance level. 2) A specific outcome will be the result of achieving a performance level. 3) There is personal value in the outcome.

The first condition is labeled *expectancy*. People will expend effort when they believe a level of performance is achievable. The relationship between effort and performance is known as the E-P link. The second condition is labeled *instrumentality*, which means performance levels are related to rewards or an outcome known as the P-O link. The third link is *valence* and refers

to the value a person places on the reward. As shown in Table 1, the motivation formula can be expressed as $M = E \times I \times V$ where: E represents expectancy, I represents instrumentality, and V represents valence (Isaac et al, 2001).

Table 1

Expectancy Theory



Expectancy. Expectancy is based on the combination of events that a person can and cannot control. Expectancy for this theory is defined as a momentary belief in the likelihood that a particular action will result in a specific outcome. Expectancy is described in terms of strength and has a value ranging from zero to +1. If an outcome is sure to follow an action, then a value of +1 is ascribed. If it is certain that the desired outcome will not follow the action, then a value of zero is ascribed.

Instrumentality. Instrumentality, in contrast to expectancy, has an outcome-outcome association. The values are ascribed, ranging from -1 to +1. A value of -1 indicates that the person believes the second outcome is inevitable without the first outcome. A value of +1 indicates that the person thinks the second outcome is only possible given the first outcome (Vroom, 1995).

Valence. Valence is defined as a preference and is also referred to as incentive, attitude, and expected utility. In Vroom's expectancy model, valence refers to a tendency toward a particular outcome. Given a set of results, x and y , a person prefers x to y , y to x , or is indifferent to whether he receives either. Valence can be positive, zero, or negative. Valence is considered

positive if the person prefers attaining the outcome and a valence of zero if there is indifference to the outcome. There is a negative valence if a person chooses not to obtain x to obtaining x . It is assumed that valence can have a wide range of positive and negative values (Vroom, 1995). The valence of outcome x is not the same as the value of x to the person. An example is a person who may join a group because they desire their status and not because they value the group. It is also essential to understand that some outcomes are preferred simply because of the value and not because of valence (Vroom, 1964-1995).

Force. Behavior is the result of a field of forces. Valences and expectancies are combined to yield hypothetical points. Assuming people make rational choices, the strength of the force is the product of valences and expectancies. According to this model, there are two independent components to motivation: an expectancy dimension and a valence dimension. They must both be strong for a behavior to occur. The valence is determined by the person's belief about whether specific outcomes are associated with the option and the desirability of each result to the individual (Brooks & Betz, 1990).

The expectancy dimension of the model will be explored as the participants reconstruct and describe how their expectations of successful completion of the pathway contributed as a force that contributed to their daily participation. The valence dimension will be explored as the participants explain the value of reaching completion. The strength of their motivational force is increased by the expectancy of reaching completion and how much value is placed on reaching the goal.

There are limitations to expectancy theory. The theory was not designed to test expectancy in the way many people have used it. Many researchers have used questionnaire measures of expectancy, instrumentality, and or valence, summed over outcomes, and used these aggregates

to predict choices, preferences, or work performance. They had participants make choices between subjects rather than options within-subjects (Vroom, 1995). The model was intended to require questionable assumptions about the content of motivation and the manipulation of the concepts. A strength is that the model was designed to have exploratory value (Vroom, 1995).

CHAPTER 3

METHODOLOGY

Women continue to be underrepresented in architecture, engineering, and computer science STEM fields despite educational institutions and employers' efforts to attract their participation (Campbell et al., 2012). In 2018, only 10% of women in professional and related occupations were employed in relatively high-paying computer and engineering fields, compared with 47% of men. Women are more likely to work in education and healthcare (U.S. Bureau of Labor and Statistics, 2018).

The average salary for a female worker age 35 and older in 2018 ranged only between 75%-80% of a man's salary (U.S. Bureau of Labor and Statistics, 2018). Careers in STEM, and engineering, in particular, offer higher salaries than many traditional occupations for women, and four of the ten fastest-growing STEM occupations that do not require a four-year degree are for drafters and engineering technicians (Fayer et al., 2017).

Few adolescent girls in high school complete the architectural, engineering drawing, and design or computer science pathways. These pathways prepare students for careers in high demand and the opportunity to solve some of the world's biggest problems (Madara & Namango, 2016). These jobs typically yield a higher salary than careers traditionally held by women (U.S. Bureau of Labor and Statistics, 2018). On average, 14% of students enrolled in high school engineering courses are young women (Riegle-Crumb & Moore, 2013). Only a few adolescent girls consider a STEM career, although the great demand for qualified workers and women is needed to fill these positions (Corbett et al., 2015). Research is found explaining why adolescent girls do not pursue STEM in education and why women leave STEM careers (Cagel et al., 2018;

Holl, 2018). However, there is little research supporting why some young women (women) choose to persist.

Purpose of the Study

The purpose of this qualitative study was to describe and explain the experiences and perceptions of young women pertaining to their participation in and completion of architecture, engineering, or computer science program. A secondary purpose is to elicit experiences and perceptions that supported or challenged their perseverance to pathway completion. A pathway completer is a high school student who completes three classes in the same field of study (Georgia Department of Education, 2020). The participants in this study completed an architecture, engineering, or computer science pathway in a public high school in the metro Atlanta area.

Research Question

The research question used to guide this study was how do young women explain what influenced their entry into and completion of the Engineering, Architecture, or Computer Science Career Pathway?

Research Design

This study was conducted using qualitative interviews. Qualitative research is defined as a process of inquiry of a complicated situation to understand a social problem of individuals in their natural settings where the participants' views are reported in detail (Nasser, 2001). Qualitative research typically takes place in natural surroundings and draws on multiple methods, all of which preserve humanity's respect and dignity and the participants in the study. Qualitative studies are fundamentally interpretive and focus on the context of the data (Marshall,

2016). The definition of qualitative research is continuously evolving to match the ever-changing impact of qualitative inquiry and its ability to transform the world (Creswell & Poth, 2018).

Qualitative research is used when individuals' experiences and meanings attached to those experiences need to be explored (Creswell & Poth, 2018). Qualitative research was appropriate for this study because the study explored the young women's explanation and understanding of completing a STEM-related career pathway. The participants and I learned and constructed an understanding of the reality and meaning they each gave to their participation and experiences in the STEM-related program so that changes may occur to attract and retain more young women to the program.

This research approach allowed insight to be gathered from participants, in their words, related to how they negotiated the complex decision-making process as it related to their educational and career choices. It was essential to listen to the participants' point of view to gain a comprehensive picture of how they perceived themselves and the value they placed on their decisions. Qualitative research was a reasonable choice for this study because it allowed me to gain insight into the learning environment from the participant's perspective (Creswell & Creswell, 2018). Qualitative research is valuable because it permitted me to give a voice to these young women, who are rarely heard, as they made meaning of their unique experiences (Nasser, 2001). There is great diversity in the number of qualitative research methods, and some disciplines emphasize some approaches over others (Creswell & Creswell, 2018). Qualitative methodologies are well established in education (Marshall, 2016).

Research Site and Participants

It was recommended to locate a setting free from distractions and where private conversations could be held that allowed recording (Creswell & Creswell, 2018). The interviews

took place online through Google Meets. The interview structure was set to last no more than one hour and the date and time was discussed before the interviews took place. While there is no specific length of time proven ideal for an interview (Seidman, 2019), an established time frame of one hour allowed me and the participant to schedule it around other responsibilities, thus reducing anxiety. The interview length was scheduled to reduce fatigue and scheduled at a time that is convenient for the participant.

The participants in this study all identified as young women who graduated high school in 2020 or 2021. They each completed a series of three sequenced courses that the Georgia State Board of Education has approved as a CTAE Career Pathway. These pathways are related to a career in architecture, engineering, or computer science. Qualitative inquiry required that the selection of participants be purposeful and based on involving individuals whom can provide a detailed understanding of the topic being explored (Creswell & Guetterman, 2019; Creswell & Poth, 2018; Marshall & Rossman, 2016; Merriam & Tisdell, 2016). Information was gathered through qualitative interviews where the young women described their experiences related to their involvement in their STEM-related pathway.

Typical sampling is a form of purposeful selection that strives to identify and engage participants who represent a typical or normal sample of the experience of interest (Creswell & Guetterman, 2019). Participants in my study were selected purposefully, because they were typical young woman who recently completed one of the three pathways, architecture, engineering, or computer science. The young women understood the research's purpose and motivation and understood that their names and identities would not be used in the results. The participants and I worked through a process that took a considerable amount of time, and they were made aware of the time commitment. Each participant was asked to commit to two separate

interviews, spaced a week apart, each lasting no more than one hour. The young women were also asked to review the data transcript and results of the study to verify the accuracy of their information.

All 2020 and 2021 graduates identifying as young women who completed at least one of the third level classes were considered for participation in the study. The participants' academic status was classified as a high school graduate. I did not exclude any participant or discriminate in any way based on color, religion, national origin, or disabilities. The participants were homogenous in that they are all pathway completers and young women. Each participant was willing and had the time to participate in the study. I started the selection with 2021 graduates and then 2020 graduates in alphabetical order by their first name. I tried to include an equal sample of students from each of the pathways starting with one from architecture, one from engineering and one from computer science.

There is no consensus on the required number of participants in a qualitative study (Baker & Edwards, 2012). The most common answer is it depends on several factors. The first factor to consider is the type of study being conducted and the type of information needed (Marshall & Rossman, 2016). An in-depth interview study requires seeking rich and detailed information from the participants, which takes time to collect. Quality of the data is more important than quantity. The ultimate number of participants is based on saturation of information (Seidman, 2019). Saturation is known when there is repetition in data. Another factor to consider is access to participants. Participants who completed the pathway in 2020 and 2021 and their initial responses are described in Table 2. There were 5 young women enrolled as third-level students in the architecture, engineering, and computer science STEM-related pathways for the 2021 school year and 8 who graduated in the 2020 school year. I contacted each young woman

inviting her to take part in the interview process. Three of the pathway completers agreed to participate. I transcribed and analyzed each interview before conducting the next interview in order to determine saturation of information and to revise the interview questions if necessary to gain complete responses.

Table 2

Potential Participants

Potential Participant	Graduation Year	Pathway Completed	Response Status
1	2021	Engineering	Under 18 years old
2	2020	Computer Science	Declined
3	2020	Engineering	Declined
4	2020	Computer Science	No response
5	2020	Computer Science	No response
6	2020	Computer Science	No response
7	2021	Computer Science	No response
8	2021	Architecture	No response
9	2021	Architecture	No show
10	2021	Architecture	No show
11	2020	Architecture & Engineering	Participated
12	2020	Computer Science	Participated
13	2021	Engineering	Participated

Data Collection

Data collection is significant in qualitative studies, given the extensive information needed to explain the unique meaning participants ascribe to their experiences in context (Creswell & Creswell, 2018). Data are ordinary bits and pieces of information and can be found in documents, by observing and describing behavior, and documenting conversations.

Interviewing is often the primary method of data collection in qualitative research (Merriam, 2016). I conducted in-depth interviews because it was a powerful way to gain insight into educational and social issues reflected in participants' lives (Seidman, 2019). The young women who completed the architectural, engineering, and computer science pathways are often not

heard. It was essential to listen to why they were making these decisions to strengthen the recruitment process.

The primary data was collected using semi-structured interviews. Creswell & Poth (2018) suggests taking notes during the research process to identify how personal experiences may influence data. As the researcher, I kept a research journal and recorded reflections.

Interview Structure

Research interviews have structure and purpose. An interview structure is usually based on the amount of flexibility needed to explore participants' experiences. A semi-structured interview has flexibility and the wording and order of questions may change from one participant to another based on each participant's responses. Semi-structured interviews are used most often in qualitative research because they provide structure but allow for deviation when needed to clarify meaning (Merriam, 2016). A semi-structured interview was used in this study and included preset and open-ended questions. This format allowed me to cover the desired areas that needed to be explored. It gave me the flexibility to construct questions during the interview, based on responses, to probe for additional information when clarification was needed. Asking the participant to elaborate on prior information with concrete details required them to reconstruct memories, which improved the accuracy of data (Seidman, 2019).

Data saturation is the optimum choice for determining the required number of participants (Merriam, 2016). I collected data until I exhausted the data pool. Seidman (2019) suggests a three-interview series where each participant is interviewed a few days to a week apart. Multiple interviews gives each interview a specific purpose. The first interview in the series allows participants to explore their experiences'. The second interview places the experiences in context, and the third interview focuses on reflection of the meaning of the

experience. This three-interview technique was not feasible because of the amount of time required. The governing model determines a logical process that can be repeated and allows data to be documented and verified (Seidman, 2019). Because of time constraints, I conducted one interview with each participant and communicated with them through email to verify the transcription.

The first part of the interview focused on each participant's history of early interests in her completed pathway. Participants were asked to reconstruct early learning experiences to explore relationships that influenced their values. Participants reconstructed their knowledge, experience, and impressions of work and career interests. They were asked to reflect on how they saw themselves in the future in both educational and work settings. We explored their expectations related to achievement and relationships with friends, parents, and teachers. I asked them to describe activities they enjoyed apart from school, such as student organizations or sports. The second half of the interview I asked participants to reflect on the meaning of their pathway experiences. The time between the interview and verification of the transcription allowed me and the participant to reflect on any additional information that needed to be added to enhance the depth of the data collected. The interview's important aspect was to create an environment where the participant could reconstruct and share contextual data (Seidman, 2019).

Interview Questions

Good interviews reflect stated research questions using familiar language (Merriam, 2016). Patton (2015) suggests asking questions relating to experience, behavior, opinions, values, feelings, and knowledge. He also suggests framing questions so participants will have to use their senses to describe memories. The last type of questions will be background/demographic to verify the participant's age and race. See Appendix A for interview questions by type.

Patton (2015) recommended against asking "why" questions, given that it causes speculation and often leads to a dead-end response. Other suggestions useful for uncovering insights during interviews were to use hypothetical questions, devil's advocate, ideal position, and interpretive questions (Merriam, 2016). The participant was asked to describe what someone would notice when they first walked into the class. A devil's advocate question used to depersonalize an issue was, "Some people might say this is a difficult class, what would you say to them?" I asked the participants to describe the ideal student for the classes in which they were a member. Interpretive questions seek opinions and feelings. "How was participating in this class different than what you expected?" was an example of an interpretive question. I used open ended questions to yield descriptive data. This type of questioning allowed me to detach from the interview guide (Merriam, 2016).

Creswell and Creswell (2018) recommended using an interview guide, an interview protocol, and asking approximately five to seven open-ended questions. It was also helpful to that I had developed probing or exploratory comments such as "Tell me more about..." or "Can you clarify what you meant by..." (Seidman, 2019). I used Kaltura to convert the recorded interviews to text files. I formatted the data into a written document using Microsoft Word and distinguished the responses so the participants were able to verify the accuracy of their conversation. They reviewed the transcript of the first interview before the second interview was conducted. The second interview was also designed to ask questions that developed due to the first interview.

According to Seidman (2019) the most critical skill of an interviewer is active listening. He suggests listening on three different levels. First, I had to listen for substance (i.e., what the participant said) and then listen for the inner voice versus the more public voice. The public

voice, or outer voice, is more guarded and may use words like "challenging" or "adventurous" to describe a situation to make it seem more positive. I had to find a way to get participants to express their experiences without feeling vulnerable. The first question I asked was how their day went as it was designed to set the participants at ease (Creswell & Creswell, 2018). I also make sure the participant was at ease by treating them with respect, being nonjudgmental and hospitable (Merriam, 2016). The third level of listening was to watch for nonverbal cues that indicated that the participant was uncomfortable and needed a break. I kept track of time and did not let the interview go past the allotted hour out of respect for the participant (Seidman, 2019).

Data Management

Organizing and managing research data was planned before data collection began. Interview recordings, transcriptions, and documents were made identifiable for easy access and copies stored in multiple locations (Merriam, 2016). My interviews were recorded using audio equipment so I was able to concentrate on listening during the interview. Seidman (2019) suggested that listening is the most crucial part of the interview. Audio equipment was available in the high school lab. Audio recordings included the date, time, and participants' code names. I asked each participant to select a code name that was used to protect the participant's identity (Marshall, 2016). Audio was recorded through the computer microphone. During the interview process, I made notes on the interview script of information that needed clarification from the participant. I also jotted down additional questions that arose during the interview. It was essential to allow the participant to talk without interruption. These interview notes recorded on the interview protocol were stored with the recordings (Seidman, 2019).

I transcribed the interview data personally. Doing so allowed me to hear and observe the data collected a second time and through a different role as the observer only. Transcribing the

data was not an easy process as spoken conversations are usually not like written responses. The conversations included unfinished sentences and pauses that added meaning to the data (Marshall, 2016). I transcribed using double-spaced, numbered line format and the words identified by who said them. I used Italics for the words I used and regular font for the participant's words. The transcribed data was shared with participants to validate accuracy because data should be validated through member checking, sharing the data, interpretations, and conclusions with participants (Creswell & Creswell, 2018). Each time the member checking process occurred, feedback and the date was recorded on the transcript (Seidman, 2019).

It was crucial to ensure the security and privacy of participant data. I collected and stored data at the collection site on two external hard drives. Data was stored in my office, which had a lockable cabinet where data files were securely kept. Each participants' data piece had a designated area for storage. Data will be kept three years after analysis (IRB). Data security and privacy methods were shared with the participants to reinsure them of their privacy rights (Creswell & Creswell, 2018).

There were three options: setting up data manually, word processor, or computer-assisted qualitative data analysis software (CAQDAS). There were several data analysis software packages to choose from. Most of them offered similar features in their basic package. There was no one best CAQDAS to select from, and they were recommended for studies that are significant in size (Seidman, 2019). Learning data analysis software was determined to be time-consuming, and a basic word processor could be used to organize, manage and manipulate qualitative data (Ruona, 2005) I decided to organize my data using Microsoft Word. I placed the data in a table format and used highlighting to color code.

Data Analysis

I conducted data analysis by organizing data, reading transcripts, coding transcripts, creating themes from the codes, and then making interpretations (Marshall, 2016). Although I learned by doing, Creswell and Creswell (2018) stressed the importance of planning for the analysis procedure before data was collected. There was no consensus on the best way to conduct data analysis, but using a planned procedure save time and frustration. Creswell and Creswell (2018) described the process as having two layers: general analysis and more in-depth analysis based on the study type. Saldana (2016) described the process as going through cycles. Regardless of the method used, data analysis was the most challenging part of the research practice. According to Merriam and Tisdell (2016), I would not see how data analysis worked until I used my data to answer my research questions.

Creswell and Creswell (2018) described the data analysis process as a spiral image where I circled through the data several times, reducing the amount of data each time while applying analytical judgments to interpret the meanings of words and phrases and how they related to my study. Data collection and data analysis went hand-in-hand, was not linear, and was messy (Marshall, 2016). I started analyzing during the collection process and did not wait until all data was collected. Analyzing and interpreting the data was very labor-intensive because it required spending a significant amount of time with the data to determine what was essential (Seidman, 2019). Data needed to be segmented and taken apart after it was collected in order for it to make sense (Creswell & Creswell, 2018). The goal of the analysis was to make sense of the data, thus requiring going back and forth between factual statements and abstract concepts (Merriam, 2016).

Organizing Data

Data was organized using a deliberate and straightforward structure. A system for organizing data is often overlooked but needed to be used so that data was readily available when needed. Data needed to be kept secure to protect the confidentiality, and multiple copies were kept to protect against accidental loss (Merriam, 2016). Consistency in file naming and file formats was important so that information could be located more easily (Bazeley, 2013).

A folder was created housing information about the project with a subfolder designated for each participant and named the participant's alias. Each participant's folder included an activity log, interview transcripts, data analysis, and other supporting documents. A log (see Appendix B) was used to organize activities and documents such as data gathering, scheduling/conducting interviews, and transcripts. It was kept in the participant folder (Marshall, 2016). All files were named, including the participant's alias and a description of the data type collected (see Appendix C), and was saved to both external and internal hard drives.

Transcription files were formatted using a template (see Appendix D) for ease of use and consistency. An interview protocol (see Appendix E) was used for each interview for the same reason. The paper copy of the transcripts were kept in my office in a locked filing cabinet. The audio files were transcribed using Otto.ai. I organized the interview transcript using an italic format distinguishing researcher questions from participant answers. I kept an electronic file, a hard copy, and an organizing scheme in its original format as a backup. A separate data set was used as a working copy during the analysis process (Marshall, 2016).

Coding

After organizing the data, I started the coding process, implementing the Holistic method by reading through the interview transcripts several times to get an overall feel, mood and

description of the data (Saldana, 2016). Coding is assigning an abbreviated designation to the data allowing specific aspects of the data to be easily retrieved (Merriam, 2016). Not all data was used in the study, and coding was a way of categorizing the data to identify the desired information. Objectivist proposals have a predefined list of data categories for coding that undermines qualitative research assumptions. However, these initial categories helped develop understandings and were modified as the data was analyzed (Marshall, 2016). Saldana (2016) recommended reducing the data by going through multiple coding cycles, each having a specific goal. I read through transcripts multiple times and immersed myself in the participants' words (Agar, 1980). This immersion process was essential because the interview must speak for itself. Since I was the research instrument, the reaction between me and the text influenced the analysis outcome. My judgment was an important and recognizable part of the process (Seidman, 2019). It was essential to become intimate with the data before focusing on the details and losing focus on the overall meaning (Marshall, 2016).

It was crucial to document reflections through memoing during the analysis cycles. Memoing, the process of writing short phrases, concepts, or ideas in the margins while reading through the data (Miles et al., 2014) was a simple way to keep track of my thoughts (Merriam, 2016). Highlighting and crafting memos during the analysis process documented my reactions and suppositions, leading me to a deeper understanding of the participant's meanings. (Creswell & Creswell, 2018).

Once familiar with the interview transcripts, I then read seeking and highlighting where to place Value Codes (Appendix F). Value codes reflect the inner cognitive systems, attitudes, beliefs, and values of the young women's worldview perspectives (Saldana, 2016). The creation

of the preliminary value codes was influenced by the study's purpose, research questions, literature review, and Vroom's (1964) Expectancy Theory.

I used provisional Value Codes (Appendix F) to identify essential data. Creswell and Creswell (2018) suggested having no more than 25-30 codes. These codes were refined, and new codes emerged from the data as expected and unexpected information was discovered.

The second coding cycle was Elaborative Coding, which expanded an existing idea or refined theoretical construct (Saldana, 2016). Coding required selecting the interview data that reflected the concepts of Vrooms (1964) Expectancy Theory: expectancy, instrumentality, and valence. Applying the Elaborative Codes was another way to segment the data. I read through the data and highlighted any text that applied to expectancy and added memoing to insert reasons for the connection. I read through the interview transcript two additional times, looking for examples of instrumentality and then valence.

Creating Themes

The next step was arranging coded data by categories (Seidman, 2019). Merriam and Tisdell (2016) explains that categories, themes, and findings are interchangeable terms. These themes were an idea or concept that the codes fit. Strategies that assisted with this task were reviewing memos, searching for quotes, creating diagrams to represent relationships among codes or concepts. Interview research required me to look at how the questions' answers were related to the literature and Expectancy Theory. Elements, and experiences of the young women's stories helped identify themes (Creswell & Creswell, 2018). Clandinin and Connelly (2000) suggested analyzing the data in narrative research for interaction, continuity, and situation. Part of the difficulty in shaping the material into a form that could be shared was having to let go of some material (Seidman, 2019).

I crafted a profile for each participant, using their words in the first person. The aim was to share what was most exciting and related to how the young women entered the program and what made them stay. I captured what this meant to them and how they see themselves. Seidman (2019) suggested that crafting a participant profile is the most consistent way to share narrative interview results. Once the participant's response was reduced through Value Codes and Elaborative Codes, the response was arranged by interview question and participant. The goal was to reveal common themes in the data. The grouping for participants and interview questions is illustrated in Appendix G.

Interpretation of Data

Raw data has no meaning without the act of interpretation and the writing of the final report (Marshall, 2016). One of the problems with writing the results is deciding when the analysis ends (Merriam, 2016). Interpretation of the data will be the final step in the data analysis process. This development will come from the memoing turned into codes, reduced to themes, and finally abstracted into a conclusion and recommendations.

There is no standard format for reporting the findings of a qualitative study. Merriam and Tisdell (2016) suggests selecting the audience, selecting a focus, and describing the particular setting where the research took place. The audience will want a description of the setting to know if the results are relatable to their situation. The final written report will include a summary of the entire study, including the purpose and research questions. A brief statement of the literature review, the theoretical lens, and a description of the method and participants will be included. The findings, a reflection of what I learned in the process are essential, but Merriam and Tisdell (2016) cautions that less is more.

My study's audience will be practitioners, and the focus will be on why young women elect to complete the engineering, architectural drawing or computer science pathway and what this accomplishment means to them. Understanding these reasons may shed light on what attracts young women into the pathway.

Validity and Reliability

There are challenges to the trustworthiness in qualitative research, but there are several procedures for establishing validation, such as member checking, triangulation, and external audits. I exercised two methods to offer credibility (Creswell & Creswell, 2018). I implemented these procedures to ensure the validity and accuracy of the analysis and conclusions. I am presenting the findings in a written format using the participants' words to illustrate key concepts and ensure the information matches the participants' ideas and responses.

Young women volunteered to participate in this study. The study's purpose was shared with the participants, and they were asked to share as much information as they felt appropriate. Participants were encouraged to participate as openly and honestly as possible. Participants had the opportunity to withdraw from participation at any time.

The interview structure and timeframe added to the data's trustworthiness because it gave participants time to reflect on their experiences and place the experiences in context. The participants and I had multiple opportunities to check for inconsistencies in the meanings of the participants' experiences (Seidman, 2019). I exercised member checking by requiring the participants to be active participants throughout the research process to ensure the data's trustworthiness by reviewing interview transcripts, themes, and results. The young women each reviewed their transcript through email and agreed with the accuracy of the written form of our conversation. The participants were informed of this responsibility before they agreed to

participate in the study. Member checking allowed corrections to be made and solicited additional important data (Creswell & Creswell, 2018). Transparency was exercised throughout the study.

My academic advisor and the review committee participated in the validity of the study by offering suggestions regarding the interview and transcription process. Academic transcripts of the participants were reviewed to verify pathway completion and academic success. Another source for external validation was my peers Erica Mayfield and Forrest Johnstone, who teach in the same field and are content experts in the area of STEM. They assisted by participating in conversations with me regarding validity of data. These reviewers were able to play devil's advocate by asking clarifying questions and pointing out information that I did not see (Lincoln & Guba, 1985).

Methodological Limitations

Qualitative interview research can be a challenging approach to use given the complexities of gathering, analyzing, and presenting data in a written form that presents answers to research questions. Life is multilayered, and it is essential to uncover the figure under the carpet to give life context. It was difficult for me to keep my background and beliefs from reshaping the participants' story (Edel, 1984). Another consideration is that research relationships are complicated when balancing multiple roles as the young women's former teacher and the interviewer (Dwyer & Emerald, 2017). It was crucial to foster a relationship with the participant, so they were willing to share information about people and values that influenced their decisions (Seidman, 2019). Another limitation is forming and maintain a teacher/student relationship during the COVID-19 pandemic. The restrictions surrounding personal contact forced teachers and students to use alternative ways to communicate.

Ethical Considerations and Subjectivity Statement

IRB approvals were essential to the research proposal process. The University of Georgia Human Subjects department was the portal for acquiring approval for my dissertation study. I worked under the direction of my advisor, Dr. Rojewski, through the IRB approval process. Part of the process required me to give an abbreviated version of my proposed research. The approval inquired about specific ethical concerns such as confidentiality and anonymity of collected data. I completed the Institutional Review Board training in June 2021.

Constructivism is the interpretive framework that is most consistent with the position of qualitative research. Researchers position themselves in a qualitative study given the interpretive nature of inquiry and analysis (Creswell & Creswell, 2018). The most common type of qualitative research is interpretive, which posits that there is no single observable reality but multiple socially constructed realities. Researchers do not find knowledge, they construct knowledge (Merriam, 2016). As the primary instrument of this qualitative study, I understand that it is essential to explain my philosophical perspective. I have had the joy and responsibility of working with young adults in a high school STEM-related program for 25 years as their teacher. During this time, the majority of my students have been young men. I often question why more young women are not completing the pathway. I want to hear from the young women who have completed the pathway to find what they found interesting and how they describe the experience of completing a STEM-related course of study.

I am a Caucasian woman and a native of Georgia. I am the oldest of three children born to Marshall and Teen Morgan of Alabama. My brother and sister and their families all reside in Georgia. I am the only child in my family to graduate from college although I do not believe that everyone needs to attend college to be successful. I was influenced by her father who was raised

on a farm in Alabama and worked as an interior trim carpenter most of his life. He worked until he suffered a stroke that left him physically disabled at age 60. He later died at age 77 in 2016. My mother, who did not work outside the home, went to work in order to support the couple financially after my dad became disabled. I saw a reversal of roles in my parents' relationship as my mother became the bread winner and my dad became dependent on her for support.

I have been married to David for 33 years and we have 2 sons, Nick and Seth. David works as a project manager for a custom stainless steel fabricator. Nick and Seth both work with their father. David has a son and daughter from a previous marriage, Scott and Mollie. Scott will retire in June 2019 from the Air Force and Mollie has a degree in psychology and special education.

My interest in STEM started in middle school when I rotated through elective classes. During this educational era, students were exposed to industrial arts, home economics and business. I enjoyed the shop class and later took 3 years of drafting in high school where I was the only girl in my class. I worked 10 years as a drafter while attending college part time. I moved into a position as a marketing rep for a commercial equipment manufacturer and earned a degree in Business Marketing. After a couple of years traveling I returned to my alma mater where I taught drafting five years. I then moved to a new high school to open a drafting program where I currently teach. I went on to obtain my Master's degree in Instructional Technology from Georgia State University.

I believe that everyone has a right to an education but that grades must be earned. I believe that most learning takes place by doing and some learners must practice more than others to become proficient. I believe that all students are capable of learning given a sufficient desire

and a supportive environment. I have a strong work ethic and have high expectations for my students.

Timeline

IRB was requested in June and approved in August. Data collection took place in August and September 2021. Interviews were held online when it was convenient for the participant and lasted no more than one hour per interview. Interviews were spaced two weeks apart allowing me time to transcribe the data. Participants were asked to verify transcriptions before the results of the study were prepared.

CHAPTER 4

FINDINGS: INTERVIEW SUMMARIES OF PATHWAY COMPLETERS

This chapter presents findings including a description of participants and their journeys to pathway completion. Their interviews were used to create themes that explained their motivation to persist. Participants graduated in either 2020 or 2021 from a high school located in the metro Atlanta area. Each individual completed at least one of the architecture, engineering or computer science pathways. Sam completed the architecture and engineering pathway, Kim completed the computer science pathway, and Susan completed the engineering pathway as shown in Table 3. I used their words to validate their values as they related to their pathway journey.

Table 3

Participant demographics

Sam	Kim	Susan
Architecture and Engineering Pathway	Computer Science Pathway	Engineering Pathway
Graduated in 2020	Graduated in 2020	Graduated in 2021
19 years old, Caucasian	19 years old, African American	18 years old, African American
Single parent home 2 older sisters	Two parent home, 2 older brothers and an older sister	Two parent home 2 older brothers

Sam's Account

Sam described herself as a 19 year-old Caucasian young woman at the time of the interview. She said graduated high school in May, 2020 completing the Engineering and Architectural Drawing & Design Pathways. A pathway is a series of three courses in a particular career cluster as defined by the Career and Technical Education division of the Georgia

Department of Education (Georgia Department of Education, 2020). I met with her for my first interview. We met online using Google Meets at the beginning of the day and had no technology issues. Our interview was very informal and not rushed. I taught Sam in five different classes during her high school experience, so we were very comfortable talking to each other. Sam indicated that she is currently a second-year student at Kennesaw State University, and is pursuing a major in environmental engineering. She said, *“I volunteer in an environmental recycling education program during the week at Kennesaw State and I work part-time on the weekends at a deli in my home town.”*

Sam shared that she lives with her mom, a technology specialist, when not at college. She said that she is the youngest of three girls, describing both of her sisters as much older which resulted in her not spending much time with them growing up. *“My mom and dad divorced when I was in elementary school. My oldest sister also moved to Ireland when I was young. It was mostly just me and my mom.”* Sam described having many friends in elementary school and enjoyed learning. She participated in the gifted program, band, and the drama club. As a child she remembered playing with Legos and Lincoln Logs. Sam said *“I stayed with a neighbor who had a home daycare after school and during the summers. My friends and I enjoyed playing outside. I remember being one of the oldest children in the group.”* While growing up, Sam considered becoming a veterinarian or a gymnast.

During her childhood, Sam spent time during summers in Tennessee at her uncle’s house playing with her two boy cousins. Her cousins are around the same age as her. *“They lived out in the middle of nowhere and we had fun shooting fireworks and riding four-wheelers.”*

Sam said she did not remember registering for her high school academics or electives, including pathway courses. She stated, *“Once I completed the Introduction class, I decided to*

continue to the second- and third-level classes.” Sam completed both pathways before graduating and decided to consider this area as her career choice. Sam stated that she did not know what engineering was before she took the class. *“I especially enjoyed the CAD drawing portion of the class.”* She also mentioned a couple of the projects that she enjoyed working on when enrolled in the class.

Sam shared that the classes were easy for her. She indicated that the key to her success was to stay focused on her work and be able to work with others. She believed that if anyone has trouble learning in the class it is due to a lack of effort. She remembered, *“The class started out with learning the basic principles of engineering and then we applied these principles using the software. Each class built on information learned in prior classes.”* Sam does not recall being treated different as one of the few girls in the classroom. She did remember during an architectural presentation that the girls were all hesitant about presenting to the group.

Sam said she is not sure why she has selected environmental engineering as her college major.

I do remember taking a field trip in elementary school to a water power plant. I have not decided on the area of the environment that I want to specialize in. Environmental engineering is preventing air, water, and land pollution and environmental engineers design things like landfills and waste water treatment plants.

Sam said one of her college professors has experience as an environmental engineer and she is mentoring her.

Kim's Account

Kim stated that she was 19 years old at the time of the interview. She said she was an African American woman and a freshman at Georgia Tech. *"I graduated high school in May, 2020 and I completed the computer science pathway while in high school."*

Kim grew up in a two-parent home and is the youngest of 4 children. Her said her mom is a nurse and her father distributes parts for the airline industry. Kim indicated that her mom earned a nursing degree and her father attended college but did not complete a degree. She said,

My oldest brother is married and has a child. He works as a digital designer and has a bachelor's in digital arts design. The next to the oldest brother is a software engineer at Michelin in North Carolina. Kim's older sister has a bachelor's degree in mathematics and athletics and is currently working on a master's degree.

Kim said she was born and raised in the metro Atlanta area. She stated, *"My family moved and, as a result, I had to transfer to a neighboring county during my sophomore year of high school."* She described this transition as a difficult one for her because of the increased level of diversity in her new school. *"It was very hard for me to leave my friends that I had gone to school with my whole life."* Kim's recollection of elementary school revolved around social events like field day, lunch, and riding the bus. She embraced the ride home from school as it was a special time spent with closest friends. *"My favorite subject was social studies and I really liked visiting the library because I knew the librarian and she would save books for me."*

Kim had many neighborhood friends growing up. She stressed the importance of playing outside with other kids in the neighborhood and the comfort of being part of a group that was familiar. Most activities with her neighbors were physical in nature like riding bikes, jumping on a trampoline, and running or chasing each other. Kim said, *"I don't want to sound like that*

person but, I think playing outside is much better than being glued to electronic devices. I always completed reading assignment during the summer breaks.”

Kim said admired her oldest brother because he was always so strong in his convictions and pushed himself to reach his goals. She said that she also admired her mother’s strong work ethic.

My mother always worked a little extra to make sure that the family was always provided for. Mom worked nights so if she did not make an effort to be home before mother left for work, I would not get to see her until the next day.

Kim said she hopes to be as motivated in her work life as her mom and oldest brother, and does not let obstacles stop her from reaching her goals.

Kim remembered the message of attending college was stressed from a very young age and was very important to her family. *“My siblings were all older, and that allowed me to see the preparation and planning required to attend and be successful in college.”* Her early thoughts of career choice were a teacher, police officer, or doctor. *“I think I my aspiration for wanting to become a doctor was important to me because of my mother being a nurse.”* Despite identifying these early possible career paths, Kim admitted that she did not really have a true knowledge of these occupations.

Kim said she entered the culinary arts pathway in the ninth grade although she never considered this as a career choice. *“I just always liked cooking and signed up for that pathway to learn more about cooking.”* When she transferred to her new high school following her family’s move, the culinary arts pathway was not offered. As a result, *“I ended up in the computer science pathway.”* She did not select the class but it was one of the few options available to her

because she entered school during the middle of the school year and many classes were already at capacity.

The first class in the pathway was introduction to digital technology. *“I really enjoyed the class even though it was not a class that I had planned to take. I liked the class because there were a lot of games and I loved playing games.”* A software she remembers learning was Scratch that was used to create games. She said it was very satisfying to play a game that she had designed. Kim said that she liked the class so much that she decided to take the next class in the pathway.

Kim said she did not feel prepared as she progressed through the pathway. *“I noticed during the first day of school that there was only one other girl in the class. I thought, this could be really bad!”* She expected the class to be tough. *“Being one of the only two girls in the class made me become really competitive.”* She wanted to make sure that she was prepared so that she could outperform the boys. She knew that her dad and brother had experience with writing code so she asked them to tutor her so she would feel prepared for class. *“It was my expectation to be better than the other students. I made sure that I was always prepared for that class.”*

Kim said that she would describe the class as very relaxed and not a class to stress over. She said that the teacher was great and was very good at explaining concepts. The class requires the use of critical thinking skills and one should expect to spend most of the time using the computer to write code. She said, *“Each class would start with an introduction of what students should do during class and then we would work on their own.”*

Kim admitted, *“It was very empowering being one of the two girls in the class. The first class in the pathway had more girls in it. As the pathway progressed, the classes got smaller and there are fewer girls.”* She said that she worked with the other girl in the class and that they

stayed to themselves. Kim said that by the third class in the pathway she was determined not to ask anyone for help because she did not want anyone to think that she did not know what she was doing. *“The longer I was in that class the more interested I became in coding.”* Kim said that she really like the pathway concept in high school. *“Pathways allow students to really learn about a career.”*

Computer science requires the use of a lot of math according to Kim. She said that it is important to know your formulas and to be able to logically think through a problem. She said the most difficult part is to debug another designer’s code. *“This requires you to try and think like that other person to determine what they were trying to accomplish.”* She said it is much easier to write your own code. Kim shared that she is currently a biochemistry and pre-med major at Georgia Tech. She said, *“My first semester of college I really considered majoring in computer science. My roommate is a computer science major.”*

Kim remembered that before she graduated high school that one of the Spanish teachers started a club for girls who could code. She said, *“That was a great idea, to create a group for girls to be able to come together and learn more about computer science to see if this is something that they might be interested in as a career.”*

Kim said at Georgia Tech that most of the STEM classes are majority guys. She said that she has experienced situations where it was difficult to work with groups of guys. She said, *“Many guys are not open to my input with group projects or they will restate your idea with different words as if it was their own.”* Kim said that most of the girls at Tech do not stand for that and that they do what is needed to get through the classes. Most students at Tech do not underestimate each other. Kim also remembered, *“I experienced being treated differently at work because I was a girl. I worked at a doughnut shop and was not allowed to work with the*

ovens and press in the kitchen. Eventually I did it anyway.” She said, “As a women it is expected that you will be treated differently in the workplace.”

Kim believed that there are more guys than girls in STEM classes because of societal norms. *“From a young age girls are conditioned to be teachers and no one encourages them to consider computer science.”* She stated that the encouragement of parents is very important. *“Many students in high school select classes based on what their friends are taking.”*

Susan’s Account

Susan and I also met online via Google classroom. Our meeting was scheduled for a Saturday afternoon and I waited for 30 minutes past our scheduled starting time before she logged on. She was very apologetic and said she had lost track of time while cleaning her apartment. Despite the late start, it turned out to be a great interview. The only technical problem was a break now and again in voice quality. Susan had attended softball practice that morning and then came home and was cleaning when she remembered our appointment. Her interview was upbeat as she is a very energetic young woman. I have known her for four years so interviewing her was very comfortable for both of us.

After I explained the process of the interview, Susan described herself as 18 years old, African American, and identified as a woman. She graduated from high school in May of 2021 and completed the engineering pathway. She is currently attending Wesleyan College on an athletic scholarship. Based on what Susan shared, she is the youngest of three children and lived with her parents until leaving home to attend college. I listened as she described living with her suite mates. She said she was very happy and appeared to be well adjusted as she shared her experiences and new friends at college.

Susan's mother is a middle grades math teacher and earned her master's degree in mathematics education. Her father is a construction manager and has a bachelor's degree. Both of her brothers attended college and played college sports. Being the only girl and having two older brothers, Susan spent a great deal of time in and around sporting events. She not only played sports but was also involved in dance, gymnastics, and cheerleading. Her dad played sports and is still coaching recreational baseball. Susan described her family life while growing up as always very busy.

When describing elementary school, Susan said, "*My friends and I were in a gifted program together.*" This meant that she was one of the higher performing students in her class. She said that throughout her elementary school years most students moved up together in the same class. Susan stated, "*I also had friends that I made through my involvement in softball and cheerleading.*" Susan's elementary school experience was relaxed even though she said she did not see it that way at the time. It impressed her that everything in elementary school was made to be special and exciting. Teachers made an effort to connect with their students. She noticed a sharp contrast as she grew older and had to work to make connections with her teachers. As she progressed in school, the work became less fun and more serious. Susan said, "*I still miss recess.*"

Susan said that she had a weird obsession with playing checkers as a child. She also loved reading, coloring, and drawing. At one point she thought that she wanted to be a fashion designer. She also had ideas of being a firefighter, nurse, veterinarian, or marine biologist. She said she also had an obsession with dolphins for a while. When asked if she and her brothers played much together as children she said,

Since I was the youngest and was not yet playing sports, most of the time I was watching them play sports until I was old enough to play. I did not start playing travel ball until I was in fifth grade. I always wanted a younger brother or sister but could not get my parents on board with the idea.

When asked about special childhood memories or summer camps, Susan remembered staying busy during summer breaks.

I had two girl cousins that I would visit during the summer and we would go on outings to the zoo and Six Flags. I always looked forward to visiting with them for a week. I spent most of my summers playing softball and attending camps. I went to gymnastic camp, church camp and art camps. I also attended a camp called Excel camp.

Susan was influenced by her parents and her oldest brother. She recognized that she and her brother were very different. Academics always came easy for her but her brother had to work to make good grades. The opposite was true when it came to sports, which was easy for him but was something that she had to really work at. *“I admired him because he was so dedicated and determined to get where he is now with baseball. I want to be really, really good. So, I want to be like him. He will forever be my idol.”*

Going away to college has allowed Susan to make new friendships that do not revolve around athletics. Her suite mates, the girls that she lives with, have all become her friends. She was excited to have friends that are outside her normal circle of friends. She is on the college softball team and they practice but the season doesn't start until the spring semester. Susan *“enjoy(s) watching Netflix. When I was younger, I enjoyed doing my schoolwork. But now it's more me time. I enjoy having more me time.”*

Growing up with brothers, Susan always wanted to compete with them. She knew that both of them had taken my class so she decided she would also. Another reason for taking the class was due to her dad being employed in the construction field. She thought taking my class would help her better understand what he did. She said that she wanted to see what the class was first hand.

So, I got in your class and I actually really enjoyed it. So I definitely wanted to take the second class. I think when you start something you should always finish it. Not completing the pathway is not getting the full story. It's like not having all of the pieces of a puzzle. When you have the whole story, then you can decide what to do when making the next decision. You have all of the details.

Susan completed the pathway during her junior year of high school and participated in dual enrollment her senior year. Dual enrollment is a program offered to qualified high school students allowing them to attend college classes and receive both high school and college credits.

Although Susan enjoyed my classes, she has decided to pursue a career in physical therapy.

I decided to become a physical therapist after I got hurt my junior year. I broke my wrist and then two weeks later I broke my nose. I didn't know my wrist was broken at first. I told the coach that I was fine and I want to play. So, he wrapped my wrist and I went back in. And of course, I made an error and had to be taken out. I couldn't do what I needed to do being hurt. I now understand what athletes go through now that I have had that personal experience. I want to be able to help them get back out there playing. So, this is my chance to help."

When asked what she would tell a student expressing the difficulty of engineering classes, Susan said that the difficulty might be the result of not putting in enough effort. She felt that if it is not a challenge then you are probably not gaining anything from it. *“If you come out of the class with new knowledge then you should be thankful that it was difficult and that you got something out of it.”*

When I asked her if she had anything else to add, Susan told me,

“I do want to be a physical therapist. In the second class in the pathway, we had a guest speaker that was telling us about the NASCAR industry. I still have an interest in being a motorcycle technician. I want to be able to tear down a bike and put it back together. I would have never had that interest if I had not taken your class.”

CHAPTER 5

FINDINGS: EXPERIENCES OF PATHWAY COMPLETION

In this chapter, findings are presented that describe a response to the research question for this study. The results address how these young women explained their experiences surrounding entry and completion of an architecture, engineering, or computer science pathway. Also addressed is how they were supported or challenged during the process of pathway completion. The results are first described based on an overall impression of the data during the first cycle of analysis. Predetermined codes were then used to identify the values, attitudes, and beliefs of the participants. The last section of the results is a description of their explanation viewed through the lens of expectancy theory. The words used by the participants are given to increase credibility.

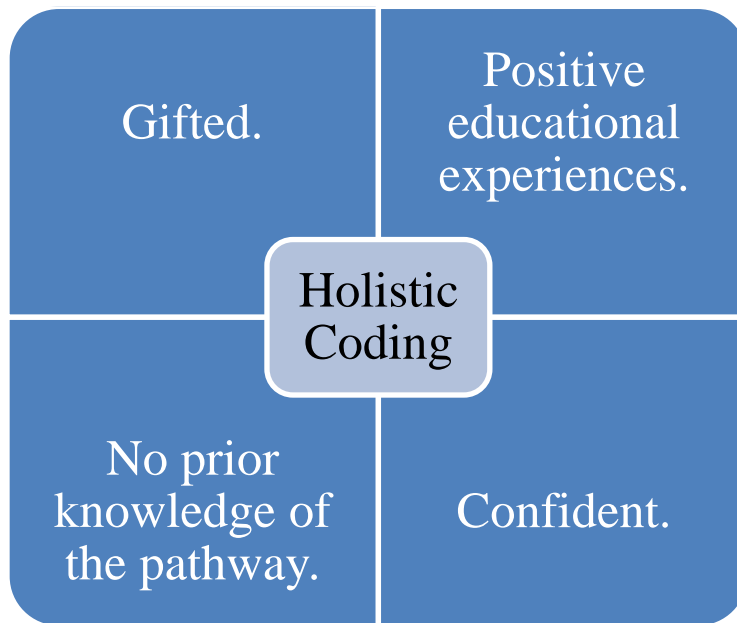
The data, summarized using Holistic coding (Saldana, 2016) is shown in Table 4. This data indicated that all three young women entered a pathway with no intentions of using the knowledge or experience from the course to guide their future career decisions. They had no prior knowledge of what the first course was about, and they did not express any initial gender biases toward the pathway. They also did not express having a career goal in mind or a plan for making a career choice. Their words expressed their self-confidence as they described their academic abilities and success without hesitation. They are each enrolled in college and have selected a major that they describe as important to them.

The data also indicated that all three young women expressed very positive reflections of their personal and educational experiences during their time spent in elementary school. They described themselves as being gifted individuals and enjoying school. They were influenced by

their family and close circle of friends. They each described their family members in terms of the level of education obtained, even if it included some college and not a college degree.

Table 4

Holistic data summary



Value Codes

The findings from the second cycle of analysis were revealed using Value codes. These codes were used to segment qualitative data to reflect the inner cognitive systems, attitudes, beliefs, and values of interview participants (Saldana, 2016). Predetermined value codes revealed insights into the relationships and experiences that the participants described. The value codes were derived from the purpose of the study, literature review, and Vroom's (1964) Expectancy Theory. Participants' responses are arranged using these predetermined codes and are summarized in Table 5. The participants' responses had many similarities and were congruent to what was found in the literature.

Table 5*Value codes data summary*

Value Code		Summary of Data
Entry	Surprising Information	I am not sure how but, I was just put in the class. I transferred in second semester and had to take the classes that were left. My brothers both took the class and I wanted to compete with them; I wanted to know more about my dad's profession.
Influencers	Influential people	Mom, influenced me the most because it was just the two of us most of the time. I thought of my oldest brother as my role model because he was so strong and kept pushing. I also admired my mom because she had such a strong work ethic. My brother influenced me because he was so dedicated and determined to succeed in baseball.
	Influential childhood activities	My favorite summer activity was visiting with my uncle and boy cousins and riding four wheelers and shooting fireworks. My neighborhood friends and I played outside mostly participating in physical activities like playing chase, hide-n-seek, or riding bikes. I had a weird obsession with playing checkers. I really enjoyed drawing, coloring, reading, and we were always very busy with sports.
	Influential educational experiences	I thought learning was fun. I was in the band and drama. I enjoyed social science, the library, field day, and the bus ride home. There were so many different dynamics on the bus. I knew everyone on the bus and that was comforting. Elementary school was relaxed and fun. I felt a special connection with my teachers.
Perceptions	Perceptions of self	I was pretty smart. I expected to be better than everyone else. I am competitive and like to finish what I start.
	Perceptions of careers as a child	Veterinarian, policeman, firefighter, teacher, nurse, doctor, scientist, marine biologist, gymnast, and fashion designer.
	Perceptions of pathway requirements	Focused and willing to work. Ask questions. Ability to work with others. Ability to think independently. Critical thinking skills. Able to visualize. Motivated. Not over confident and willing to learn.
Values	Values of education	Post-secondary education is important. Completing a pathway was important.
	Values of others	Family, friends. Learning from others. Helping others.

Value Code	Summary of Data	
	Values of character	Good work ethic. Determination. Finish what you start. Helping others. Motivation. Persistence.
Identity	Social norms	Was not treated differently in class. A little insecure in the class. Empowered being one of the few girls in class. Women being treated differently in the workplace is expected. High school students are not usually independent thinkers. Interest in being a motorcycle technician. Men think they know everything and do not value a woman's opinion.
Goals	Career goal	Environmental engineer, Doctor, Physical therapist.

The first code I searched for was the value of entering the pathway. The participants expressed different reasons as to how they entered the pathway. Sam said she did not recall registering for high school classes. *"I do not remember signing up for the class. I was also put in Music Appreciation and had no idea how to get out of it"*. Kim changed high school in the middle of her sophomore year. She left a school where she was in the culinary arts pathway.

"I was just put in there because I came the second semester. They did not have Culinary Arts, and the closest thing was Nutrition and Wellness. I did not want to take that, so I had to take what was left."

Susan's rationale for taking the first class in the pathway was because her brothers had taken the class and she wanted to see if she could outperform them. *"I also wanted to learn more about what my dad did for his job."* The participants did not enter the pathways to fulfill a career expectation. They all shared an uncertainty as to what the pathway was. Most students do not accurately know what engineers do (Madara & Namango, 2016).

The second value code I used to locate essential data was influences. The participants were influenced by people from their childhood, childhood activities, and educational experiences. Mom and older siblings were reported to have the most significant influence on the

participants. Most often, the role of a mother includes being involved in their children's education. Participants' moms worked as professionals in an area related to STEM. Sam's mom works in IT support, Kim's mom is a nurse, and Susan's mom is a math teacher. Kim admired her mom's work ethic and her ability to provide extra income to support the family. Perhaps having a mother in a STEM field minimized the stereotype threat, maximizing a girl's performance in STEM fields (Reinking & Martin, 2018). Kim and Susan were also influenced by their older brother's dedication and determination.

Childhood activities may also influence a girl's participation in STEM pursuits (Reinking & Martin, 2018). Participants in the study reported playing either gender-neutral or male-oriented games as children. Sam reported, *"some of my favorite summer activities involved visiting with my uncle and cousins and riding four-wheelers and shooting fireworks. They lived in the middle of nowhere."* Kim enjoyed playing with neighborhood friends, *"we mostly played outside, rode bikes, and played games like Red Robin, Hide and Seek, Man Hunt, all that stuff. I was super active."* Susan admitted, *"I had a weird obsession with playing checkers. I really enjoyed drawing, coloring, reading....we were always very busy with sports."*

The participants reported having enjoyable early learning experiences. Susan felt she had a special connection with her teachers, and *"everything was made to feel frou-frou like everything had a tutu on it. When I was younger, I enjoyed doing my homework."* She said things changed as she got older because it seemed more difficult to form relationships with her teachers. Sam spoke, *"learning was fun, and I was in band and drama. In elementary school, everyone is your friend."* Kim enjoyed *"social science and visiting the library. I looked forward to riding the bus home at the end of the day because there were so many different dynamics on that bus."*

The third value code used to segment the data was perceptions. Each of the participants described themselves as having above-average intelligence. Sam's comment was, *"I was pretty smart, so it was fun to learn. I really liked it [elementary school]. I am in the Honor's Program [at college], so I had to interview one of the advisors, one of the environmental engineering advisors."* Kim *"but I definitely was expecting to be better than everyone [at coding]."* When speaking of her college experiences Kim commented, *"This is a very tough school [college] to get in. So a lot of people here are high-headed and think that they know a lot of things and they can do whatever."* Susan's account *"My friends in elementary school, we were all in program challenge [gifted classes] together."*

Childhood career aspirations were explored with the participants. Their career ideas were not bound by the social norms of girls but included careers that were typical of boys. Sam *"Well, I really liked animals, so I wanted to be a vet. And I did gymnastics, so then I wanted to be a gymnast. Whatever thing that I liked [that is what I wanted to be]."* Kim *"So at a young age, it was put in my head that I wanted to be a doctor. My mom was a nurse. I can kind of be like her and be a doctor."* Kim also had other ideas *"Sometimes I thought about being a teacher or a police officer."* Susan supplied the most extended list of possible careers as a child. She said she jumped around a lot.

I wanted to be a fashion designer. I did want to be a scientist for a while. I did the science fair every single year in elementary school. I wanted to be a firefighter, a nurse. Well, I wanted to be a marine biologist. I had an obsession with dolphins for a little while. And from a marine biologist, I wanted to be a veterinarian.

The participants provided what they thought to be the qualities of the ideal student for the pathway. They all mentioned mental focus, and collaboration with other students. Sam *"well, you*

need to be focused on the work, for sure. But it is a lot of community work; you get to work with a lot of people, so you can't be real quiet." Kim "Someone that just does their work. And, like, asks questions....someone that is motivated, but also not too confident. So if you are experienced [in coding], that is also a good thing." Susan said the ideal student should "definitely [be] independent and focused. Able to focus and get their work done by themselves without someone sitting there holding their hand. Someone who can go beyond what is right in front of them."

When the young women were asked if the pathway was what they expected, they said they did not know what to expect. Sam shared,

I didn't know what engineering was. I really liked the CAD portion. I really liked learning how to use the software. And that was very hands-on. In the third pathway, we got to rebuild the big wheel. That was very interesting.

Kim said she started the pathway with a different teacher. When she started the second class in the pathway, *"I was not prepared. I think there was only one other girl there."*

The fourth value code I placed was to determine the values expressed by the participants. The young women highlighted what they deemed as important during the interviews. They mentioned education, people who supported them, and character qualities used to bring about success. They voiced that post-secondary education was important to them and their family. When asked to talk about their family, each described their family members in terms of their level of education. The participants themselves were enrolled in college at the time of the interview. The young women also conveyed the value of family and friends. They recounted the influence of their family and the importance of friends from elementary school and extracurricular activities. The young women also mentioned the value of character traits as they

described the ideal student for the pathway. Qualities for the ideal student were focus, motivation, independence, and persistence.

The fifth value code used to segment the data was identity. This code determined how the participants identified themselves as a member of the class. Identity was also used to determine how the young women defined social norms. When asked what it was like being one of the few girls in the class, two participants said it was empowering. Susan expressed,

It was kind of empowering because I felt like I was able to hang with the boys. I was able to do this [solve problems] as well as them, and even help them sometimes. So it felt good to be that person or that girl.

Kim expressed how she felt being one of the few girls in the pathway.

Honestly, it was kind of empowering. It was only us in the second class of the pathway. My friend was there as well. We worked on things together. I wanted to be better, just because I had to because there's girl society. I made sure I knew my code and that I knew my work and knew about computers. Sometimes I'd go home and ask my dad to help me make sure I was prepared for class.

Sam expressed how she felt being one of the few girls in the pathway.

I think it was fine. Most people do not really treat you differently or anything. But, I remember one time, we were presenting, and only the boys were presenting. So maybe you do feel a little insecure because you're the only couple of girls, but it's not like such a big deal.

Elaborative Codes

Findings from the second coding cycle were revealed using elaborative coding.

Elaborative coding is used to refine an existing construct (Saldana, 2016). This journey through

the data focused on elaborating the theoretical constructs of Vroom's (1964) Expectancy Theory. Expectancy theory states that motivation is based on the product of expectancy, instrumentality and valence. A person is motivated to act if their effort leads to a positive outcome, the outcome is instrumental in reaching a goal, and reaching that goal is valued.

I started by seeking out data revealing what Vroom (1964) described as *expectancy* (i.e., participants' belief that their efforts would lead to an acceptable level of performance). All young women were enrolled in gifted classes since elementary school, which reinforced their beliefs that academic efforts would result in high-performance levels. Their past performances may have given them the confidence and self-efficacy in math and science to meet the pathway challenges even though two participants did not purposefully select the pathway. The majority of gifted girls in math and science have a neutral attitude of gender characteristics and agree with non-traditional gender roles. They also have an above average career self-efficacy (Yu & Jen, 2021).

I then segmented data to locate examples of Vroom's (1964) *instrumentality* (i.e., belief that performance will lead to desired reward or outcome). While enrolled in the career pathways, participants' basic reward was the pleasure experienced by learning and participating in class activities. Sam's words used to describe her experience of learning CAD as, "*I enjoyed learning the software.*" Kim described her experience learning to write computer codes as, "*and it was super fun. I became super, duper interested in coding.*" Susan explained that she enrolled in the first class in the pathway because her older brothers had. She then said, "*I actually really enjoy this [class].*" Two of them stated that being one of the few girls in the class was empowering.

I found examples of Vroom's (1964) variable referred to as valence (i.e., value in reaching the goal) as I sifted through the data again. Participants found the rewards of

participating in the class to be desirable. They were intrinsically motivated to continue through the three classes to reach pathway completion. Susan stated,

[Pathway completion was] definitely important. When you start something, you should always want to be able to finish. What you learn in one class, you take it and continue learning in the next class. Not completing the pathway is not getting the full story.

Sam said it was definitely important to her to complete the pathway. She also described the courses as building on previously learned skills. Kim *"I really like the pathways in high school because it helps you go through a career. It was a chance to see what my career could be."*

Examining the data using Saldana's (2016) value codes, elaborative codes, and through the lens of expectancy theory (Vroom, 1964) allows us to see the values and experiences of young women who complete a pathway in architecture, engineering, and computer science. The participants recalled how they came to enter the pathway having no real knowledge of the content. They described their family and friends who have influenced them. We were able to hear how the participants described the value of education and their own educational achievements. The participants made meaning of being one of the few girls to complete the pathway.

CHAPTER 6

DISCUSSION

The purpose of this qualitative study was to describe and explain the experiences and perceptions of young women related to their entry and completion of an architecture, engineering, or computer science pathway in high school. They each graduated from a public high school in the metro Atlanta area between 2019 and 2021. A secondary purpose was to discover what supported or challenged their perseverance to pathway completion. A pathway completer is a high school student who completes three classes in the same field of study (Georgia Department of Education, 2020).

The research question that guided this study was “How do young women explain the influences on their entry into and completion of an Engineering, Architecture, or Computer Science Career pathway?” Research exists explaining why young women do not pursue STEM in education but not why they do (Cagel et al., 2018). Many occupations are seen as being an appropriate fit based on a person’s gender (Campbell et al., 2012) and some young women may not see STEM subjects as relevant to their interests (Reinking & Martin, 2018). The answer to this research question may help recruit and retain more young women to these pathways and ultimately increase the number of women in these workforce areas. An increase in the diversity of workers in these fields will provide more diverse solutions to design, engineering, and computing challenges. Careers in these areas typically pay higher salaries improving the financial position of women who work in them (U.S. Bureau of Labor and Statistics, 2021).

This chapter summarizes findings from interviews with three young women and examines how their experiences reflected existing literature and could be explained by Vroom's (1964) expectancy theory. This chapter also includes a discussion of the study's limitations and the opportunities for future research.

Background

STEM jobs are an essential part of the sustainability of our highly technological society. STEM-related concepts support developing a workforce prepared to collaborate and solve critical problems to maintain economic competitiveness (Reinking & Martin, 2018). The STEM workforce is broad and includes healthcare, computer science, engineering, architecture, physical, and earth science. While women make up half of the STEM workforce, they are underrepresented in architecture, engineering, and computer science (Fry et al., 2021). Women are more likely to work in health and education and earn on average only 75%-80% of what men earn (U.S. Bureau of Labor and Statistics, 2018). STEM careers typically pay 70% higher salaries than non-STEM careers (Ball et al., 2017). Women who earn increased wages will improve their financial positions, promoting positive social change (Turanli et al., 2015).

Increasing the diversity of the STEM workforce is predicted to increase creativity, innovation, and productivity. However, increasing diversity in the STEM workforce is contingent on increasing the diversity of participation in STEM education (Jones et al., 2018). STEM elective classes have historically received low participation of young women. Although the number of young women earning STEM-related degrees has increased, young women typically only occupy 14% of the students in high school engineering classes (Riegle-Crumb & Moore, 2013). Nationally, girls make up about 20% of the students in STEM-related courses (National Coalition of Women and Girls in Education, 2017).

Reasons that explain why women are not interested in STEM careers are plentiful. Young women are thought to avoid STEM courses in secondary education beyond what is compulsory because they do not accurately know what STEM is. Young women see STEM environments as unwelcoming and not matching their interests and abilities (Swafford & Anderson, 2020). STEM environments are perceived as unwelcoming by women because they are usually dominated by men inferring a gender-biased. These environments usually lack support in creating a culture that welcomes diversity (Corbett et al., 2015).

Society views many occupations as gendered or appropriate for men or women's skills and abilities (Campbell et al., 2012). These stereotypes and biases are taught through families, the media, and educators. Students may believe these biases and not explore non-traditional careers, fearing a negative social identity (O'Brien et al., 2015). These views may cause many people not to understand what engineers, architects, or computer programmers do. These careers may be perceived as masculine and requiring superior intellectual abilities (Madara & Namango, 2016).

The theoretical framework of Victor Vroom (1964) was used as a lens for classifying, predicting, and interpreting the data gathered from the participants. Expectancy theory is based on three conditions. The first condition is that personal effort will result in an acceptable level of performance. The second condition is that there is a specific outcome resulting from reaching an acceptable level of performance. The third condition is that there is personal value in reaching the outcome. Each participant explained their level of performance in the program, the outcome of performance, and the personal value in pathway completion. These three variables were used as a way to help explain each participant's motivation.

The expectancy variable of pathway completion was based on a combination of events both in and beyond the control of participants. The important aspect of this variable was whether or not the participants expected that they would reach the goal of completing the pathway. The second variable of instrumentality was determined based on whether completing the pathway was instrumental in allowing the participant to reach a higher goal. The valance variable was determined by the level of importance the young women placed on reaching pathway completion. The combination of these variables is what determined the behavior of the participants that led them to complete the pathway. The interviews revealed that the participants expected to reach their goal because they had determined how and understood the value in pathway completion.

Method

Qualitative research was deemed appropriate for this study because this method allowed me to hear how young women negotiated the decision-making process related to their high school education and career choices. Qualitative research was valuable in this situation because it presented an opportunity for the voice of these participants to express the meaning of their unique experiences (Creswell & Creswell, 2018). This qualitative study was fundamentally interpretive as the participants and I worked together to gain insight into how they decided to enter and complete the pathway (Nasser, 2001).

This study had a finite sample based on the number of young women who completed at least one of the three pathways and graduated in the timeframe selected. The young women were at least 18 years of age and were graduates from the same high school. They must have graduated in either May of 2020 or May of 2021. They had to identify as a woman and have completed one or more of these three cluster pathways: Architecture and Construction, STEM,

and/or Computer Science. Pathways and course sequence are shown in Table 6. A student who completes three classes in the same pathway is considered a pathway completer (Georgia Department of Education, 2020).

Table 6

Examples of Career Cluster Pathways

Cluster	Architecture and Construction		STEM	
Career Pathways	Architectural Drawing and Design		Engineering Drafting and Design	
Three Course Sequence	-Introduction to Drafting and Design (IDD)	-Architectural Drawing and Design I (ADDI)	-Introduction to Drafting and Design (IDD)	-Survey of Engineering Graphics (SEG)
	-Architectural Drawing and Design II (ADDII)		-3D Modeling and Analysis (3DMdl)	
Cluster	Information Technology			
Career Pathways	Programming		Computer Science	
Three Course Sequence	-Introduction to Digital Technology (IDT)	-Computer Science Principles (CSP) or AP Computer Science Principles (APCSP)	-Introduction to Digital Technology (IDT)	-Computer Science Principles (CSP) or AP Computer Science Principles (APCSP)
	-Programming, Games, Apps, and Society (PGAS)		-AP Computer Science A	

(<https://www.gadoe.org/Curriculum-Instruction-and-Assessment/CTAE/Pages/>)

There were 12 young women who met the criteria for the study. All of the young women were identified by my colleague or me and had completed one or more of the pathways. In all cases, the young women were recruited through an introductory email asking them to participate

in the study. Three of the 12 young women agreed to participate in the interview process. Five of the young women declined to be interviewed, stating that their schedule would not allow it. Four of the contacts did not respond to the emailed invitation.

The data was collected between a two-month period from August to October 2021. One semi-structured interview of approximately one-hour duration was conducted with each participant. All interviews were held virtually and were conducted without distraction or interruption. An interview protocol was used to guide the interviews, but respondents were allowed the freedom to ask questions and expand their answers consistent with the semi-structured approach to interviewing. The interview started with questions concerning demographic information and focused on early childhood experiences relating to family and school. Participants were asked about who influenced them and what their career aspirations were as elementary school students. Students were asked to recall any special childhood memories that may have influenced their career goals.

The second half of the interview focused on how the participants were enrolled as a student in the pathway courses and experiences surrounding their participation. Each participant was asked to recall what it was like being one of the few girls in the class and the level of difficulty mastering the course material. Respondents were asked to discuss their career goals. The last question I asked was if they had additional information to add involving their participation in the pathway.

The data was organized and stored in both an electronic and paper format. The electronic data was stored on a secure network drive and the paper copy in a locked filing cabinet. I analyzed the data using a planned two-layer process: general analysis and more in-depth analysis (Creswell & Creswell, 2018). The first layer of data analysis began with noting thoughts and

questions during the interview and then transcribing the interview with an application called Otter.ai (Otter.ai, 2021). I then repeatedly listened to the audio recording and reviewed the transcript numerous times, memoing thoughts as I listened.

The second layer or cycle of analysis was completed to reduce and segment data. The first pass of the second coding phase focused on locating data related to Value Codes (Appendix F). These Value Codes reflected the participant's perspectives including their attitudes, beliefs, and standards (Saldana, 2016). The selected Value Codes were influenced by the purpose of the study, research questions, literature review, and Vroom's (1964) expectancy theory. The final coding cycle was influenced by Saldana's (2016) Elaborative Coding. This method of coding was used to elaborate on Vroom's (1964) components of expectancy theory, expectancy, instrumentality, and valence. This was accomplished by analyzing the data again seeking information related to how their participation in the pathway led to a desirable outcome.

Findings

Participants entered their respective pathways having no prior knowledge of what the pathway was about. This is consistent with the literature. For example, Swafford and Anderson (2020) found that a lack of awareness of STEM-related educational and career opportunities was a major barrier women experience. Girls do not typically make a connection between a STEM career and the ability to make a positive contribution to society (Boe et al., 2011). High school girls often describe engineering as uninteresting and irrelevant to their life expectations (Hill et al., 2010) even though most do not have a true understanding of engineering.

Even though students in my study did not have a true knowledge of what the pathway was about, they were willing to stay in the class to find out. Perhaps this was because of parental influence. Parents are the most influential role models for students. Parents' attitudes, related to

STEM, impact their child's interests (Hutton, 2019). Participants' mothers all worked in STEM-related careers, and each one acknowledged that they were influenced most by their mom. Two of the participants were also influenced by an older brother. Reasons listed for being a positive influence were a good work ethic, strength, dedication, and determination. Susan said that she entered the pathway to learn more about her dad's career as a building contractor.

Another general observation was that each young woman described herself as being academically gifted. Yu and Jen (2021) found that a majority of girls who were gifted in math and science had a neutral attitude toward gender characteristics and greater acceptance of non-traditional gender roles. They also found that gifted girls had an above average career self-efficacy. This may explain why the young women did not eliminate pathway participation because of cultural norms based on gender and were willing to enter the pathway having no knowledge of the pathway.

Participants were motivated to complete the pathway because they found participation to be enjoyable. Kim stated that she liked learning to code. Sam said that what she liked was learning CAD software. The participants described the ideal student for the pathway as having an ability to focus and a willingness to learn new things. The young women said that successful students would be motivated and able to apply critical thinking skills. They should be willing to ask questions and be able to visualize.

Participants did not experience an issue with being one of the few girls in pathway courses. Two participants actually found it empowering. Susan explained that it felt good to be able to compete and even help boys in the class. Sam said that she did not feel that she was treated any differently in the class as a young woman. Each participant found enjoyment in their participation in the pathway and expressed confidence in their abilities.

The participants expressed their belief that completing the pathway was important. Susan said, “Not completing what you start is like having missing pieces to a puzzle.” They voiced that in each class they learned information that was applicable to the next level. They expressed a sense of anticipation in reaching the next step in the pathway. Kim said she liked how pathways are set up in high school because it helped her see what would be expected in that career.

Vroom’s (1964) expectancy theory suggests that people are motivated to act based on their attitudes, beliefs, and perceptions in order to enhance pleasure or avoid pain. His theory states that motivation is equal to the product of expectancy, instrumentality and valence. Each of these values hold unique meaning to the individual. As each variable increases so does the individual’s motivation to participate in behaviors related to the act believed to bring them pleasure.

The young women were motivated to enter and complete the pathway. They entered the pathway with a positive expectancy variable based on their history of academic success. Their success continued through each level of the pathway and their efforts were instrumental in providing them with enjoyment as they worked toward pathway completion. They expressed that completion was important in allowing them to receive a full understanding of a career related to the pathway.

Limitations and Future Research Considerations

Despite the strength in the voices of the participants, caution must be acknowledged based on the small and finite sample in the study. Very few young women complete these STEM related pathways each year and it was difficult to contact students during the COVID-19 pandemic. The participants had recently graduated high school and entered a new phase of life. Several were working a job and had entered college. They expressed that these new

commitments did not allow them time to commit to an interview. The young women who participated in this study are all from the same high school and were selected based on their completion of the pathway. Their responses are not guaranteed to represent all of the young women who have completed the pathway. These findings highlight opportunities for further investigation using a larger sample size from multiple locations.

Perhaps it might be worth expanding the participant pool to include both young women and men to compare the similarities and differences in their experiences related to entry and completion of the pathways. Another suggestion is to conduct a longitudinal study and collect information from young women who completed the pathway and investigate the long-term benefits of pathway completion. An evaluation of the middle school advisement process may be worth an investigation. It may also bring about important information to interview girls who complete only the introduction class and choose to leave the pathway. Another consideration is to interview students who completed other pathways and investigate why they did not consider engineering, architecture, or computer science pathways.

Implications for Practice

The results of this study expand our understanding of why young women elect to enter and remain in the architecture, engineering, and computer science pathways. The participants did not have an understanding of what architecture, engineering or computer science was prior to entering the pathway. This information can be used to create opportunities in middle school to increase knowledge of STEM careers through academic, elective, and extra-curricular activities to girls. While the girls who participated in the study had role models with STEM careers, it is important to educate all parents of girls about the benefits of a STEM career. Math and science

teachers need to act as role models and communicate the connections between academic skills and STEM careers.

More effort needs to be channeled toward the recruitment and advertisement of architecture, engineering, and computer science classes in high school. Two of the participants reported that they had not heard of the courses before being enrolled. It was mentioned by one of the participants that these courses are not as popular as some of the other electives. The instructors of these pathways can create promotional literature with both young women and young men representing these careers. It may prove beneficial for elective teachers to extend their recruitment efforts by visiting classes dominated by students who do not traditionally take their course or even trade classes for a day to expose students to elective classes they are not familiar with.

Summary and Conclusions

Young women in this study explained what influenced their entry into and completion of the architectural, engineering, and computer science pathways. They expected that their efforts would lead to an acceptable level of performance because they identified as gifted and were supported by family, friends and teachers. They each had a mother who served as a STEM role model. The young women expressed that their performance in the pathway lead to a desired reward. They each said, *“I enjoyed what I was doing in the pathway and I found being one of the few girls empowering.”* They shared that completing a pathway was important because it was a credential that gave them status and completing a pathway allowed them to understand what it was like to be in that career. *“Each level of the pathway allows you to use your knowledge from the previous class.”*

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Appendix A
Interview Questions

Question type	Interview question
1. Experience and behavior questions that encourage participants to describe their actions and activities.	4. What kinds of things did you enjoy when you were younger? 5. How did you spend your summers growing up? 9. Tell me the story of how you came to be in my class.
2. Opinion and values questions designed to explore participants' beliefs as they relate to the research topic.	8. Tell me about your first thoughts of what you wanted to be when you grew up. 10. Describe the ideal student for this class. 14. How would you describe the importance of completing this pathway? 20. What other career pathways are you interested in?
3. Feeling questions that ask participants to extract their human emotions on experiences related to the study.	12. If you were going to tell one of your friends what it is like to take this class what would you tell them? 16. Some people might say this class it difficult, what would you say to them? 17. What do you think of this interview process?

	19. Are there any questions that you think I should have asked about your connection to this class or your career ambitions?
4. Knowledge questions designed to allow participants to share facts as they reconstruct them.	<p>1. Tell me about your family.</p> <p>2. Tell me about your friends in elementary school.</p> <p>7. Who were the people who influenced you as a child?</p> <p>15. Describe your career goals.</p> <p>18. Is there anything that we have discussed that you need to add to?</p>
5. Sensory questions that are aimed at eliciting details of how participants use their senses to describe experiences.	<p>3. What was elementary school like?</p> <p>6. Tell me your favorite childhood memory.</p> <p>11. How is participating in this class different than what you expected?</p> <p>13. What is it like being one of the few girls in this class?</p>
6. Background/demographic questions that refer to participants' age, grade level and other information relevant to the research.	<p>Age</p> <p>Grade</p> <p>Ethnicity</p>

Appendix B

Data Collection Log

Participant: Sam

Date	Activity or item collection	Notes
<i>8/17/2021</i>	<i>Scheduled interview for 8/4/2020</i>	<i>Via email</i>
<i>8/17/2021</i>	Interview via Google Meets	9:00 A.M.

Appendix C

Data Organization Structure

Connie Highnote Data Collection 2021

Participant 1_Sam

Participant 1 data collection Log

Participant 1 interview 1 recording

Participant 1 interview 1 transcript

Participant 1 interview 1 transcript analysis 1

Participant 1 interview 1 transcript analysis 2

Participant 1 interview 2 recording

Participant 1 interview 2 transcript

Participant 1 observation notes

Participant 2_Alias name

Participant 2 academic transcript

Participant 2 data collection Log

Participant 2 interview 1 recording

Participant 2 interview 1 transcript

Participant 2 interview 2 recording

Participant 1 interview 2 transcript

Appendix D

Interview 1 Transcription example

Participant 1: 7/28/2020, 12:00 p.m.

Location: Online

Researcher: *Participant 1, tell me about where you live.*

Participant 1: I live in a house with my mom and my dad and my brother. I guess I have older parents than most of my friends. And my brother is 1.5 years older than me. My mom is a financial analysts as she works with numbers and money in the health care sector. And my dad is a civil engineer. My brother's going to school for nursing. Well, he just graduated from Georgia State.

Researcher: *Participant 2, tell me about your situation.*

Participant 2: Yeah.yeah. So it's just me. I'm at my house. I have two older siblings. They both live in Ireland. My mom works for the technology department in the school system. I don't know what my sisters do.

Appendix E

Interview Protocol

Participant name: _____

I want to thank you again for volunteering to participate in this study as I examine why some young women elect to take my classes and complete this pathway. All of this information will be kept secure and your identity will be kept confidential. Before we continue, what name would you like for me to use as your participant name? _____

The interview should take approximately one hour and I will be using a video recording device to make sure information collected is accurate and complete. I will also ask you to verify the accuracy of the interview transcript once it is converted to text. This is informal so anytime you have something to say, please do. If you need to take a break let me know. There are no wrong answers to any of the questions. Also you are not obligated to answer all of the questions. Do you understand and are you ready to get started?

First I will collect demographic information.

What is your current age?

What grade are you in?

What is your ethnicity?

1. Tell me about your family.
2. Tell me about your friends in elementary school.
3. What was elementary school like?
4. What kinds of things did you enjoy when you were younger?
5. How did you spend your summers growing up?
6. Tell me your favorite childhood memory.
7. Who were the people who influenced you as a child?
8. Tell me about your first thoughts of what you wanted to be when you grew up.

9. Tell me the story of how you came to be in my class.
10. Describe the ideal student for this class.
11. How is participating in this class different than what you expected?
12. If you were going to tell one of your friends what it is like to take this class what would you tell them?
13. What is it like being one of the few girls in this class?
14. How would you describe the importance of completing this pathway?
15. Describe your career goals.
16. Some people might say this class is difficult, what would you say to them?
17. What do you think of this interview process?
18. Is there anything that we have discussed that you need to add to?
19. Are there any questions that you think I should have asked about your connection to this class or your career ambitions?
20. What other career pathways are you interested in?

Appendix F

Provisional Values Codes

Code	Description	Source
Influencers	People who have influenced the participant's decisions.	Research question 1 and 2 Literature, parental influence
Benefits	Any outcomes realized or expected from participating in the class.	Research question 3 Expectancy Theory
Perception	Perceptions of self and others in or out of the program	Research questions 4 Social norms
Values	Ideas or things valued by the participant.	Research question 1, 2 and 3
Goals	Educational or career goals mentioned by the participant.	Research question 1 and 2
Interests	Issues or career interests mentioned.	Research question 1 and 2
Pressures	Internal or external pressures pertaining to the class.	Research question 2 Social norms
Uncertainty	Cannot give a definite reason.	Research questions 1-4
Efforts	Any description of effort required pertaining to participation in the class.	Research question 3 and 4 Expectancy Theory
Identity	How the participant identifies herself as a member of the class, her family or in society.	Research question 4 Literature social norms
Surprising information	Information that is unexpected and does not meet any of the criteria listed above.	

Appendix G

Data organized by interview question and participant.

	Participant 1	Participant 2	Participant 3
Question 1	Response summary	Response summary	Response summary
Question 2	Response summary	Response summary	Response summary
Question 3	Response summary	Response summary	Response summary
Question 4	Response summary	Response summary	Response summary
Question 5	Response summary	Response summary	Response summary
Question 6	Response summary	Response summary	Response summary
Question 7	Response summary	Response summary	Response summary