Fall 2021

Middle and High School Experiences That Lead First-Generation College Students to Select a Stem Major

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MIDDLE AND HIGH SCHOOL EXPERIENCES THAT LEAD FIRST-GENERATION COLLEGE STUDENTS TO SELECT A STEM MAJOR

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Submitted in Partial Fulfillment of the Requirements

For the Degree of Doctor of Philosophy in

Teaching and Learning

College of Education

University of South Carolina

2021

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DEDICATION

Thank you to my amazing wife who always gave me the encouragement to keep going. Thank you to both of my wonderful boys, Grayson and Avett, who always encouraged me to keep working and understood when I had to spend time writing. Thanks to my mom and dad who always believed in me and have always given me that extra push to get through things in life. Thank you to my dog Sedona who would always lay next to me no matter how long I wrote. Thank you to Laing Middle School and my teaching family who always covered for me when I had to leave early to drive to Columbia for class. This never would have been possible if not for all of you.

ACKNOWLEDGEMENTS

I would like to acknowledge my advisor Dr. Christine Lotter, for her support through the many years. Her feedback, encouragement, and support have helped me grow professionally and personally. I would like to acknowledge my committee members for providing valuable feedback that pushed me to dig deeper into the research. I would like to acknowledge Dr. Angela Starrett for her help with statistics and Dr. Pinkney Epps for introducing me to the Opportunity Scholars Program. This dissertation would not have been possible without the guidance and dedication from each of you. Thank you.

ABSTRACT

Careers in science, technology, engineering, and mathematics (STEM) fields are increasing but the number of qualified individuals to fill these positions are not meeting the demand. One way to increase the number of qualified STEM employees is to garner the interest of students from underrepresented groups in the STEM fields. One of these underrepresented groups are first generation college students (FGCS). Understanding what experiences led FGCS to pursue a degree in a STEM field may help attract more students to STEM and help meet the demand of filling future STEM jobs.

In this study, FGCS in the Opportunity Scholars Program (OSP) and a comparison group of nonFGCS STEM majors, both enrolled in the same large Southeastern University, were surveyed about the experiences that led to their pursuit of a degree in a STEM field. Questionnaire and follow-up interviews were completed to collect data to answer three main research questions. These questions were: How do select economic, sociological, and psychological factors differentially influence FGCS and non-FGCS decisions to major in a STEM field? How does participation in informal learning experiences in middle and high school influence FGCS and nonFGCS STEM degree selection? How does participation in formal learning experiences in middle and high school influence FGCS and nonFGCS STEM degree selection?

Analysis of the data showed that there were multiple influencers on the FGCS decision to pursue a dree in a STEM field. Influences that ranked highest among a

majority of the students included support from school counselors, access to tutors, engaging STEM courses in middle and high school, watching STEM related videos on streaming sites, and access to scholarships. Providing FGCS with these opportunities may not only attract more FGCS to major in STEM fields but may also help retain them once in a STEM program.

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LIST OF ABREVIATIONS

FGCS.. First-Generation College Student

NonFGCS.. Non-First-Generation College Student

OSP .... Opportunity Scholars Program

Chapter 1

INTRODUCTION

Background and Significance

Introduction. Science, technology, engineering, and mathematics (STEM) careers are on the rise. Most STEM jobs require postsecondary education (73%) but according to Carnevale et al., (2013), 42 million Americans from ages 18 to 64 do not have any type of postsecondary degree. From 2009 to 2015, 8 million jobs (10.5% of all available jobs) were available in STEM fields. The U.S. Bureau of Labor Statistics estimates that STEM careers will increase two times faster than the total of other careers over the over the next ten years. Two-thirds of these new careers will be in computer science (Bureau of Labor Statistics, 2021). There is a concern that this increase in demand will not be met due to low proficiency in math and science and students lack of interest in STEM fields (Ozis et al., 2018).

One way to develop more STEM graduates is to find ways to attract underrepresented groups (people of color and women) of students to STEM careers (Gilliam et al., 2017). Out of the 1.8 million bachelor's degrees awarded in 2016, only 18% were in STEM fields. Only 12% of these degrees were obtained by African Americans, 14% American Indian/Alaska Native, 15% Hispanic and Pacific

Islander, 18% Caucasian, and 33% Asian (National Center for Educational Statistics, 2017).

First-generation college students (FGCSs) are another underrepresented group in STEM. The United States Department of Education's definition of a first-generation student is: "(a) an individual both of whose parents did not complete a baccalaureate degree; or (b) in the case of any individual who regularly resided with and received support from only one parent, an individual whose only such parent did not complete a baccalaureate degree." (Higher Education Act of 1965, 2008, p. 9). These students come from all races and ethnicities, but Dika and D'Amico (2016), found that students who make up the majority of the FGCS population are underrepresented minority students (URMs). According to The National Institute of Health website (2019), URMs are defined as "Blacks or African Americans, Hispanics or Latinos, American Indians or Alaska Natives, Native Hawaiians, and other Pacific Islanders." (p. 1).

Some of the challenges that face first generation students of color when looking at going to college include: lower standardized test scores, low socioeconomic status (households making less than $50,000 a year), lack of college-related information (application process), and lack of family support (Blackwell & Pinder, 2014; Dika & D'Amico, 2016). Many of these students also have family responsibilities that may include working to help provide for their family (Ishitani, 2016). All these challenges can prevent FGCSs from even considering going to college. Ward et al., (2012) found that eighth grade students who will be FGCSs have low aspirations about going to college. But even with all these challenges, there are still FGCSs that are attending college and some that are majoring in STEM fields. Dika and D'Amico (2016), stated that FGCSs make up 25% of the entire undergraduate student population in the United States. With a quarter of the undergraduate student body being composed of FGCSs it is important to recruit some of these students into STEM majors. One major issue is determining how to get these students interested in STEM fields. Chen (2005) found that FGCSs are less likely to select a college major in a STEM field.

This dissertation will focus on how select psychological, sociological, and economic factors differentially influence FGCS and non-FGCS decisions to major in a STEM field. It also looks at how participation in informal learning experiences and formal learning experiences (parental influence, attending a STEM-based school, taking advanced STEM classes) in middle and high school influence first-generation college students (FGCS) STEM degree selection.

There are many factors that can contribute to a student's decision to go to college. Multiple studies have been conducted on how different psychological and sociological factors impact college degree selection. Some influential factors include self-efficacy, (Strayhorn, 2015; Zeldin et al., 2008; Luzzo et al., 1999) identity (Jones & Abes, 2013), microaggressions (Sue et al., 2007) stereotype threat (Herrmann et al., 2016), educational aspirations (Mau, 2003; Sax et al., 2015), and gender familial background (Kim et al., 2015). In addition, students' formal and informal experiences can influence their decision to go to college. There have been multiple studies conducted on informal experiences such as summer camps, participation in sports, and before and after school activities (Barton & Tan, 2010; Maltese & Tai, 2010; Rahm & Moore, 2016) and formal experiences such as parental influence, attending STEM-based schools, GPA, and taking advanced level classes (Gayles & Ampaw, 2011; Myers & Fouts,1992) that may lead students to select a specific degree. However, there have been fewer qualitative studies that investigate the above-mentioned factors and delve into the experiences that first-generation college students have during middle and high school that influence them to pursue a degree in a STEM field (Dika & D'Amico, 2016; Mitchall & Jaeger, 2018).

With such a demand for STEM graduates, there have been numerous programs, curricula, and STEM-based schools created to increase the number of students attending college and majoring in a STEM field. In addition to the increase of STEM content in the classroom, there have been major increases in the number of afterschool and summer programs that promote STEM activities (Dejarnette, 2016). Ferrara et al., (2018) states "participation in after-school, summer, and other informal STEM programs is viewed as an experience that is critical to positive outcomes for learners" (p. 74).

Informal Learning

Clubs. Clubs are considered non-formal learning opportunities that occur in a formal or informal school setting. Students who participate in the non-formal learning experiences have demonstrated an improvement in achievement level, social development, development of positive social networks, leadership abilities, involvement with new peer groups, and interest in the subject matter (Gottfried & Williams, 2013). This type of learning is termed informal learning and occurs in addition to that which is done during the regular school day. Informal science learning is any learning that takes place outside of traditional school time (Dierking et al., 2003). According to Feder et al. (2009), there are six overall goals and practices of informal science learning: developing interest in science, understanding science knowledge, engaging in scientific reasoning, reflecting on science, engaging in scientific practices, and identifying with the scientific enterprise.

Informal learning benefits. Students who participate in informal learning experiences have been shown to gain a sustained interest in science (Basu & Barton, 2007). These types of programs have also been shown to increase science interest in students of color which then translates into better academic success in science and math (King & Pringle, 2019). By implementing informal science learning experiences for all students, there is an increased chance that a larger and more varied group of students are gaining and sustaining an interest in the STEM fields.

After-school clubs help students to discover their interest in science as well as help build confidence in their ability to complete challenging tasks (Shah et al., 2017). There are many national, state, and regional STEM clubs. Some examples of these clubs are: Lego Robotics, SeaPerch (underwater robotics), Math Olympiad, Science Olympiad, National Ocean Sciences Bowl, Trebuchet Club, Odyssey of the Mind, Rocket Club, among many others. These STEM clubs provide students with the opportunity to learn through authentic science and help to strengthen the standards being taught during the school day. Burrows et al. (2018) define authentic science as "participants working in the natural world, working towards a problem, exploring information, using technology, utilizing mathematics, analyzing evidence, developing conclusions, refining questions and methods for future use, communicating results, and re-coding the results and disseminating information for others to use" (p. 2).

STEM clubs are one of the experiences this dissertation will focus on as well as if participation in one of these clubs influences FGCSs more than other life experiences to pursue a degree in a STEM field. Determining these influential experiences could help inspire more FGCSs to major in STEM fields, helping to increase the number of STEM graduates and ultimately putting more STEM professionals in the workplace. Falk et al. (2016) found that learning science in informal environments can be an effective approach to increase learning opportunities and address educational inequities, thereby broadening the participation of individuals engaged in STEM learning.

Formal learning benefits. Formal learning typically takes place in a classroom setting where students are instructed by a teacher. Direct instruction is provided, and a set of learning goals or objectives is stated (Cramer & Ball, 2019). There are multiple formal factors that have been found to be beneficial in influencing a student's decision to pursue a degree in a STEM field. Borman et al. (2017) found that the number of math and science courses, the level of math and science classes taken, and the grade point averages in these classes can be used to help determine if URM students will enroll and complete a degree in a STEM major. Students in high school who take upper-level math and science classes and achieve grades of B or higher are found to be more prepared when entering a STEM degree programs in college as well as persisting and obtaining a STEM degree (Mattern et al., 2015).

Theoretical Framework

Lent, Brown, and Hackett's 1994 Social-Cognitive Career Theory (SCCT) and Bandura's 1986 Social Cognitive Theory are the two conceptual theories influencing this study. Bandura's Social Cognitive Theory is used to explain how through cognitive processes a person's environment can shape their thoughts, beliefs, interpretations, and motivations (Bandura, 1986).

Lent, Brown, & Hackett developed SCCT based on the principals of Bandura's Social Cognitive Theory and Hackett and Betz's (1981) career self-efficacy theory. SCCT is composed of five elements: educational and career-related interests, choices, and performance/persistence behavior (Lent et al., 1994), the satisfaction and well-being in academic and work settings (Lent & Brown, 1996), and career self-management (Lent & Brown, 2013). The theory also considers a person's gender and environmental factors (supports, barriers) that impact one's college major or career path decisions (Lent & Brown, 1996).

Lent and Brown (1996) state that SCCT was developed to explain "processes through which (a) academic and career interests develop, (b) interests, in concert with other variables, promote career-relevant choices, and (c) people attain varying levels of performance and persistence in their educational and career pursuits" (p. 311). SCCT has been found to help determine the factors that can influence URMs educational and career paths (Flores & O'Brien, 2002; Quimby et al., 2007; Lent et al., 2011). As the majority of FGCS are URMs, this theory will be crucial to understanding the experiences that guide FGCSs to majoring in a STEM field (Engle & Tinto, 2008). SCCT is a practicable framework for studying FGCS since it focuses on individual and contextual factors that lead students to follow a certain career path (Garriott et al., 2013).

Purpose of Study and Rationale

The purpose of the study was to determine how economic, sociological, and psychological factors differentially influence FGCS and non-FGCS decisions to major in a STEM field. The study also determined how participation in informal learning experiences in middle and high school influenced first-generation college students

(FGCS) STEM degree selection. The study investigated the following formal factors that have been shown in prior research to be important career deciding factors: teacher influence, counselor influence, and taking advanced science and mathematics courses in high school.

Learning how various formal and informal experiences as well as the economical, sociological, and psychological factors influence a FGCS decision to pursue a degree in a STEM field may allow future researchers and curriculum developers to develop better programs and practices that would encourage future FGCSs to pursue a degree in a STEM field. The data will be collected using a mixed methods approach that includes a questionnaire and follow-up interviews. The questionnaire and interviews were conducted to learn first-hand from FGCS and nonFGCS the experiences that led them to major in STEM. FGCS are underrepresented in STEM and determining the reasons they chose or did not choose STEM needs additional research (Dika & D'Amico, 2016).

Research Questions

This dissertation focused on three questions.

1. How do select economic, sociological, and psychological factors differentially influence FGCS and non-FGCS decisions to major in a STEM field?
2. How does participation in informal learning experiences in middle and high school influence FGCS and nonFGCS STEM degree selection?
3. How does participation in formal learning experiences in middle and high school influence FGCS and nonFGCS STEM degree selection?

Delimitations

All participants are in their first year of a STEM major at a large four-year college. Each of the participants must be a FGCS, meaning that neither of their parents attended college.

Definition of Terms

1. STEM: Science, Technology, Engineering, and Math (Martín-Páez et al., 2019).
2. STEM Students: Any first-year student with a declared major in a science, technology, engineering, or math program.
3. Informal Learning: "voluntary, self-directed, motivated by personal needs and interests, and often socially mediated; it engenders cognitive, affective, and other non-cognitive outcomes" (U.S. Department of Education, 2007, p.20).
4. First-Generation College Students (FGCS): A college student whose parents never attended a four-year university. Other variations to this definition include the parents attending a 2-year college or attending a 4-year college but not completing a degree (Fernandez et al., 2008).

Chapter 2

LITERATURE REVIEW

Introduction to Literature Review

The lack of STEM graduates and the need for more professionals in STEM (Science, Technology, Engineering, and Mathematics) careers in the United States has led government leaders to pursue methods to attract more people to these fields (Starr et al., 2020). One such group that has been targeted are first-generation college students (FGCS). A large percentage of students entering college are FGCS and many of these students are not selecting degrees in STEM fields (Choy, 2002). The majority of FGCS are underrepresented minorities (URM) and it has been shown that URM students do not make up a large percentage of STEM graduates (Dika & D'Amico, 2016). There can be many factors and experiences in students' lives that impact their decisions and lead them to select a degree and career in a specific field. Determining the specific experiences and factors that have the most impact on students selecting a STEM degree would help researchers and educators develop efforts to capitalize on these experiences and attract more FGCS to STEM degree programs. The social cognitive career theory (SCCT) is a theoretical framework that has been shown to be useful in determining the STEM interests and goals of URM students (Callahan et al., 2017; Lent et al., 2003; Nauta & Epperson, 2003). SCCT shows the importance of learning experiences and various factors that occur during students' lives and how these factors determine their future career selection (Lent et al., 1994). The majority of the factors that influence a student's decision to pursue a certain degree fall under three major categories: psychological, sociological, and economical. Examples of these factors include total family income, parental influence/encouragement, student employment status, cultural influences, student motivation, STEM identity, self-efficacy, sense of belonging, and career aspirations.

Other influences that can lead a student to pick their future career are the experiences they have during their lives. These experiences fall under two major categories, formal and informal. These include participation in school clubs (before, during, or after school), out of school time experiences (museums, vacations, summer camps), taking advanced classes, GPA, and attending STEM-based schools.

STEM. During 2012-2022, the U.S. Bureau of Labor Statistics predicts that employment in science and engineering occupations will grow by 14.8%, compared to 10.8% for all occupations (Ozis et al., 2018). For the past forty years, researchers have been trying to determine the best method to get more students interested in STEM fields and to get them to pursue a college degree in STEM and then continue to a career in a STEM field (Maltese et al., 2014; Tal & Dierking, 2014).

According to the National Assessment of Educational Progress (NAEP) only 43% Caucasian, 61% Asian, 19% Hispanic, and 13% Black eighth-grade students are at or above proficiency in math. (Ozis et al., 2018). The Program for International Student Assessment (PISA) exam, reports that students in the United States that are fifteen years old rank sixteenth overall, out of twenty-six countries, in math and science proficiency (Gottfried & Williams, 2013). This is troubling since students who get interested in

STEM at an early age and have a positive view about their mathematics and science ability are more likely to pursue a degree in a STEM field (Maltese & Tai, 2011). Some of the factors that can influence a student's decision to pursue a degree in a STEM field include pre-college grades, test scores, and family income (Dika & D'Amico, 2016). These factors tend to affect underrepresented minorities the most, as shown in the statistics above.

Underrepresented Minorities in STEM. Certain demographic groups such as people of color are underrepresented in STEM degree programs. Some fields like biology and health science have shown some improvement but fields like engineering, math, computer science, and physical science are still lacking (Dika & D'Amico, 2016). The life sciences are the most popular STEM majors (~11% of student enrollment). Around 3% of student enrollment is in mathematics, and 2% physical science (Chen 2013). Latinos, as of 2012, make up 16% of the United States population. They earn around 9% of the engineering degrees and 7% of the physical science degrees (Dika & D'Amico, 2016). African Americans make up 13% of the U.S population as of 2012 and only earn 11% of the computer science, 7% physical science, 5% mathematics, and 4% engineering degrees (Dika & D'Amico, 2016). Toven-Lindsey et al., (2015) found that students of color face many challenges once in a STEM degree program that can cause them to leave the program. These issues can include transitioning into college life, due to the majority being first-generation college students. Many of these students struggle with the introductory mathematics and science courses that are required. Finally, Toven-Lindsey et al. (2015) found that URM students can face an academic culture in the STEM departments that is unwelcoming. All these factors can contribute to students switching to another major or transferring or dropping out of college.

Many URM students lack exposure to STEM professionals that have similar cultural and racial/ethnic backgrounds. This lack of exposure can cause URM students to overlook STEM as a potential career option (Koch et al., 2002). Having a role model or mentor has been shown as an effective method of recruiting and retaining URM students in their STEM degree program (Griffin et al., 2010).

Young and Young (2018) found that nearly 25% of Black students are interested in STEM but lack the mathematics skills to enter a STEM degree program or graduate with a STEM degree once enrolled in a STEM degree program. Students who are accepted into a program may have to enter remedial mathematics courses which can be time consuming and rigorous causing them to switch to a non-STEM major. Young and Young (2018) also found that many students of color do not receive the same level of out of school STEM instruction as other students do. This causes the students to miss additional opportunities to improve their academic performance in the STEM areas and may prevent them from pursuing a degree in a STEM field.

Student income can be a major factor in determining URM student's success in obtaining a degree in a STEM field. URM students tend to have to work while attending college which can limit the possibility of majoring in a STEM field due to work conflicting with the time needed to study or to conduct independent research. Working also causes students to feel disconnected from campus which can lead them to drop out of their program or switch majors (Hurtado et al., 2010).

Some experiences have been shown to be effective ways to keep URM students in their STEM degree programs. Hurtado et al. (2010) found that URM students who planned on pursing a graduate degree were more likely to stay in their undergraduate degree program. The long-term goal of obtaining a graduate degree motivated the students to stay in their degree program and obtain their undergraduate degree. There are many peer support and academic support programs that have been found to increase the attrition of URM students in STEM degree programs as well as other degree programs. These programs include the TRIO program, Opportunity Scholars, Meyerhoff Scholars, Biology Scholars, and many more that are found at colleges around the United States. These programs have been found to increase the rate of URM students staying in their current majors two to four times the national average when compared to students not in the program (Summers and Hrabowski, 2006). These programs are set up to provide different support features to help students be successful. Some of these supports include: providing a mentor for academic advising, skill workshops (writing, mathematics, etc.), help in developing an academic success plan, free tutoring, study groups, free technology rentals (computer/iPad), textbook lending, help with applying to grants and scholarships, cultural events, career advising, and assistance with financial aid and college applications (TRIO Homepage, 2020).

Another group of students that are underrepresented in STEM majors are first-generation college students (FGCSs). This classification includes all races, ethnic groups, and genders but most are members of an underrepresented racial ethnic group (Engle & Tinto, 2008). These students who are at a four-year university have a higher percentage of being a transfer student, usually from a two-year college (Dika & D'Amico, 2016).

FGCSs make up about 25% of the undergraduate student population in the U.S. (Engle & Tinto, 2008).

First-Generation College Students (FGCS). As stated in the introduction, Fernandez et al., (2008) defined a first-generation college student (FGCS) as a college student whose parents never attended a four-year university. Other variations to this definition include the parents attending a 2-year college or attending a 4-year college but not completing a degree (Dika & D'Amico, 2016).

In 2005, a study published by Chen, using data collected from national datasets, found that FGCSs were less likely to select a major in a STEM field. These students face many challenges that students whose parent(s) went to college do not. Garriott et al. (2013) stated that some of the challenges FGCS's face include "lower quality learning experiences in mathematics/science than their peers, less support for attending college, and low confidence in academic performance" (p. 202). Trenor et al., (2008) found that without the guidance of role models, FGCSs may also lack the social capital needed to pursue a degree in a STEM field. Social capital is as defined by Broh (2002) as "the accrue to obtain benefits through membership in social networks" (p. 72). More specifically, Bourdieu, (1973), defined college-going social capital as the resources students obtain though relationships, social networks, and connections. Parents, teachers, counselors, and coaches can all help students gain college-going capital. Without parents who have gone to college, FGCS must rely more on teachers, counselors, and coaches (Snodgrass et al., 2020).

Other problems that FGCSs face when trying to access higher education or once they have started a STEM degree program include lacking knowledge of admission processes, financial concerns, balancing college with personal commitments, challenging curriculum, and graduating with a degree in their original STEM major (Fernandez et al., 2008). Doerschuk et al. (2016) found that only 12.2% of FGCSs graduate from college over a six-year period compared to 37% of students who come from college educated families. Due to the social and economic hardships these students face the graduation rate of low-income students over a six-year period is 19% whereas for high-income students it is 42%. Shaw and Barbuti (2010) found that FGCSs majoring in STEM fields switched their major to non-STEM fields more than non-FGCSs. Without having parents who went to college, these students lack a valuable source of cultural capital to effectively navigate college (Cataldi, 2018). Bourdieu (1986) defines cultural capital as the knowledge, skills, and behaviors that are transmitted to an individual within their socio-cultural context through pedagogic action. Parents provide this capital to their children through various experiences. People can gain cultural capital by increasing their education level and or increasing their income level (Young & Young, 2018).

Certain types of activities and experiences have been shown to increasing the percentage of URMs students and students from lower socioeconomic backgrounds, to be able to pursue a degree in a STEM field. These experiences take place before or after school, or during the summer. They can be an official school program or a program that is not related to school. These experiences are termed Out-of-School-Time (OST) or informal learning experiences.

Informal STEM Experiences. Rukavina et al., (2012) define Out-of School-Time (OST)/Informal STEM learning as authentic experiences that take place outside of the traditional classroom, before, during, or after school, and help promote STEM career interest. This authentic learning allows students to connect what they are learning about with the real word. Students can get engaged in creative and innovative activities while learning STEM skills at the same time (Hooker & Brand, 2009). Students are learning in ways they do not necessarily experience in their classrooms. Some examples of OST/Informal experiences include participation in clubs, STEM programs, field trips, competitions, reading science related content, watching science television shows, and summer camps (Dabney et al., 2012). Students who participate in informal experiences in science at an early age have a high percentage of later interest in a STEM career (Maltese and Tai, 2010). Boedecker et al. (2015) found that participation in a two-week summer STEM camp improved the participants SAT scores. OST/Informal STEM experiences have been found to increase students STEM literacy and achievement, which helps to explain why students make certain career choices (Dou et al., 2019).

Lack of Access to Informal STEM Experiences. With the increase in demand to produce more STEM graduates, there have been many OST STEM programs developed around the United States. Even with the increase in the number of programs, some areas around the country do not have access (Young & Young, 2018). These often include urban and rural communities where most of the population is made up of URM students and students with low socioeconomic status. Dotterer et al., (2007) discussed three major challenges that can lead to Black students not being able to participate in OST/Informal STEM experiences. These include program availability, influence of gatekeepers, and student interest.

OST programs availability depends on the location. More affluent communities tend to have more OST/Informal learning opportunities and programs than areas of high poverty and crime (Young & Young, 2018). Many times, the urban communities are overlooked due to stereotypical beliefs about the residents there. Outside organizations that are for profit that offer OST programs pick their location based on marketability and accessibility.

When parents, coaches, or instructors of OST STEM experiences prevent students from participating directly or indirectly, they are called the gatekeepers (Young & Young, 2018). School STEM clubs are examples of OST/Informal learning experiences but to benefit from them all students must be able to participate. Many of the academically focused clubs tend to recruit students who do not have prior discipline problems and have higher grades. Black students who tend to receive more discipline referrals and score lower in STEM areas are not targeted as often to join these groups (Harper, 2010). Other issues include student transportation. Parents who must work may not be able to take students to before or afterschool experiences. If the school or district does not provide transportation to and from school, students will not get to participate in these experiences.

Parents act as their children's' advocates. Parents with enough cultural capital can provide their students with opportunities to participate in OST/Informal STEM experiences. Methods to increase a person's cultural capital include increasing education levels and/or increasing income levels. One tends to influence the other. By increasing your level of education, you are more likely to increase your income level (Young & Young, 2018). By not having the needed cultural capital, students from these families with low cultural capital may not be able to participate in OST STEM experiences. By missing out on these experiences they may not gain the experiences needed to major in a

STEM career. Research has shown that there is a relationship between the number of STEM clubs and experiences students participate in and their decision to major in a STEM field (Sahin, 2013).

Psychological Studies

The current research literature on the various experiences that students undergo in middle and high school that leads them to pursue a college degree in a STEM field can be broken into two major groups: psychological and sociological/economic. The psychological studies include motivation, self-efficacy, sense of belonging, parental encouragement, career aspirations, and identity (Callahan et al., 2017; Glessner et al., , 2017; Starr et al., 2019; van Aalderen-Smeets et al., 2019). The sociological/economic research includes socio-economic status, parental beliefs, and gender studies (Eccles, 2007; Garriott et al., 2013). Each body of research provides valuable insight into what influences students to select a college major in a STEM field. Each of these aspects of influence will need to be considered while conducting my research on the experiences that influence FGCSs decisions to major in a STEM field.

There is a growing amount of research on what drives students to pursue a career path in a STEM field. The psychological factors that have been studied include motivation, self-efficacy, career aspirations, sense of belonging, science identity, and parent encouragement. Studies have included students from elementary school through graduate school, with research focusing on how to both capture and sustain student interest in STEM fields.

Career Aspirations and Science Identity. One important predictor of STEM occupational aspiration is science and math identity. Andersen and Ward (2014) found that students who consider themselves “science people” are more likely to follow a STEM career track. The study looked at gifted high school students and the results of the study found this to be true for not only white students, but Black and Hispanic students as well (Anderson & Ward, 2014). A student's decision to follow a STEM college and career path is significantly related to their belief that they, as well as others around them, can see themselves as a specific type of person (science person) (Hazari et al., 2010). Studies have also been conducted on student’s math identity and how it can contribute to students selecting a STEM degree (Boaler & Greeno, 2000; Cribbs et al., 2015). Like science identity, a student who identifies themselves as good at math are more likely to pursue a degree in a STEM field (Piatek-Jimenez, 2015). A factor that ties in with science and math identity is a student’s self-efficacy for science and math. van Aalderen-Smeets et al. (2018) found that a student’s self-efficacy for science and math can negatively affect a student’s STEM aspirations and affect their science and math identity. Students who are in secondary school that have “stronger entity beliefs may develop more negative self-efficacy beliefs due to setback experiences during their years in high school and may therefore be more reluctant to opt for a STEM field-oriented bachelor’s degree when entering college” (p. 3-4).

STEM Identity and Interest. Another type of study that looked at student’s perception of science involved how they visualize scientists. There have been multiple studies where researchers get students to draw a picture of what they think a scientist looks like. These studies were based on the Draw A Scientist Test (DAST) (Chambers 1983) and the Draw A Scientist Checklist (DAST-C) (Finson et al., 1995). Fralick et al., (2009) had middle school students draw what they thought an engineer looked like and what a scientist looked like. The majority drew the scientists as male, wearing a white lab coat, and conducting some type of experiment with science equipment. The engineers (mostly drawn as male) were depicted as having more tools and posing with buildings and bridges. The data collected in this study were consistent with other studies (Buldu, 2006; Fralick et al., 2009; Gottfredson, 1981; Knight & Cunningham, 2004; Thompson & Lyons, 2005). Therefore, students who do not fit this stereotype may not self-identify as a scientist or engineer. Informal experiences may help students to identify differently through positive STEM experiences. Dou et al., (2019) found that STEM identity is based on STEM interest and STEM recognition and that both factors can influence a student's career choice. If a student sees themselves as a science person, then they are more likely to pursue a career in a science field (Dou et al., 2019; Graham et al., 2013).

Rennie (2014) found that the earlier students get interested in science, the earlier they develop their science identity, and the more likely they are to pursue a career in a science field. This is also true for other STEM disciplines. A student's STEM identity can also be influenced by others. People may refer to them as a "science person" or a "math person" (Dou et al., 2019). Multiple studies have shown that URM students who participated in various OST/Informal STEM experiences developed new science identities. Students who did not think of themselves as science or math people, after experiencing science in new ways, found that they enjoyed it and that they could "do it" (Barton et. al., 2013; Barton & Tan, 2010; Carlone et al., 2015; Elmesky, 2005; Grant et al., 2015).

Motivation. It is crucial for a student's success that they feel inherently motivated to learn as they progress through school. Motivation in schools as defined by Wentzel and Wigfield (2009), is "the energy students bring to school-related tasks, beliefs, values, and goals that determine which tasks they pursue and their persistence in achieving them, and the standards they set to determine when a task has been accomplished" (p.1). There are links between a student's motivation, the classes they take, and the career they decide to pursue (Rosenzweig & Wigfield, 2016).

Science and engineering careers have been predominately filled by white males (64%) even though 50% of the science and engineering degrees as of the 1990's were obtained by females (Gagnon & Sandoval, 2020). Many students may need motivation intervention to do well in STEM fields due to race and gender stereotypes that make them feel as though they will not be successful in STEM fields. If students feel as though they do not fit the stereotypical STEM student persona, they will lack motivation to even pursue a career in this field. Groups that often feel they do not fit the stereotype include females, students from low socioeconomic status, and students of color (Eccles, 2007). Due to these stereotypes student's self-efficacy can also decrease or they can gain negative attitudes toward certain subjects causing them to do poorly in them academically (Rosenzweig & Wigfield, 2016).

Self-efficacy. Self-efficacy first made its way into career literature in 1981 in an article by Hackett and Betz. Bandura (1997) defined self-efficacy as the "perceived ability of an individual to perform particular behavior that may contain difficult and stressful elements" (p. 3). Bandura (1977) also states that self-efficacy beliefs are "derived from the cognitive appraisal of four categories of experiences: enactive mastery, vicarious experience, verbal persuasion, and physiological arousal" (p. 79). Bandura used self-efficacy as the cornerstone for his social cognitive theory. This theory focuses on a student's self-efficacy, outcome expectations, and goals. This theory can help examine how students decide to select STEM as a career or college major by looking at how the students developed their interest in STEM (Lent et al., 1994). Self-efficacy has also been used to understand how to recruit and retain URM students in STEM majors (Strayhorn, 2015).

Students who have high self-efficacy beliefs in STEM related fields are more likely to enter a STEM related degree program or career. Increasing a student's self-efficacy can help students become more persistent (overcoming setbacks or failures) when enrolled in challenging STEM subjects (Findley-Van Nostrand & Pollenz, 2017).

There are four processes that impact the development of self-efficacy beliefs according to Bandura, as summarized by Rosenzweig and Wigfield (2016). To be effective, any type of self-efficacy intervention must include these four processes. "These include students' mastery or success experiences on a task; vicarious experiences, whereby students witness others succeeding at a task; verbal persuasion, whereby other individuals encourage students; and physiological arousal, whereby students reinterpret the negative emotion information they receive about a task" (p. 149). The mastery experiences give the individuals feedback of success or failure (Glessner et al., 2017). The vicarious experiences are based on the idea that while observing others, the person can learn and increase their self-efficacy in that subject or task (Bandura, 1997).

van Aalderen-Smeets et al., (2019) looked at how implicit STEM ability beliefs predict secondary school students' STEM self-efficacy beliefs and their intention to opt for a STEM field career. Some students think that if they are not good at a subject, they will never be good at it (entity belief). Other students think that if they practice, their ability in that subject will improve (incremental belief). The idea that there is a relationship between achievement and implicit beliefs has been suggested many times in the literature but is still being debated (Bahnik & Vranka, 2017; Susperreguy et al., 2018; van Aalderen-Smeets et al., 2019).

A good example of an entity belief would be students who say, “I’m not good at math”, or “I’m just not a math person”. Students come to believe these things about themselves for a variety of reasons. They may not have done well one year in school mathematics or their parents or even teachers may have told them something to this effect. These students do not feel they will ever get better at what they think they are bad at. These entity beliefs can have long-term effects and cause students to shy away from college degrees or careers.

Improvement in a student’s self-efficacy for a certain subject is possible. One study by Blackwell et al., (2007), had students complete eight workshop sessions examining how their brains can change over time. These sessions focused on showing students that they can change their beliefs about their own intelligence. The group was measured against a control group and the results demonstrated that the students changed their theories about intelligence and scored better in mathematics than the control group. King and Glackin (2010) found that the more science-related experiences students participate in, the higher their self-efficacy in these fields.

Sense of Belonging. Another factor that can influence a student’s career aspirations is having a sense of belonging in a group or community. According to Findley-Van Nostrand and Pollenz (2017), this sense of belonging is related to a student’s group identity. “Commitment to STEM or science identity is important for understanding motivations and decisions regarding academic careers and is linked to greater rates of persistence and lower intentions to leave STEM, as well as to career choices" (p 3). Students who feel like they belong in the classroom and can be comfortable and actively engage with peers have higher academic success (Bandura, 1986). Middle and high school students who get involved in extra-curricular activities at school develop better self-confidence and learn skills to help during competitions. All these skills have been shown to increase interest and performance in STEM (Gottfried & Williams, 2013). This holds true for college students as well. The students who get involved, make connections, and feel a greater sense of belonging have higher success rates and tend to stay in their chosen major (Strayhorn, 2012). This is also true for OST programs. Namakshi (2016) found that females that participated in a mathematics camp made connections with their peers which increased their social capital and in turn increased their mathematical identity. Hicks et al., (2018) research found similar results with African American students attending a mathematics camp. The students developed their mathematical identity while also developing their sense of belonging to a community of mathematical learners.

Parental Encouragement. Parents can play a large role in students' motivation and sense of belonging in certain subjects, which can affect their future college and career decisions. Students who come from families where talking about science is part of their day to day activities, benefit no matter their socioeconomic status (Dou et al., 2019). URM students have better grades and have higher levels of self-efficacy when their parents encourage them to do well in school (Garriott et al., 2013). Students whose parents took them to museums, talked about science at home, and provided encouragement to go into a science field have a greater sense of belonging and self-efficacy for science and are more likely to go on to pursue a career in a STEM field. (Dabney et al., 2013; Friedel et al., 2007; Nugent et al., 2015).

Dika et al., (2016) found that family contextual factors were one of the strongest predictive factors when determining career interest. This included “perceptions of their parents’ expectations, frequency of communication about college, and perceived emphasis on a STEM career, and parental educational attainment” (p. 34). Gibbons and Borders (2010) found that first generation college students have lower self-efficacy for mathematics and science. They also found that these students had to overcome more barriers to attend college.

Another factor related to the students’ career decisions and their sense of belonging is their parent’s career. Chakravarty and Tai (2013) found that students whose parents have jobs in a STEM field tend to have higher chances of going into a STEM career themselves.

With parents having such an effect on students’ career aspirations, some programs and schools have used the method of sending resources to the student’s parents so that they can learn the importance of the subject (mathematics and science) and share that information with their children. The idea is that when the parents understand the importance of the subject, they pass it on to their children which builds the utility value of the subject(s) (Harackiewicz et al., 2012).

Sociological Studies

Many studies have focused on the sociological aspects of success and goals in education, mainly socio-economic status. Students from low-income communities may have less social and cultural capital, which may cause them to have limited access to quality education, fewer role-models, less access to support networks, lower achievement, and less access to educational and vocational trajectories (Tuijl & van der Molen, 2016).

Other sociological studies have focused on how students perceive some careers as unobtainable due to their race, gender, or socio-economic status. It is important for students to develop educational and occupational aspirations for motivational purposes. Osborne et al., (2003) found that there could be a connection between the early formation of these motivational forces and the lack of disadvantaged students entering STEM professions. These students may shy away from STEM, believing that it is too difficult of an area of study for them. This concept relates back to the studies on self-efficacy discussed in the psychological portion of this review.

Multiple researchers have performed studies on individual agency and social/cultural capital. Students with high levels of economic, social, and cultural capital tend to have higher career aspirations and ambition. Tuijl, & Molen (2016) stated that SES should be considered when studying STEM enhancement studies or projects since SES is not always direct and is related to “family and individual agency factors” (pg. 164). van Aalderen-Smeets et al. (2018) found that students who thought they could change their ability levels with practice and experience (incremental beliefs) had a higher chance of opting for a STEM field career. These students, when they experienced a problem or setback, attributed it to a lack of effort and maintained their level of self-efficacy. Students who held beliefs that abilities are fixed and cannot be changed (entity) had lower levels of self-efficacy. When these students experienced a setback, they thought it was due to innate ability. Students with entity beliefs were found to have lower self-efficacy at the end of their four-year degree program than when they started (Robins & Pals, 2002).

Gender Studies. Women make up a small percentage of STEM graduates. The highest percentage of degrees in STEM obtained by women are in the biological/life sciences (~60%). The second highest percentage of female STEM degrees is in the Earth and physical sciences (40%), and engineering has the smallest percentage (~2%) (Dika & D'Amico, 2016). These low percentages may be since females, as well as URM students, experience stereotypes that incorrectly portray females as having lower intelligence levels, abilities, and performance compared to males (Brown & Leaper, 2010).

Tuijl and van der Molen (2016) pointed out that gender stereotyping is prominent when discussing STEM aspirations. Gender stereotyping "reflects societal norms of personal characteristics, activities, studies, occupations and lifestyles (e.g., work-family balance) that are deemed appropriate for men and women" (p. 167). Gender stereotyping is acquired, implicitly and explicitly, through parenting, education, and the media. Tuijl and van der Molen (2016) stated that the aspects of certain jobs "fulfills personal values" and that men value money and power more than women, with women valuing family and helping others. These values transfer to the way careers are selected (p.167).

Archer et al. (2012) found that females aged ten and eleven thought that science was masculine and that by being a scientist they would lose the ability to be "girly" (p. 974). The study found that girls must be able to identify with being a "clever" learner and "negotiate a socially acceptable performance of femininity that can balance their engagement with the aspects of science that are perceived to be masculine" (p. 980).

Stoeger et al. (2013) found that STEM interest is three times higher for boys than girls. This study also found that even though females are not limited in their ability, they benefited from a positive mentor or instructor to support them to overcome ingrained stereotypes.

Ethnic Groups and STEM. When comparing how students from different ethnic groups perceive STEM, Ozis, et al., (2018) found that Asian students showed more positive perceptions toward STEM than any other ethnic group. It was also found in this study that students who were involved in STEM clubs, no matter their ethnic background, had similar positive perceptions of STEM. This study provides some evidence that STEM clubs have a positive effect on students of color. Ozis et al. (2018) found that "STEM club enrollment has a statistically significant correlation with STEM perception" (p. 28). This study also found that females perceptions are the same as males which goes against most of the literature. This variance may be caused by the study being conducted at a STEM-oriented school where students were involved in STEM every day. This poses an interesting question for my study. Will data collected about students who are FGCSs who were at STEM-based schools vary from data collected from FGCSs students who were at non-STEM-based schools?

There have been many successful STEM club and OST experiences that have benefited students who are underrepresented in STEM, such as URM and female students. Some of the benefits include increasing social capital, increasing science and mathematics identify and self-efficacy, and improving science and mathematics grades and scores on the ACT and SAT. (Dika & D'Amico, 2016; Dou et al., 2019; Fernandez et al., 2008; Gilliam et al., 2017; Gottfried & Williams, 2013; Young & Young, 2018).

Fadigan and Hammrich (2005) conducted a longitudinal study of 117 female students enrolled in an after-school program called Women in Natural Science where they learned about careers in science through hands on, real-world learning. Half of the participants went on to pursue a career in science. Another example of a successful program is one in which URM students participated in a five-week summer program that used alternate reality gaming. This program engaged students in STEM activities and helped show the students how STEM is relevant to the real world (Gilliam et al., 2017). Students who are shown how STEM relates to their community and can make real-world connections, show increase interest in the STEM fields (Dika & D'Amico, 2016).

Teacher, and counselor influence. STEM interest and career decisions can be influenced by parent(s), friends, teachers, and counselors (Bergin, 2016, Humaymon et al., 2018, Owens et al., 2010). FGCS's have less access to help with the college application process at home since their parent(s) never went through the process. As mentioned earlier, FGCS do not have the same amount of college-going social capital that nonFGCS do (Rangel et al., 2020). This requires FGCS to rely more on teacher and counselors at their school to help them. Schmidt et al., (2012) states that counselors play an important role in guiding students to explore the many careers that are available to them. Owens et al., (2010) suggests having career counselors develop partnerships between high schools and colleges to help FGCS through the process of learning about college majors, obtain mentors, and learn strategies to get through the difficulties of the admission process. According to Choy et al. (2000), this is not the case, stating that FGCS are less likely to work with school staff to get assistance with applying to college.

Stem-Based Schools. STEM-based schools are viewed as one of the best ways to improve STEM education (Saw, 2019). According to Means et al., (2018), to be considered a STEM-based school, a school needs to have three major characteristics:

1. The majority of the school's curriculum must be based on intensive STEM preparation.
2. The school's enrollment must be based on student interest rather than aptitude.
3. The overall goal of the school is to prepare the next generation of STEM workers by preparing the students to enter college programs in STEM.

Many of these schools rely on the surrounding community and external organizations to partner with the school to incorporate real-word experiences for the students. This allows the students multiple opportunities to work with STEM colleges and STEM professionals (Saw, 2019). The curriculum at these schools typically project-based and students have an extensive network of support from teachers and staff (Means, 2018). Many of these schools offer classes that are not available at non-STEM schools, including a variety of classes that offer college credit (Saw, 2019). Means (2018) found that students from underrepresented groups have a higher chance of taking advanced STEM classes if they attend a STEM-based high school. Saw (2019) found that URM students have a higher rate of graduation at these schools and more go on to college. The study found that the reason that more URMs go on to college may be due to more access to information about colleges, careers, and help with the admission process.

All the studies reviewed here cover the many varied spheres of influence on a student's choice to enter the STEM field. For my own research, I will have to consider both the psychological and sociological factors that play a role in the student's overall decision. I will consider the many factors that shape student perception of STEM as well as their perception of their own success in this area of study. The methods used in previous studies employing questionnaires will be very helpful when creating a valid questionnaire with questions that will lead to a better understanding of the relationship between being FGCS and the pursuit of STEM careers. Thoughtful construction of these questionnaires will help provide adequate data to examine if the measured factors influence students' decision to major in a STEM field. The interviews conducted with the FGCSs will help to validate the results of the questionnaire and provide further insight. It is hoped that these results can contribute to improved initiatives to inspire a diverse group of students to pursue opportunities and excel in STEM fields.

Chapter 3

METHODOLOGY

Introduction

Even though the number of students in the United States becoming proficient in STEM is increasing, the rate of increase is slow (Corbett et al., 2008). To be competitive in the global market, the US must increase the STEM workforce and increase the diversity of workers within these fields (Meador 2018). With the US becoming more and more diverse, it is important to focus on how to get more students of color interested in STEM (King, 2017). One way to do this is to determine what factors influenced the URMs who are already enrolled in a STEM major in college. First generation college students are primarily underrepresented minorities and according to RTI International (2019), as of the 2015-16 school year, make up 56% of the undergraduates in the US.

To determine what factors influenced first year college students to major in STEM, a mixed methods study analyzed first generation and non-first-generation college students' experiences that led them to pursue a STEM degree. The study took place at a large public four-year Southeastern University. A questionnaire was used to collect data on FGCS and non-FGCS STEM students. A sample of the questionnaire can be found in the Appendix A.

Participants were interviewed on Zoom using open-ended questions. These interview questions, which can be found in the Appendix B, helped gain further insight into the experiences that led to their selection of a STEM college major.

Research Questions

There is a small percentage of FGCSs that enter college on a path to obtain a degree in a STEM field. This investigation was designed to answer the questions:

1. How do select economic, sociological, and psychological factors differentially influence FGCS and non-FGCS decisions to major in a STEM field?
2. How does participation in informal learning experiences influence FGCS and nonFGCS STEM degree selection?
3. How does participation in formal learning experiences in middle and high school influence FGCS and nonFGCS STEM degree selection?

Research Design

Type of Study The goal of this study was to determine the experiences that FGCS and nonFGCS have prior to applying for college that affect their decision to select a STEM major. A mixed methods approach was used for this study. A questionnaire was distributed to FGCS and nonFGCS who are majoring in STEM and are in their first year of college to collect demographic data and background information on various STEM experiences. A follow-up interview with open-ended questions was then conducted to obtain more information about the individuals experiences. The researcher looked for meaning in these experiences and how they related to the participants pursing a STEM degree. Once the interviews were complete, the researcher analyzed the data.

Methodological Approach For this mixed-methods study, data was collected by electronic questionnaire and interviews. Participants were selected based on the following criteria: First Generation College Student (FGCS), with a declared major in a STEM field, and currently enrolled in their first year at a large public four-year Southeastern University. The comparison group was made up of non-FGCS STEM majors in their first year at the same large public four-year Southeastern University. According to the website of the university chosen for this study, more than 17% of the 2018-19 incoming class identified themselves as FGCS. According to the university's registrar website (2020), the school's population is made up of 76.7% Caucasian, 10.2% African American, 4% Hispanic, 2.3% Asian, .2% Native American, .1% Pacific Islander, 3.2% two or more races, and 1.6% NR Alien. 1.7% did not give a response. A total of 21.6% of the student population is made up of minorities.

To recruit FGCS, the researcher worked with the Opportunity Scholars Program (OSP). The OSP is a branch of the Federally funded TRIO program which is available at universities throughout the United States. The TRIO program helps low-income, FGCS plan and prepare to go to college. Students can start participating in the program as early as seventh grade. The OSP is for FGCS freshman who are current residents of the state in which the University is in, have a family income not greater than 150% of DHS poverty guidelines, and have been accepted to the University campus. The program provides mentors, tutoring, undergraduate research help, cultural enrichment, and small class size for their freshman classes, tuition reduction, and career advisement. There are 149 students that have been accepted into the OSP for the Fall 2020 freshman class with 72 of those being STEM majors.

The researcher distributed a participation letter via email explaining the study and a link to the electronic questionnaire, developed using Survey Monkey, to advisors and instructors in the OSP at the selected University. They then provided the link to their students. Data entered in the Survey Monkey were automatically collected on the website. The questionnaire was also distributed to a comparison group, which was made up of first year, nonFGCS that are majoring in a STEM field. The link to the questionnaire was distributed by the secretaries of each STEM department (Biology, Physics, Mathematics, Chemistry, Engineering).

After the researcher sent out multiple reminders for students to complete the questionnaire, a total of 171 questionnaires from both the FGCS and nonFGCS were completed. All the participants questionnaires were reviewed to ensure they met the criteria (in their first year of college and a STEM major). Any participants data that did not meet this were removed from the study. Forty-seven of the participants were from FGCS in the OSP. With 79 incoming freshman STEM majors in the OSP for the Fall of 2020, the questionnaire participation rate was 59.5%. The researcher was able to interview ten FGCS and ten non-FGCS. To select these students for the interview, the researcher paired the FGCS with a nonFGCS with the same ethnicity and major. The data collected were then examined to determine the dominant experiences that led the participants to major in a STEM field and if these experiences are similar among the participants in the study verses the comparison groups.

Data Collection and Analysis

Data Sources: online questionnaires. To collect background data and select candidates for face-to-face interviews, a questionnaire (Appendix A) was given to first year, FGCSs/non-FGCS majoring in STEM fields. The questionnaire questions pertained to ethnicity, gender, family background, college major selection, courses completed in high school, and participation in clubs during middle or high school. The questions were designed to eliminate students who do not meet the study criteria and to provide the researcher with initial information about the students' backgrounds and choices to major in a STEM field. Information from the questionnaire was also used to further refine the interview questions and delve deeper into the students' school experiences that influenced their decision to major in a STEM field.

The questionnaire was created using Survey Monkey. The link to the Survey Monkey questionnaire was provided to students that were enrolled in the Opportunity Scholars Program (OSP) at a large southeastern University. The researcher worked with the assistant director of the OSP program who helped distribute the questionnaire via email to the first-year students in the OSP.

To survey nonFGCS, the link to the questionnaire was sent to the multiple STEM departments (Biology, Physics, Mathematics, Chemistry, Engineering) so that they could email it to the undergraduate students. The researcher matched the nonFGCS with FGCS regarding various factors (race, gender, and major).

The students were given two months to complete the questionnaire and the researcher sent out multiple email reminders to students who met the study inclusion criteria. After the two months, 171 students had completed the questionnaire (47 FGCS, 124 nonFGCS). The online questionnaire served as the initial data set and allowed the researcher to select students based on the above criteria for the interview portion of the study. The null hypothesis for the study states that there is not significant difference between FGCS and nonFGCS influences that led the students to major in STEM. The data from the questionnaire were analyzed using statistical software. T-tests were run to determine if the dependent variables were statistically significant. Cohens d were calculated and analyzed using Cohen's (1988) methods to determine effect size. A small effect size is if d is≥ ± 0:20. A medium effect size is if d is ≥ ±0:50 a medium effect, and large effect size is if d is ≥ ± 0:80as a large effect. Analyses of variance (ANOVA) were run using JASP to determine if ethnicity, gender, FGCS/nonFGCS explained the difference in means for counselor influence, college concerns, STEM confidence, and growth/fixed mindset.

Thirty of the students agreed to participate in the follow-up interview (20 nonFGCS and 10 FGCS). Since only ten students were FGCS from the OSP, ten nonFGCS were selected by matching ten to the FGCS base on race, gender, and major.

Participant Demographics

Table 3.1 presents the demographics of the participants. A total of 171 participants completed the questionnaire. Forty-seven of the participants were enrolled in the OSP and are FGCS in their first year of college. One hundred and twenty-four participants were students from various STEM departments in their first year of college and were not FGCSs.

More male FGCS completed the questionnaire than females. Sixty-eight percent of the FGCS were male and 32% were female. This was opposite from the nonFGCS who completed the questionnaire. Twenty-seven percent were male, and 73% were female.

Out of the 47 FGCS that participated, 34% considered themselves white and 66% nonwhite. Out of the one 124 nonFGCS, 23% considered themselves nonwhite and 77% white. These data can be seen in Table 3.1

Table 3.1 Reported Demographics of Participants

Demographic category	OSP/FGCS		nonOSP/nonFGCS	
	n	%	n	%
Ethnicity				
Asian	12	25.53	8	6.45
Black or African American	12	25.53	3	2.42
Hispanic or Latino	3	6.38	8	6.45
Middle Eastern or N. African	4	8.51	2	1.61
Multiracial or Multiethnic	0	0	7	5.65
White	16	34.04	96	77.41
Gender:				
Male	32	68	34	27
Female	15	32	90	73

The questionnaire asked participants for their current family income. This information can be found in Table 3.2. Students who apply to be in the OSP must have a family income not greater than 150% of DHS poverty guidelines. Sixty-eight percent of the FGCS have a combined family income less than $30,000. Seventy-two percent of the nonOSP/nonFGCS family income was $75,000 or higher.

Table 3.2 Reported Family Income of Participants

Demographic category	OSP/FGCS		NonOSP/nonFGCS	
	n	%	n	%
Family income				
Under $15,000:	17	36	0	0
Between $15,000 and $29,999	15	32	4	3
Between $30,000 and $49,999	10	21.3	10	8
Between $50,000 and $74,999	3	6.4	21	17
Between $75,000 and $99,999	2	4.3	20	16
Between $100,000 and $150,000	0	0	36	29
Over $150,000	0	0	33	27

To ensure that all participants in the nonFGCS group were nonFGCS, participants were asked about their mother and father's highest level of education (Table 3.3).

Table 3.3 Reported Highest Earned Degree of Participants Mother and Father

Demographic category	OSP/FGCS		NonOSP/nonFGCS	
	n	%	n	%
Mother's highest earned degree				
Less than high school	9	19.15	1	0.81
High school diploma	19	40.43	13	10.43
Some college:	18	38.39	14	11.29
Undergraduate degree	0	0	58	46.77
Master's degree	0	0	31	25
PhD:	0	0	5	4.03
M.D.	0	0	2	1.61
Father's highest earned degree:				
Less than high school	11	23.4	2	1.61
High school diploma	26	55.32	16	12.9
Some college	10	21.28	13	10.48
Undergraduate	0	0	47	37.9
Master's degree	0	0	36	29.03
PhD	0	0	3	2.42
M.D.	0	0	7	5.64

Interview participant selection and matching. NonOSP and OSP students that participated in the questionnaire were asked if they would be interested in a follow up interview. Twenty interviews were conducted, ten with students from the nonOSP student group and ten students from the OSP student group. To keep the participants information private, students who participated in the interviews were assigned a pseudonym. These data can be found in Table 3.4

Table 3.4 Interview Participants Pseudonyms and Background Information

Pseudonyms	FGCS/NonFGCS	Gender	Ethnicity	Major(s)
Angie	nonFGCS	Female	Middle Eastern or N. African	Biology
Linda	FGCS	Female	Middle Eastern or N. African	Public Health
Adam	FGCS	Male	Middle Eastern or N. African	Public Health
Caleb	nonFGCS	Male	Middle Eastern or N. African	Biochemistry
Tara	nonFGCS	Female	Asian	Biology
Sara	nonFGCS	Female	Asian	Biochemistry
Sydney	FGCS	Female	Asian	Biology
Erin	FGCS	Female	Asian	Biology
Sedona	nonFGCS	Female	Black or African American	Biology
Mary	nonFGCS	Female	Black or African American	Physics
Myranda	FGCS	Female	Black or African American	Engineering
Anders	FGCS	Female	Black or African American	Biology
Colton	FGCS	Male	Black or African American	Biology
Kathleen	FGCS	Female	Hispanic or Latino	Nursing
Josh	NonFGCS	Male	Hispanic or Latino	Biochemistry
Mark	NonFGCS	Male	Hispanic or Latino	Biology
John	FGCS	Male	Hispanic or Latino	Computer Science
Grayson	FGCS	Male	White	Computer Science
Charles	NonFGCS	Male	White	Physics
Avett	NonFGCS	Male	White	Mathematics

FGCS and nonFGCS were matched for the interviews based on their ethnicity, gender and major if possible. In some cases, there were more of a certain gender or ethnicity due to the number of students that were willing to participate in the interview. For some groups more females opted to be interviewed and the reverse was true with other groups. Out of the twenty students, eleven were female (55%) and nine were male (45%). Out of the twenty students who interviewed, two females and two males self-identified on the questionnaire as being Middle Eastern or North African, four females registered as being Asian, four females and one male registered as being Black or African American, one female and three males registered as being Hispanic or Latino, and three males registered as being White.

A list of interview questions were asked to each participant to gather more information about the influences that led the student to select a major in a STEM field. The questions were created with the purpose of answering the main research questions and can be found in Appendix B.

Data Source: interviews. The researcher designed a twenty-four question semi-structured interview protocol that was used to interview the FGCS and non-FGCS that agreed to be in the study. Each interview took approximately twenty to thirty minutes and was recorded using Zoom and transcribed for analysis. Temi.com, an automated online transcription service, was used to transcribe the video/audio recordings. The interview questions were designed to gather more data about the participant's personal experiences that led them to major in a STEM field (Appendix C). The questions were designed to be open-ended so that the interviewee felt comfortable to add information not asked in the questionnaire. Furthermore, the questions were designed to gather information to answer the research questions.

The questions in the interview were created to gather data about both the psychological and sociological factors in FGCSs lives prior to college that led them to pursue a degree in a STEM field. Additional questions were developed about parent/family influence, socioeconomic status, if a STEM-based middle or high school was attended, and STEM club participation. Questions also addressed the influence of any informal and formal STEM experiences on the FGCS and non-FGCS's choice to pursue a STEM major. Lastly, a series of questions to determine the participants growth mind set and STEM confidence were also included.

An interview protocol (Appendix D) was developed using the Interview Proposal Refinement (IPR) technique. By using the IPR, qualitative researchers can increase the reliability of the interview data (Gay et al., 2011). There are four phases of the IPR which include: (a) making sure that the interview questions align with the research questions, (b) inquiry-based conversation creation, (c) feedback on the interview protocols, and (d) a pilot study on the interview protocol (Fadzli et al., 2020). All four phases were met at the start of this study in the Fall semester by creating an interview protocol to ensure the interview questions aligned with the research questions and a pilot study was conducted to check that the interview questions created inquiry-based conversation during the interview process.

Before starting the study, the questionnaire and interview questions were given to 20 FGCS and 20 nonFGCS STEM majors who were not in the study. Since the total population of the incoming Freshman class of Opportunity Scholars Program students declaring a major in a STEM field is seventy-nine, twenty students represent a quarter of the study population that will be used in the actual study. FGCS who were enrolled in the OSP during the Spring 2020 semester were surveyed for the pilot study. The pilot study took place over the Summer before the new school year started. This allowed the researcher time to modify the questionnaire and interview questions before collecting data from students at the beginning of the Fall semester.

The questionnaire was emailed to the students by one of the faculty in charge of the OSP. NonFGCS were sampled using freshman enrolled in summer courses. The questionnaires were sent out by the various secretaries of the different departments and summer course instructors.

The pilot questionnaire included additional open-ended questions that allowed the researcher to obtain information on any aspect of the survey the participant found confusing, if they felt the survey was too long, and if anything should be added. Ten students who answered the questionnaire agreed to a follow-up interview on Zoom. The interview questions in the study were designed to spark inquiry-based conversation by being open ended. This allowed the participants to tell stories about their experiences. The students were asked to provide any additional information about changes they thought needed to be made to the questionnaire and interview. After the pilot study, the questionnaire and interview questions met the researcher's goals. One question was added about the influence of online video services such as YouTube/Netflix. All the questions asked in the pilot study were answered.

The purpose of the interviews, based on findings from the literature, was to determine if there were psychological, sociological/economic factors, and informal/formal experiences that overlap among the different participants that lead the FGCSs to pursue a degree in a STEM field. The results from the interviews and the questionnaires were compared to see if there were trends between the participants (income bracket, race, gender, ethnicity, etc.). These trends can help to inform future work to encourage more URG and FGCs to major in a STEM field.

The data collected from the interviews were analyzed using JASP, an open-source statistical program. Descriptive statistics were run to determine the mean, median, and mode for each category of the collected data. Mean values were compared by running t-tests on the data and Cohens *d* was calculated to determine effect size. When comparing three or more averages, ANOVA's were run with Tukey post hoc tests to determine the overall significant influence.

Analysis of questionnaires and interviews

Questionnaires. All the data from the questionnaires were collected using Survey Monkey. Before being selected for an interview, the data from the questionnaires were checked to make sure the student qualified for the study (first year STEM major). The data from any student who did not meet the qualifications for the study were deleted.

All the names of the participants in the study were changed to pseudonyms for confidentiality. A separate file was created to store the participants real names. The questionnaire data were organized into categories based on the questions asked and combined with the data from the interview (explained below). A table was created to organize all the data for each student in one place.

Interviews After the completion of the interviews, the audio recordings were transcribed for analysis using automated transcription tools (Temi and Zoom). The goal of the researcher was to determine common themes from the questionnaires and interviews (Saldaña, 2016). The data from the questionnaires and interviews were coded using structural coding also termed utilitarian coding (Saldaña 2016). This was the first cycle of coding and allowed the researcher to find and group themes that showed up on multiple interviews and questionnaires. Structural coding allowed the researcher to categorize the data into themes and examine these themes to find similarities, differences, and relationships (Saldaña 2016). The first cycle of coding was completed by organizing the interview data based on which of the research questions they helped to answer. Themes were then developed for each research question. These included: Economic, Family/Friends, Teacher Influence, Counselor Influence, College Concerns, Fixed Mindset, STEM Confidence, Growth Mindset, Informal learning experiences, and Formal learning experiences.

After the completion of the first cycle of coding, a second cycle of coding took place. Pattern coding was used for the second cycle of coding. This process helped to organize and condense the first-round coding into more specific subcodes that helped answer the three research questions by helping to identify an "emergent theme, configuration, or explanation" (Saldaña, 2016, p.236). The condensed data allowed the researcher to determine if informal/formal experiences, and/or psychological, sociological/economic factors influence a FGCSs decision to pursue a degree in a STEM field. After the first and second cycle of coding was complete and themes were developed, the data were peer reviewed by a professional with a PhD in teaching and learning who is familiar with qualitative analysis and coding. This was done by having another person familiar with qualitative research code 20% of the interviews. The researchers coded independently and then met on Zoom to compare codes. This helped ensure the themes were credible (Yin, 2009). All the coding completed by both researchers were very similar except for one statement. After discussing this difference, the researchers came to a consensus. A few examples of the second-round coding that both researchers agreed on include future salary influence, parental influence, teacher encouragement, lack of parent help, and determination. After the coding was compared, the data from each category were summed for frequency data. This was done by calculating a percentage of the overall frequency under each category. This allowed the researcher to determine which categories had the highest percentage of influence on the study participants decision to choose a STEM degree. The interview data were then compared to the questionnaire data. This was completed by looking at the responses of each participants questionnaire data and comparing it to what they stated in the interview. If a participant stated in the interview that a certain person was a major influence, the researcher looked back at the questionnaire data to see if they stated the same influence.

Role of the Researcher

Another validity check used in this study was to list the existing preconceptions the researcher had about the study. Moustakas (1994) calls this process epochè. By eliminating existing preconceptions, the researcher can collect, analyze, and interpret the data without bias, which adds rigor to a phenomenological study (Patton, 2002). The researcher has been a middle school science teacher for sixteen years at multiple schools around the United States. The schools have ranged from low income to high income, public and private, and STEM-based and non-STEM based. The researcher has also been a coach of a STEM club for six years. Working with this club has shown the researcher that students get excited and are engaged when working on a hands-on project with other students. From the experiences the researcher has seen, he feels that participation in a STEM club(s) gets students interested in STEM and increases their chances of pursuing a degree in a STEM field. Because of this bias, the researcher looked for contradictory evidence in the interviews to counter the bias by using multiple sources of data in the coding.

Initiating Research

Approval and exempt research status from the University's Institutional Review Board for Human Subject research was obtained. The link to the questionnaire was shared with the assistant director of the Opportunity Scholars Program. As students took the survey, the researcher monitored to see which students agreed to be interviewed. All students who agreed to be interviewed were given a gift card. Students who agreed to be interviewed were contacted and scheduled for a face-to-face interview on Zoom.

Data Validity

Creswell and Miller (2000) define validity as "how accurately the account represents participants' realities of the social phenomena and is credible to them" (p.124). To determine the validity of this study, triangulation was used (Crewell & Miller, 2000). The initial questionnaire data were compared to the participant interview data. This comparison was used to create themes among the data.

Chapter 4

RESULTS

Results

The purpose of the study was to determine how economic, sociological, and psychological factors differentially influence FGCS and nonFGCS decisions to major in a STEM field. The study also determined how participation in formal and informal learning experiences in middle and high school influenced FGCS STEM degree selection. Within this chapter, the results are organized under each relevant research question. Data gathered from both the questionnaire and interviews pertaining to each research question's theme(s) (economic, sociological, psychological, informal, and formal influences) are presented.

The study took place at a large Southeastern University where 17% of the freshman entering the 2018-2019 school year were considered first-generation college students. This investigation was designed to answer the following questions:

1. How do select economic, sociological, and psychological factors differentially influence FGCS and nonFGCS decisions to major in a STEM field?
2. How does participation in informal learning experiences in middle and high school influence FGCS and nonFGCS STEM degree selection?
3. How does participation in formal learning experiences in middle and high school influence FGCS and nonFGCS STEM degree selection?

To answer these questions, data were collected using questionnaires and interviews that were sent to both FGCS and nonFGCS STEM majors. The data collected from the questionnaires and interviews are provided in this chapter. The questionnaire data provides the results from the 171 questionnaires that were received from nonFGCS STEM majors and FGCS STEM majors in the Opportunity Scholars Program at a large Southeastern University. Interviews were conducted with ten nonFGCS STEM majors and ten FGCS STEM majors.

STEM Experience Questionnaire and Interview Results

SurveyMonkey was used to create a questionnaire that was sent to STEM majors in the OSP program and to other STEM departments at a large Southeastern University. Questions for the survey were designed to help answer the research questions. To obtain background information on each participant, questions about their ethnicity, gender, family income, primary means of paying for college, current work status, mother's highest degree earned, and father's highest degree earned were included within the questionnaire. Out of the one hundred seventy-one participants, all of the questions asked were answered.

Research question number one asks, "How do select economic, sociological, and psychological factors differentially influence FGCSs (nonOSP students) and non-FGCSs (OSP students) decision to major in a STEM field"? As described in Table 1, this question was divided into three main topics: Economic, Sociological, and Psychological. Interview questions were created for each main topic to help determine the influence of each on the student's decision to major in a STEM field. To determine patterns for the participants' decision to enroll as a STEM major, the researcher created themes and subcodes for each of the main topic areas.

Economic Factors

Family income level. On the questionnaire, students were asked to provide their family's combined income. These data can be found in Table 4.2. For students to be accepted into the OSP, they must have a family income not greater than 150% of DHS poverty guidelines. Sixty-eight percent of the FGCS have a combined family income less than $30,000. Twenty-one percent stated $30,000-$49,000, 6% stated $50,000-$74,999, and 4% $75,000-$99,999. Over 72% of the nonFGCS family income was $75,000 or higher and 3% stated having an income less than $30,000.

Students current work status. FGCS who are in the OSP do not have to pay tuition but do have to pay a technology fee of two hundred dollars per semester. To pay for these fees, some students work part time. Thirty-eight percent of the FGCS in this study work part time, zero percent work full time, and sixty-two percent do not work at all. For the nonFGCS who took the questionnaire, forty-eight percent worked a part time job, one percent worked full time, and fifty-one percent did not work at all. The questionnaire also asked students about the ways in which they paid tuition and fees.

Paying for college. One hundred percent of the FGCS that answered the survey stated that they received scholarships. Eighty-nine percent state that they received additional grants. Forty-five percent stated that they received financial aid, and thirteen percent stated that their parents helped them pay for college. For the nonFGCS, eighty percent stated that they received scholarships, twenty-eight percent stated that they received grants, forty-seven percent received financial aid, and sixty percent stated that their parents were paying for college. The FGCS have a lower percentage of parents paying for college, students using finical aid, and working compared to the nonFGCS in this study.

Economic Influence from Interview. From the interviews three subcodes were created. These included STEM scholarship availability, future salary influence, and future job availability. Out of the 20 interviews, two FGCSs and one nonFGCS stated that the availability of STEM scholarships influenced their decisions to major in a STEM field. The Opportunity Scholars program is not a STEM specific scholarship, but it does provide tuition for all its students. Four FGCSs and two nonFGCS stated future salary was an influence. Future job availability was influential for two FGCSs and one nonFGCS.

Future salary influence. Erin, a FGCS stated "My favorite subject is science, so I wanted to do something within that field and also be able to have a stable income for my family for future years so that's pretty much why I chose this path." Future salary also influenced Adam, a FGCS, decision to major in STEM. He stated that if you open your own medical practice "you're kind of your own boss, you decide your hours and things like that, so I like the flexibility and they do make good money so thankfully I'll be able to support for my family and live a comfortable lifestyle". Sara, a nonFGCS stated "I wanted to go into premed because I thought I would make a lot of money".

Future job availability. Mary, a nonFGCS found that future job availability was an important influence. She stated that "being able to get a job after college is important" and that "STEM is a growing field with many unfilled jobs". Grayson, a FGCS, shared similar feelings. He stated that "at STEM fair, they were talking about how there are lots of STEM jobs and getting away from the blue-collar lives my parents have lived is important to me. I wanted something that was like for sure profitable because, like I can't afford to spend $100,000 in education and then not be able to profit off it."

FGCS who were interviewed were more motivated by future salary than nonFGCS when selecting a STEM major. In one case, this translated into wanting to make more money than their parents and moving into a new economic class. Other students were more concerned about finding a job after college. They had heard that STEM was a growing field and that there would be a lot of jobs available in the future. This helped them make the decision to pursue a degree in a STEM field.

Sociological Influences

Family/Friend influence. The family and friends influence category included anyone in the student's immediate family and their friends who influenced, positively or negatively, their decision to pursue a STEM major. As it applied to their mother, father, or siblings, participants selected the level of influence on a scale of 1-5, with 5 being extremely influential. Table 4.1 shows that nonFGCS students had a mean of 2.595 out of 5 with a standard deviation of 1.047 and FGCS students had a mean of 2.560 out of 5 with a standard deviation of 1.083.

Table 4.1 NonFGCS and FGCS Family and Friends Influence Data

Descriptive Statistics

	Family influence	
	NonFGCS	**FGCS**
Number of Students	124	47
Missing	0	0
Mean	2.595	2.560
Std. Deviation	1.047	1.083
Minimum	1.000	1.000
Maximum	5.000	5.000

An independent samples t-test was run to determine whether there was a statistical difference between the group's mean family influence scores. This can be seen in Table 4.2. The family influence difference between nonFGCS and FGCS was not significant ($p>0.05$). Therefore, the null hypothesis, which states that there is a not significant difference between nonFGCS and FGCS family difference, is not rejected.

Table 4.2 Independent Samples t-test On Participants Family Influence Data

	t	df	p	Cohen's d
Family influence	0.197	169	0.844	0.034

Note. Student's t-test.

Sociological Influence from Interviews. Sociological influence included family and friend influence. Through the data analysis, this major theme was found to have additional subcodes that further described the data.

Family/Friends influence. The subcodes for family and friends include parents, siblings, and friends (Table 4.3). Out of the twenty students interviewed, more FGCS were encouraged by family and friends than the nonFGCS to enter a STEM field major. At the same time, more FGCS mentioned in the interviews that they had members of their family or their friends that tried to discourage them from pursing a degree in STEM.

Table 4.3 Family Friends Influence on Pursuing a STEM Degree

Family/Friend Influence Subcodes	FGCS	NonFGCS
	n	n
Mother	1	2
Father	3	2
Sibling	4	0
Friends	2	2
Both Mother and Father	4	2
Family Medical Issue	1	2
Family Discouragement	4	0
Friend Discouragement	1	1

Caleb, the one nonFGCS who mentioned being told discouraging comments about majoring in a STEM field, said that the comments came from his friends, not his parents, who were very supportive. Caleb stated:

Almost all my friends were like, dude, no way you're going to be a doctor. I said, I want to be a doctor. My friend's kind of laughed and were like, dude, no way you could be a doctor, you're as dumb as all of us.

The researcher asked Caleb how these comments made by his friends made him feel. Caleb stated that the comments "didn't bother him". He also stated in the interview that "I knew I didn't really try hard in high school, and when I get in college, I'm going to have to work harder".

Kathleen, a FGCS, also had friends who tried to discourage her from going into STEM. She stated that her friends would say things like “you're not good at math”. Kathleen did not have the full support of her mother either. Kathleen said her mother told her “That it was going to be too hard a program and she did not want to see me drop out”. When asked how she overcame these challenges, Kathleen stated in the interview that she was “a very stubborn person”, and she “worked a lot” to get into the Opportunity Scholars Program, “even though I wasn’t naturally gifted”.

Colton, a FGCS, explained how his parents were very encouraging while growing up:

> I was considered kind of smart by my parents. They're like ‘yeah you really do well’, at least when it came to science, mathematics, and English. They're like ‘you're really smart, you should definitely do that’ (in reference to pursuing a STEM major). They supported me big time.

Multiple nonFGCS and one FGCS discussed the influence their family’s culture had on their decision. Three of the students’ parents promoted the stereotype that certain ethnicities are better at STEM and expected their children to go into these high paying STEM fields. Sydney, a FGCS stated that “My parents expected me to go into medicine.” When asked why this was, she stated “they expect me to be successful, as most Asian parents do”.

Sara, a nonFGCS had a similar experience. Sara stated that:

> I’m Indian so you just know that you are going off into the STEM world. Culture is important. I know personally if I did go into like the arts or history or like a language my parents would be like, what's wrong with you, you know, so I didn't have options, but also like personally I’m just more of a science and math person.

> I think that kind of like influenced me because growing up, they kind of brainwash you into doing STEM.

Tara, a nonFGCS, had stated a similar experience, she stated that “It's like the stereotypical, first-generation American, first-generation Asian American parents are always going to suggest kindly that you become a doctor or a lawyer or something super successful”.

A few students stated in the interviews that spending time in a hospital with sick family members inspired them to go into health sciences to help people with similar illnesses. Tara, a nonFGCS, told a story about her grandmother. “My grandmother was in and out of the hospital a lot. I'd see my grandfather administering insulin for her. I didn't realize how much that influenced me until maybe my senior year of high school. But I realized that was what made me want to be in the medical field or do something related to STEM.”

Family influence results from the interviews showed that verbal encouragement or discouragement was not the only method in which family can influence students' decisions. Adam mentioned wanting to get a good job so that he could support his family. This would fall under the future salary subcode as well as the family influence code. Grayson also discussed how important future salary was to him. He wanted to get a job that would take move him out of the “blue collar lives” that his parents have. This lifestyle helped motivate him to pursue a career in a field that would provide a high salary.

Sociological influence summary. Overall, when comparing the questionnaire data regarding family and friends influence on the FGCSs and nonFGCSs decision to pursue a

STEM degree, the difference was not statistically significant. During the interviews more FGCSs than nonFGCS stated that they had a family member(s) influence their decision. During the interviews, participants were asked if anyone ever tried to discourage them from pursuing a degree in STEM. Four of the ten FGCSs stated they received discouraging comments from family and friends compared to only one of the ten nonFGCS interviewed. All five of these students still pursued a degree in STEM. Determination was the shared reason for all these students for disregarding the negative comments they received.

Psychological Influence

The third part of research question one examined how psychological influences affect a student's decision to major in a STEM field. This section is broken into three major components: college concerns, STEM confidence, and fixed and growth mindset.

College concerns. In the questionnaire, data regarding nonFGCS and FGCS students' concerns about applying to college were collected using a Likert scale (1-5) with 1 representing not at all concerned and 5 representing extremely concerned. These concerns included: financial concern, time management, course difficulty, and feeling welcome/comfortable on campus. To look at the larger patterns within the college concern items, students' responses to these items (average financial concern, time management, course difficulty, feeling welcome/comfortable on campus) were averaged with the overall mean results categorized as College Concerns. For college concerns nonFGCS students had a mean of 2.986 with a standard deviation of 0.777 and FGCS students had a mean of 3.364 with a standard deviation of 0.892 (Table 4.4).

An independent samples t-test was run to determine whether there was a statistical difference between the group's mean college concern scores. This can be seen in Table 4.5. The college concern difference between nonFGCS and FGCS was statistically significant ($p<0.05$). Therefore, the null hypothesis, which states that there is no significant difference between nonFGCS and FGCS college concerns. This hypothesis is rejected due to $p<0.05$. The effect size for college concerns is medium ($d \geq \pm 0.50$). A two-way ANOVA (Table 4.6) was run to determine if there was a difference between the amount of college concerns on males versus females. The results show that there was not significant difference between the amount of college concerns on males vs. females

Table 4.4 NonFGCS and FGCS College Concerns Data

College Concerns

	College concerns	
	NonFGCS	**FGCS**
Number of Students	124	47
Missing	0	0
Mean	2.986	3.364
Std. Deviation	0.777	0.892
Minimum	1.300	1.500
Maximum	4.800	5.000

Table 4.5 Independent Samples t-test On Participants College Concern Data

	t	**df**	**p**	**Cohen's d**
College concerns	-2.720	169	0.007	-0.466

Note. Student's t-test.

Table 4.6 Two-Way ANOVA Showing NonFGCS/FGCS, Gender, and College Concerns

Cases	Sum of Squares	df	Mean Square	F	p
NonFGCS (1) FGCS (2)	5.129	1	5.129	7.826	0.006
What is your gender? Female (1) Male (2)	0.029	1	0.029	0.044	0.835
NonFGCS (1) FGCS (2) ✻ What is your gender? Female (1) Male (2)	0.835	1	0.835	1.273	0.261
Residuals	108.801	166	0.655		

Note. Type III Sum of Squares

A two-way ANOVA (Table 4.7) was also run to determine whether ethnicity was a factor in the amount of college concerns students have. Due to a small sample size, only two groups, white and students of color, were created. The results of the Tukey post hoc tests (Table 4.8 and 4.9) show that white students reported significantly less college concerns than students of color.

Table 4.7 Two-Way ANOVA Showing NonFGCS/FGCS, Ethnicity, and College Concerns

Cases	Sum of Squares	df	Mean Square	F	p
NonFGCS/FGCS	1.198	1	1.198	1.877	0.173
Ethnicity	4.093	1	4.093	6.411	0.012
NonFGCS/FGCS ✻ Ethnicity	0.077	1	0.077	0.12	0.729
Residuals	106.629	167	0.638		

Note. Type III Sum of Squares

Table 4.8 Tukey Post Hoc Comparison for NonFGCS/FGCC and College Concerns

Post Hoc Comparisons - NonFGCS (1) FGCS (2)

		Mean Difference	SE	t	p_{tukey}
1	2	-0.208	0.152	-1.37	0.173

Note. Results are averaged over the levels of: What is your race or ethnicity?

Table 4.9 Tukey Post Hoc Comparison for Ethnicity and College Concerns

Post Hoc Comparisons - What is your race or ethnicity?

		Mean Difference	SE	t	p_{tukey}
1	2	-0.384	0.152	-2.532	0.012

Note. Results are averaged over the levels of: NonFGCS (1) FGCS (2)

When looking at the individual questions that were asked about college concerns, FGCS were more concerned than nonFGCS about how they were going to cover the cost of tuition, feeling welcome on campus, and course difficulty. NonFGCS were more concerned than FGCS about time management (Table 4.10).

FGCS are eligible for a program as early as middle school, titled Upward Bound, which is part of the TRIO program. It is only offered at certain schools that are in the school district where the University in this study is located. This program helps prepare FGCS for college by offering tutoring and other programs. Programs like this need to be promoted more in other areas to help reduce FGCS concerns about attending college.

Table 4.10 Percentage of FGCS and NonFGCS College Concerns

College Concerns	FGCS	NonFGCS
	%	%
Financial Concern	89	79
Time Management	89	95
Course Difficulty	98	96
Feeling Welcome on Campus	64	46

College concern interview data. During the interviews, participants were asked if they had any concerns when applying to college. Subcodes were created to determine which concerns students had about pursuing a degree in a STEM field (Table 4.11).

Table 4.11 FGCS and NonFGCS College Concerns Subcodes

College Concerns Subcodes	FGCS	NonFGCS
	n	n
Cost of college	4	1
Lack of information about majors	0	1
Working while going to college	1	0
Challenging college schedule	2	0
Challenging courses	2	1
Living far from home	1	1

Out of the twenty students interviewed, four nonFGCS and ten FGCSs had at least one concern. More FGCSs were concerned about the cost of college than the other mentioned concerns. One nonFGCS and zero FGCS stated having a lack of information about STEM majors.

Avett, a nonFGCS lacked information about the different majors in science. He stated, "I wish I had more information going into picking a specific branch of science because I think when you leave high school, or at least when I left high school, either in engineering or medical, I didn't know anything about the research field at all."

Tara, a nonFGCS, worried about being far from family. She stated "being far away from my family, that was a big thing. Not only was I concerned about that, but they were concerned about it too. They were worried about the very heavy workload on top of, you know, having to take care of myself and having work on the side." John and Anders, both FGCSs, were worried about the cost of tuition. They both stated how grateful they were to find the Opportunity Scholars Program. John stated, "I was really worried about the cost of college but once I found out about Opportunity Scholars from my high school counselor, I knew that I would be able to go. I hope to get a scholarship for medical school though".

STEM confidence. In the questionnaire, STEM confidence was measured using a Likert scale (1-4) with 1 representing not confident and 4 representing extremely confident. Participants were asked to answer nine questions about their comfort level on completing different science and mathematics tasks. A full list of these questions can be found in Appendix E. Students' responses collected from these nine questions were averaged and labeled STEM confidence for analysis in JASP.

Table 4.12 shows that nonFGCS (1) students had a STEM confidence mean of 3.193 with a standard deviation of 0.568 and FGCS (2) students had a STEM confidence mean of 2.673 with a standard deviation of 0.487. These data show that FGCS in this study have a significantly lower STEM confidence than nonFGCS. An independent samples t-test was run to determine whether there was a statistical difference between the group's mean STEM confidence scores. This can be seen in Table 4.13. The STEM confidence difference between nonFGCS and FGCS was significant ($p<0.05$). The effect size for STEM confidence is large ($d \geq \pm 0.80$).

Table 4.12 Questionnaire Results Showing Average STEM Confidence for NonFGCS and FGCS

Descriptive Statistics

	STEM confidence	
	nonFGCS	**FGCS**
Number of Students	124	47
Missing	0	0
Mean	3.193	2.673
Std. Deviation	0.568	0.487
Minimum	1.500	1.750
Maximum	4.000	3.875

Table 4.13 Independent Samples t-test On Participants STEM Confidence

	t	**df**	**p**	**Cohen's d**
STEM confidence	5.555	169	< .001	0.951

A two-way ANOVA (Table 4.14) was run for ethnicity, FGCS status, and STEM confidence. The results show that there is main effect for ethnicity so ethnicity is significant for explaining the variance for FGCS and nonFGCS STEM confidence. A Tukey post hoc comparison of FGCS status and ethnicity was run to confirm the results of the two-way ANOVA (Table 4.15 and 4.16). The results show that students of color reported significantly less STEM confidence than white students. A two-way ANOVA (Table 4.17) was run for gender, FGCS status, and STEM confidence. The results show that there is not significant difference between the amount of STEM confidence for males vs. females.

Table 4.14 Two-Way ANOVA Showing NonFGCS/FGCS, Ethnicity, and STEM Confidence

ANOVA STEM Confidence

Cases	Sum of Squares	df	Mean Square	F	p
NonFGCS/FGCS	5.161	1	5.161	17.46	< .001
Ethnicity	1.191	1	1.191	4.031	0.04
NonFGCS/FGCS ✻ Ethnicity?	0.078	1	0.078	0.264	0.60
Residuals	49.349	167	0.296		

Note. Type III Sum of Squares

Table 4.15 Post Hoc Comparisons for NonFGCS/FGCS and STEM Confidence

Post Hoc Comparisons - NonFGCS (1) FGCS (2)

		Mean Difference	SE	t	p_{tukey}
1	2	0.431	0.103	4.179	< .001

Note. Results are averaged over the levels of: What is your race or ethnicity?

Table 4.16 Post Hoc Comparisons for Ethnicity and STEM Confidence

Post Hoc Comparisons - What is your race or ethnicity?

		Mean Difference	SE	t	p_{tukey}
1	2	0.207	0.103	2.008	0.046

Note. Results are averaged over the levels of: Non FGCS (1) FGCS (2)

Table 4.17 Two-Way ANOVA Showing NonFGCS/FGCS, Gender, and STEM Confidence

ANOVA - STEM confidence

Cases	Sum of Squares	df	Mean Square	F	p
NonFGCS (1) FGCS (2)	7.581	1	7.581	25.035	< .001
What is your gender? Female (1) Male (2)	0.191	1	0.191	0.631	0.428
NonFGCS (1) FGCS (2) ✻ What is your gender? Female (1) Male (2)	0.006	1	0.006	0.019	0.892
Residuals	50.264	166	0.303		

Note. Type III Sum of Squares

Fixed and growth mindset. Fixed and growth mindset data were collected using a Likert scale (1-4) with 1 being strongly disagree and 4 being strongly agree. To measure fixed and growth mindset, the questionnaire contained ten questions, five corresponding to a student having a growth mindset and five corresponding to a student having a fixed mindset. Students reported their perceptions about a person being able to change their intelligence/abilities with work and how they feel when they are given feedback on their performance. The full set of questions can be found in Appendix F. Data collected from these questions were averaged: fixed mindset (average of the fixed mindset items), and growth mindset (average of the growth mindset items) to compare the FGCS and nonFGCS participants. The data are shown in Table 4.18.

Table 4.18 Questionnaire Results Showing Average Growth and Fixed Mindset for NonFGCS and FGCS

Average Fixed and Growth Mindset

	Average nonFGCS	**Growth FGCS**	**Average nonFGCS**	**Fixed FGCS**
Number of Students	124	47	124	47
Missing	0	0	0	0
Mean	2.288	2.421	0.983	0.953
Std. Deviation	0.413	0.339	0.374	0.494
Minimum	1.200	1.800	0.200	0.200
Maximum	3.000	3.000	2.000	2.200

For growth mindset, nonFGCS students had a 2.288 mean with a standard deviation of 0.413. FGCS students had a 2.421 mean with a standard deviation of 0.339. For fixed mindset, nonFGCS students had a 0.983 mean with a standard deviation of 0.374. FGCS students had a 0.953 mean with a standard deviation of 0.494. With these data, there was a violation of the equal variance assumption based on the results of the Levenes's test. Table 4.19 shows that after conducting the required Welch test, averaged fixed mindset difference for nonFGCS and FGCS was not statistically significant ($p>.05$).

Table 4.19 Independent Samples t-test on participants average growth and fixed mindset for nonFGCS and FGCS

	Test	**Statistic**	**df**	**p**	**Cohen's d**
Average Growth	Student	-1.967	169	0.051	-0.337
	Welch	-2.149	100.395	0.034	-0.352
Average Fixed	Student	0.431	169	0.667	0.074
	Welch	0.381	66.96	0.704	0.069

Therefore, the null hypothesis, which states that there is no difference between nonFGCS and FGCS fixed mindset, is not rejected ($p>.05$). The average growth mindset was shown to be statistically significant ($p<.05$). This shows that FGCS had a significantly higher growth mindset than nonFGCS. Therefore, the null hypothesis, which states that there is no difference between nonFGCS and FGCS growth mindset, is rejected due to the results of the t-test ($p<.05$). The effect size for fixed mindset is small ($d \geq \pm 0.20$) and for growth mindset it is medium ($d \geq \pm 0.50$).

A two-way ANOVA (Table 4.20) was run to determine if FGCS status or ethnicity had a larger effect on a student's growth mindset. The results show that there are no main effects for growth mindset so it is not explaining any variance. There is not significant difference between the amount of growth mindset on white students versus, students of color.

Table 4.20 Two-Way ANOVA for NonFGCS/FGCS, Ethnicity, and Average Growth Mindset

ANOVA - Average Growth

Cases	Sum of Squares	df	Mean Square	F	p
NonFGCS/FGCS	0.361	1	0.361	2.3	0.131
Ethnicity?	0.037	1	0.037	0.235	0.629
NonFGCS/FGCS ✻ Ethnicity?	0.017	1	0.017	0.109	0.742
Residuals	26.232	167	0.157		

Note. Type III Sum of Squares

A two-way ANOVA (Table 4.21) was also run to determine if FGCS status or gender had a larger effect on a student's growth mindset. The results show that there is not significant difference between the amount of growth mindset on males versus female students.

Table 4.21 Two-Way ANOVA for NonFGCS/FGCS, Gender, and Average Growth Mindset

ANOVA - Average Growth

Cases	Sum of Squares	df	Mean Square	F	p
NonFGCS(1) FGCS (2)	0.371	1	0.371	2.366	0.126
What is your gender? Female (1) Male (2)	0.131	1	0.131	0.837	0.361
NonFGCS (1) FGCS (2) ✻ What is your gender? Female (1) Male (2)	0.034	1	0.034	0.219	0.640
Residuals	26.030	166	0.157		

NonFGCS and FGCS's were asked if they were ever told "you're good at science or mathematics". Two nonFGCS and three FGCSs stated they had been told that they were good at science or mathematics. Myranda, a FGCS, said that "people told me that I was good at math and science and that I should major in computer science." Angie, a nonFGCS, stated that "science was always my best subject." The other fifteen students who were interviewed did not state that anyone had told them they were good at mathematics or science.

Growth mindset. Both FGCSs and nonFGCS were asked the question, "If you are not good at a subject, could you work hard and get better at it?" They then were asked to provide examples from their own lives that related to STEM. The sub codes that were created from their answers included: GRIT, motivation, self-doubt, extra work/tutoring, overcoming friends/family's negative comments about STEM/rejection (Table 4.22).

Table 4.22 Growth Mindset Interview Data for FGCS and NonFGCS

Growth Mindset	FGCS	NonFGCS
	n	n
GRIT	3	3
Motivation	2	0
Self-Doubt	0	1
Extra Work/Tutoring	6	0
Overcoming Negative Comments/Rejection	3	2

Adam, a FGCS, stated “I just know growing up I had a lot of self-doubt because I was first gen and I felt like I couldn't go home and be like hi mom, dad, can you help me with this? They couldn't read over any of my essays or things like that, so I feel like now I'm battling my self-doubt. Now I think I could be a doctor. I'm going to go all the way. I'm not going to stop at being a nurse or a nurse practitioner”.

Caleb, a nonFGCS, stated:

> I was struggling pretty hard in AP calculus my senior year. I mean, it was tough. I would stay up late. I was getting C's on tests or high D's. I really was considering like, am I cut out for this? Like, do I even have the mental strength to do this? If I can't even get through this AP calculus class and the kids around me are flying through it. All it came down to was me thinking to myself like, this is what I'm good at. So, realizing that science is what I'm good at and science is what I want to do, I was like, I just got to buckle down. I got to work harder. I like learning so I'm going to sit here and learn this until I know it inside and out and until I feel

> confident that I can go to college and apply what I learned because I don't want to forget all of it. Because I know that even some of the stuff you learn in high school is going to transcend using it in college and grad school and med school. So yeah, it definitely just came down to like understanding that this is the path that I chose, and I have to work hard to do it and so that's what I did.

Fixed mindset interview data. During the interview, participants were asked if they ever felt that mathematics or science classes were hard for them. The participants were asked to explain their answer. Mathematics negativity was the only subcode for the fixed mindset theme. None of the students that were interviewed stated that science classes were hard for them. One nonFGCS and one FGCS stated that they did not enjoy mathematics or that they were not good at it. Kathleen, a FGCS stated "Math is my worst subject. I don't like it very much". Mark, a nonFGCS, stated "I have never been very good at math".

Summary of RQ1: Influence of economic, sociological, and psychological factors: Research question number one asked how do select economic, sociological, and psychological factors differentially influence FGCS and nonFGCS decisions to major in a STEM field? In terms of economic factors, both FGCS and nonFGCS stated STEM scholarship availability, future job availability, and job salary as factors that influenced their decisions to pursue a degree in STEM. The sociological influences, such as family and friend influence were found not to be statistically significant when comparing the two groups (FGCS and nonFGCS). Data from the interviews showed that more FGCS stated having family members influence their college degree selection. The psychological influences when comparing FGCS with nonFGCS showed that FGCS have higher college concerns, lower STEM confidence, and higher growth mindset than nonFGCS. When comparing the students fixed mindset, there was not a statistically significant difference between FGCS and nonFGCS.

Informal influences on STEM major selection

Research question two was developed to determine the importance of informal experiences on nonFGCS and FGCS decision to pursue a degree in a STEM field. In the questionnaire, nonFGCS and FGCS were asked to rate the various informal experiences that may or may not have influenced their decision to choose a STEM major using a Likert scale of 1-5, with 1 being not influential at all and 5 being extremely influential.

Informal STEM influences are considered experiences that influenced the student to pursue a degree in a STEM field but occurred outside of school or during school but were not part of the regular school curriculum. All of the influences for informal experience were grouped together. An example would be visiting a museum or attending a STEM camp. The individual questions can be found in Appendix G.

Table 4.23 shows the informal learning influences on the nonFGCS and the FGCS. NonFGCS students had a mean of 2.358 with a standard deviation of 0.616 and FGCS students had a mean of 2.381 and a standard deviation of 0.892.

Table 4.23 Informal Learning Influences on NonFGCS and FGCS STEM Major Decision

Descriptive Statistics

	Informal learning influence	
	nonFGCS	**FGCS**
Number of Students	124	47
Missing	0	0
Mean	2.358	2.381
Std. Deviation	0.616	0.892
Minimum	1.300	1.000
Maximum	4.400	4.100

An independent samples t-test was run on the informal learning influences to determine the p value. This can be found in Table 4.24. With these data, there was a violation of the equal variance assumption based on the results of the Levenes's test. Table 4.18 shows that after conducting the required Welch test the averaged informal learning influence for nonFGCS and FGCS is not statistically significant ($p>.05$). The null hypothesis states that there is a not significant difference between nonFGCS and FGCS informal learning influence. Therefore, the null hypothesis is not rejected due to the results of the t-test ($p>.05$). The effect size for informal learning influence is small ($d \geq \pm 0.20$).

Table 4.24 Informal Learning Influences Independent Samples t-test

	Test	**Statistic**	**df**	**p**	**Cohen's d**
Informal learning influence	Student	-0.190	169.000	0.850	-0.032
	Welch	-0.161	63.376	0.872	-0.030

Table 4.25 shows the percentage of FGCS and nonFGCS who were slightly to extremely influenced by various informal learning experiences that were asked on the questionnaire. Watching STEM related videos on YouTube or other video streaming services was the highest informal influence for both FGCS (76%) and nonFGCS (92%). Being a member of an organization (Girl Scouts, Boy Scouts, 4H, etc.) was the least influential in both FGCS (40%) and nonFGCS (40%).

Table 4.25 Informal Influence on FGCS and NonFGCS Decision to Major in STEM

Informal Influences	FGCS	NonFGCS
	%	%
Watching STEM related videos on YouTube or other video streaming services	76	92
Participating in a club	65	69
Visiting a museum	49	69
Vacation	47	55
Attending camp	40	40
Attending a cultural event	51	36
Being a member of an organization (Girl Scouts, Boy Scouts, 4H, etc.)	40	35

Informal learning experiences interview data. FGCS and nonFGCS were also asked during the interviews to describe the influence of informal learning experiences on their STEM degree selection. The researcher created subcodes from the interviews that included: participation in a club, workplace tours, real-world experiences, internship/job shadowing, watching YouTube, field trips, summer camps/programs, and STEM fairs. Eight FGCSs and four nonFGCS described these experiences as influential in their decision to pursue a STEM degree.

Colton, a FGCS, was a member of the Health Occupation Students of America (HOSA) club in high school, which was mentioned by multiple students as what got them interested in the health sciences. Colton stated that:

At the HOSA competitions, they brought professionals to us, so we got to see for

> ourselves what each occupation looked like. One of the days it was a cardiac surgeon, so I literally got to go to them and ask them questions about the field and what his work is like and it was really helpful.

Adam, another FGCS said:

> I was thinking of health care, but I wasn't 100% sure, so I joined this club (HOSA) to help me make a decision and it did, because they were able to bring in physicians who were hands-on, and they would bring in like mannequins and intubate the patients and things like that is like really fun so you're actually getting to do stuff. It kind of showed you like, do I actually like this, am I enjoying this or is it just fun right now, but like spending the rest of my life doing this isn't something I would imagine, so it kind of helped me, you know validate my truth."

Tara, a nonFGCS, mentioned how TV/YouTube influenced her decision. Tara said that:

> I watched a lot of Grey's Anatomy growing up, watching it I switched back and forth a lot between whether I wanted to do law or business or something in the medical field, you know, but I ended up on YouTube one day and I just found a bunch of like, neurosurgery videos and I just couldn't stop watching them, so I guess that was a big factor in me coming here for health science."

Summary of RQ2: Influence of informal learning experiences. Through the analysis of the interview and questionnaire data, no significant difference was found when comparing the influence of informal learning experiences on FGCS and nonFGCS' decision to pursue a degree in a STEM field. In the interviews, students described the influence of STEM clubs they were in, or by watching videos on digital streaming services, on their decision to pursue a degree in a STEM field. For individual students, some of these experiences were influential in their decisions to go into STEM.

Opportunities like the HOSA club and online videos mentioned above, allowed students to see first-hand what a career in these fields would look like, or spark an interest into a topic, which in turn influenced some of the participants to pursue a career in STEM. Data from the questionnaire shows that the most influential informal experience for both FGCS and nonFGCS was watching STEM related videos on YouTube or other video streaming services. The least influential informal learning experience for both FGCS and nonFGCS was being a member of an organization (Girl Scouts, Boy Scouts, 4H, etc.).

Formal influence on STEM major decision:

Research question three asked if formal STEM influences affected FGCS decision to pursue a degree in a STEM field. Formal STEM influences are considered experiences that occurred at school that influenced the student to pursue a degree in a STEM field. These included: elementary, middle, and high school science and mathematics courses, middle and high school science and mathematics teachers, and middle and high school counselors.

Table 4.26 shows the mean formal influences on STEM major decision. With these data, there was a violation of equal variance assumption.

Table 4.26 Mean Formal Influences on STEM Major Decision of NonFGCS Compared to FGCS

Descriptive Statistics

	Teacher influence		**Counselor influence**		**Subject influence**	
	nonFGCS	**FGCS**	**nonFGCS**	**FGCS**	**nonFGCS**	**FGCS**
Number of Students	124	47	124	47	124	47
Missing	0	0	0	0	0	0
Mean	2.710	2.423	1.435	2.245	2.946	2.802
Std. Deviation	0.745	0.943	0.781	1.042	0.742	0.929
Minimum	1.000	1.000	1.000	1.000	1.300	1.000
Maximum	5.000	4.000	5.000	4.500	5.000	4.500

After conducting the required Welch test, counselor influence was shown to be statistically significant ($p<.05$). The null hypothesis states that there is a not significant difference between nonFGCS and FGCS counselor influence. Therefore, the null hypothesis is rejected due to the results of the Welch test ($p<.05$). The effect size for family influence is large ($d \geq \pm 0.80$). Teacher and subject influence were not statistically significant ($p>.05$) when comparing FGCS and nonFGCS. Therefore, the null hypothesis, which states that there is a not significant difference between nonFGCS and FGCS teacher and subject influence, is not rejected due to the results of the t-test ($p>.05$) The effect size for teacher influence is medium ($d \geq \pm 0.50$) and for subject influence it is small ($d \geq \pm 0.20$) (Table 4.27).

Table 4.27 Welch test for informal influence data

Independent Samples T-Test for formal influences on STEM major decision

	Test	Statistic	df	p	Cohen's d
Teacher influence	Student	2.078	169	0.039	0.356
	Welch	1.871	68.896	0.066	0.337
Counselor influence	Student	-5.495	169	< .001	-0.941
	Welch	-4.835	66.539	< .001	-0.879
Subject influence	Student	1.054	169	0.294	0.18
	Welch	0.953	69.405	0.344	0.171

The two-way ANOVA (Table 4.28) shows that there is main effect for ethnicity so ethnicity is significant for explaining the variance for FGCS and nonFGCS counselor influence. A Tukey post hoc test was run (Table 4.29 and 4.30) to determine if the influence of counselors explained more of the variance on ethnicity or FGCS status. A two-way ANOVA (Table 4.31) was run to determine if there was a difference between counselor influence on gender. The results show that there is not significant difference between the amount of counselor influence on males vs. females

Table 4.28 Two-Way ANOVA Showing NonFGCS/FGCS, Ethnicity, and Counselor Influence

Cases	Sum of Squares	df	Mean Square	F	p
Ethnicity	7.415	1	7.415	10.566	0.001
NonFGCS/FGCS	9.413	1	9.413	13.413	<.001
Ethnicity ✻ NonFGCS/FGCS	0.212	1	0.212	0.302	0.583
Residuals	117.197	167	0.702		

Table 4.29 Post Hoc Comparisons on NonFGCS/FGCS and Counselor Influence

Post Hoc Comparisons - NonFGCS (1) FGCS (2)

		Mean Difference	SE	t	p_{tukey}
1	2	-0.582	0.159	-3.662	< .001

Note. Results are averaged over the levels of: What is your race or ethnicity?

Table 4.30 Post Hoc Comparisons on Ethnicity and Counselor Influence

Post Hoc Comparisons - What is your race or ethnicity?

		Mean Difference	SE	t	p_{tukey}
1	2	-0.517	0.159	-3.251	0.001

Note. Results are averaged over the levels of: NonFGCS (1) FGCS (2)

Table 4.31 Two-Way ANOVA Showing NonFGCS/FGCS, Gender, and Counselor Influence

ANOVA - Counselor influence

Cases	Sum of Squares	df	Mean Square	F	p
NonFGCS (1) FGCS (2)	23.605	1	23.605	31.993	< .001
What is your gender? Female (1) Male (2)	0.399	1	0.399	0.541	0.463
NonFGCS (1) FGCS (2) ✻ What is your gender? Female (1) Male (2)	2.370	1	2.370	3.212	0.075
Residuals	122.478	166	0.738		

Note. Type III Sum of Squares

On average, FGCS were significantly more influenced than nonFGCS by their school counselors and nonFGCS were more influenced more by their teachers than FGCS. In the interviews, both FGCS and nonFGCS discussed the influence their teachers had on them but only FGCS discussed how their counselors helped them decide to major in a STEM field.

Table 4.32 shows the percentage of FGCS and nonFGCS who were influenced by their middle and high school counselors, and their middle and high school mathematics and science teachers to pursue a degree in a STEM field. According to the questionnaire data, more FGCS (85%) and nonFGCS (94%) stated that their high school science teachers had more influence on their decisions to pursue a STEM degree than their counselors and mathematics teachers. The data also show that more FGCS were influence by their counselors and more nonFGCS were influenced by their science and mathematics teachers.

Table 4.32 Percentage of FGCS and NonFGCS Influence by Teachers and Counselors

Formal Influences	FGCS	NonFGCS
	%	%
Middle School Counselor	43	14
High School Counselor	68	32
Middle School Mathematics Teacher	44	56
High School Mathematics Teacher	51	81
Middle School Science Teacher	60	61
High School Science Teacher	85	94

Table 4.33 shows the percentage of FGCS and nonFGCS that were influenced by their elementary, middle, and high school mathematics and science teachers to pursue a degree in a STEM field. The data collected from the questionnaires show that FGCS and nonFGCS were more influenced to pursue a STEM degree by their high school science classes than their other mathematics and science classes taken from elementary to high school. Overall, except for elementary mathematics courses, more nonFGCS were influenced by their mathematics and science classes than FGCS were.

Table 4.33 Percentage of FGCS and NonFGCS Influence by Science and Mathematics Courses

Formal Influences	FGCS	NonFGCS
	%	%
High School Science	94	99
High School Mathematics	70	85
Middle School Science	79	84
Elementary School Science	70	72
Middle School Mathematics	64	71
Elementary School Mathematics	57	56

Formal influence interview data.

Teacher influence. Both the FGCSs and nonFGCS used various adjectives to describe how a teacher or teachers influenced their decision to pursue a degree in a STEM field. These adjectives became the subcodes for this theme. The subcodes included encouraging, positive, helpful, caring, easy to understand, enthusiastic, challenging, and engaging. Overall, seven nonFGCS and nine FGCSs were influenced by a teacher or teachers. Each participant was asked if they had a teacher negatively influence their decision to purse a STEM degree. None of the FGCS nor nonFGCS stated that a teacher negatively influenced them.

Colton, a FGCS, stated:

> My AP Biology teacher was probably one of the best teachers that I ever had because he was so inclusive. I feel like it was the environment that he created because, unlike all my other classes, where the teachers just have you sit down and memorize information, his class allowed us to have discussions. He wanted us to get something out of the class besides just information.

Grayson, another FGCS, had a similar experience. "My high school engineering teacher, Mr. Williams, was a huge influence on my decision because he always supported my path and he'd give me extra projects on what I was interested in."

NonFGCS were also influenced by their teachers. Josh, a nonFGCS, stated:

> "My first chemistry teacher was very influential; she was just super enthusiastic about teaching chemistry. She was very engaged with the students and had fun labs. AP chemistry was just more challenging, and the labs weren't that fun, but it was there to help us understand and learn the material".

Colton, Grayson, and Josh were all influenced by a teacher to pursue a degree in STEM. Each of these students is currently majoring in a field that relates to the class in which their influential teacher taught. Colton who stated that his biology teacher influenced him is now a biological science major. Grayson's engineering teacher was his influence and now he is a computer science major, and Josh's chemistry teacher influenced him to pursue a degree in biochemistry/molecular biology.

School counselor influence. During the interviews, the researcher asked the participants which people helped influenced their decision to pursue a degree in STEM. The subcodes created for this them included college application/scholarship guidance. Four of the ten FGCS participants were influenced by their school's guidance counselor and zero nonFGCS.

Colton, a FGCS, stated "my guidance counselor was a big help. I remember going through the whole process when I came to her room and we signed up for classes and then I came back after my health science course, and was like, I want to take more. She was like, um why, I was like, I find it so interesting, I think this is what I want to do in college. And from there she sat down with me and went over what I needed to take if I wanted to do this in college. She set me up with the track to follow. I wouldn't have any idea what to do".

School counselors helped guide students to scholarships and through the application process. Linda, another FGCS, stated that "My high school counselor helped a lot with the application process and finding scholarships".

The questionnaire data showed that counselor influence was statistically significant but when interviewing the students, only a few mentioned that their counselors were influential in their decision to major in STEM. These data suggest that the counselors helped the students with applying and finding degree programs, but all the students came to their counselor with the predetermined goal of majoring in a STEM field.

Other subcodes under the formal experiences theme included AP STEM course influence, STEM elective course influence, hands-on classes, in school tutoring, and guest speakers. Eight FGCSs and nonFGCS stated that one or more formal experience influenced their decision to major in STEM. Colton, a FGCS, stated, “I ended up taking Health Science courses. I just kind of fell in love with health science. I found it really interesting.”

Sara, a nonFGCS, found that she enjoyed the classes that were hands-on. She stated:

> I liked the chemistry labs. They were fun. I liked the chemical reactions and everything. I just know the world is just filled with chemistry all around us and everything has a structure and I just find it interesting. I think this is what got me interested in majoring in chemistry.

Caleb, a nonFGCS, also enjoyed AP Chemistry. He stated that:

> The only extra class I took was AP chemistry, which kind of skyrocketed me into like being pre-med now and like where I am now in college with AP chemistry. I instantly fell in love with it. I thought it was so cool. As soon as I got here, I immediately went into organic chemistry one and two and got A's in both.

Summary of RQ3: Influence of formal learning experiences: Research question number three asked how does participation in formal learning experiences in middle and high school influence FGCS and nonFGCS STEM degree selection? When comparing the FGCS and nonFGCS formal influences counselor influence was statically more influential for FGCS than nonFGCS. When comparing the means, more nonFGCS were influenced by their teachers and subjects taken. During the interviews, both FGCS and nonFGCS stated teacher, counselor, and subject as having an influence in their decision to pursue a STEM degree.

Chapter summary: In this chapter, data collected for the mixed-methods study from questionnaires and interviews from FGCS and nonFGCS were analyzed and explained to help answer three research questions:

1. How do select economic, sociological, and psychological factors differentially influence FGCS and nonFGCS decisions to major in a STEM field?
2. How does participation in informal learning experiences in middle and high school influence FGCS and nonFGCS STEM degree selection?
3. How does participation in formal learning experiences in middle and high school influence FGCS and nonFGCS STEM degree selection?

CHAPTER 5

CONCLUSIONS, DISCUSSIONS AND RECOMMENDATIONS

Summary of study:

According to the Bureau of Labor Statistics (2021), STEM careers will increase twice as fast as other careers over the next decade. With the number of STEM jobs increasing, there is a concern that the number of STEM graduates will not meet these current needs (Ozis et al., 2018). There is a call, therefore, to increase the number of STEM graduates by getting more students in K-12 interested in STEM. Getting more students interested in STEM means looking at populations that have historically been shown to have a low interest in STEM careers. Currently, there is a low percentage of FGCS enrolling as STEM majors (Dika and D'Amico, 2016). The purpose of this study was to learn how various formal and informal experiences, as well as the economic, sociological, and psychological factors, influence FGCSs decision to pursue a degree in a STEM field. To determine what factors influenced first-year college students to major in STEM, a mixed methods study analyzed first-generation and non-first-generation college students' experiences that led them to pursue a STEM degree. A questionnaire was distributed to FGCS and nonFGCS STEM majors at a large public four-year Southeastern University. Forty-seven FGCS from the OSP program and one-hundred and twenty-four nonFGCS participated in the questionnaire. A follow-up interview conducted with ten FGCS and ten nonFGCS helped gain further insight into the experiences that led to their selection of a STEM college major. The data collected from the questionnaire were analyzed using JASP statistical software. The interviews were transcribed and analyzed using structural coding. Both the questionaries' and interview data were compared to determine which factors had the most influence on FGCS decision to pursue a degree in a STEM field.

Synopsis of major findings:

Question one of the study asked how do select economic, sociological, and psychological factors differentially influence FGCS and nonFGCS decisions to major in a STEM field? STEM scholarship availability, future salary, and job availability were economic factors that influenced both FGCS and nonFGCS decisions to pursue a degree in STEM.

The sociological influence results from the questionnaire showed that, when comparing nonFGCS with FGCS, influence from family and friends were found not to be significantly different in the decision to major in a STEM field. In the interviews, many of the FGCS discussed how members of their family encouraged them or inspired them to go into STEM. However, some of the FGCS described receiving more discouraging comments from family and friends than nonFGCS.

The psychological influences measured included college concerns, STEM confidence, fixed mindset, and growth mindset. When comparing the FGCS with nonFGCS, their degree of college concerns and STEM confidence were significantly different. STEM confidence had a large effect size according to a Cohen *d* value of .951. Ethnicity and gender were also measured to determine if these factors explained more of the variance than FGCS status. Gender was not as significant as FGCS status for any of the measured influences. Ethnicity was shown to have a higher influence on college concern than FGCS status. FGCS status was shown to have a higher influence than ethnicity on STEM confidence and growth mindset. FGCS had a lower STEM confidence than nonFGCS. The main college concerns included the cost of college, feeling welcome on campus, and the difficulty of college courses. NonFGCS main college concern was time management. When comparing the FGCS with nonFGCS, their scores on the questionnaire for fixed and growth mindset were not significantly different, but FGCS had a higher overall mean for growth mindset than nonFGCS. Having a low STEM confidence level and a high growth mindset level shows that the FGCS in this study know the importance of working hard to overcome challenges to meet their goals. Many of the FGCS in the interviews stated having to get extra help through tutors or teaching themselves topics that they were underachieving in academically to get caught up. Table 4.10 and 4.12 show that the majority of the FGCS in this study show growth mindset.

Question two of the study asked how does participation in informal learning experiences in middle and high school influence FGCS and nonFGCS STEM degree selection? When compared, the student's perceptions of the influence of informal experiences were not significantly different between the groups in influencing the participant's decisions. Despite the lack of statistical significance between groups, both sets of students found participation in STEM clubs slightly to extremely influential to their STEM major decisions with 68% of FGCS and 69% of nonFGCS stated that clubs slightly to extremely influenced their STEM major decision. NonFGCS were more influenced by museum visits and vacations than FGCS. FGCS were more influenced by attending a cultural event and being a member of an organization like 4H than nonFGCS.

The third and final question of the study asked, how does participation in formal learning experiences in middle and high school influence FGCS and nonFGCS STEM degree selection? When comparing the FGCS and nonFGCS formal influences, counselor influence was statistically more influential for FGCS than nonFGCS (Table 5.1).

Counselor influence had a large effect size with a Cohen *d* of -0.941. Gender and ethnicity were also analyzed to determine if these factors explained more of the difference than FGCS status. It was found that neither ethnicity nor gender explained more of the difference than FGCS status.

When comparing the means, more nonFGCS were influenced by their teachers. High school science teachers were the most influential with 94% of nonFGCS and 85% of FGCS stating that they were slightly to extremely influenced to pursue a degree in a STEM field. A large percentage of nonFGCS (81%) were influenced by their high school mathematics teachers compared to 51% of FGCS. Middle school science and mathematics teachers influenced nonFGCS less than their high school teachers. More nonFGCS were influenced by their middle school mathematics and science teachers than FGCS.

Table 5.1: Percentage of FGCS and nonFGCS in the Study Influenced by Formal and Informal Learning Experiences

% Influenced	Type of Influence	FGCS	NonFGCS
0-33%	Formal		Counselors (32%)
34-67%	Informal	Member of organization (40%) Attending a cultural event (51%) Visiting a museum (49%) Vacation (47%)	Member of organization (35%) Attending a cultural event (36%) Vacation (55%)
	Formal	Counselors (68%) M.S. mathematics teachers (44%) H.S. mathematics teachers (51%) M.S. science teachers (60%)	
68-100%	Informal	Clubs (68%) Streaming STEM videos (76%)	Clubs (69%) Visiting a museum (69%) Streaming STEM videos (92%)
	Formal	H.S. mathematics courses (70%) H.S. science teachers (85%) H.S. science courses (94%)	M.S. mathematics teachers (56%) M.S. science teachers (61%) H.S. mathematics teachers (81%) H.S. mathematics courses (85%) H.S. science teachers (94%) H.S. science courses (99%)

The course influence data were similar to the teacher influence data, in that more nonFGCS were influenced by their courses than FGCS. High school science courses were the most influential with 99% of nonFGCS and 94% of FGCS claiming slight to extreme influence of these courses on their STEM major decisions. Eighty-five percent of nonFGCS and 70% of FGCS were influenced by their high school mathematics courses. Elementary mathematics courses had the lowest influence on both FGCS (56%) and nonFGCS (57%). Middle school science courses were the second most influential courses for FGCS (79%). During the interviews, both FGCS and nonFGCS described how their teachers, counselors, and mathematics/science courses influenced their decision to pursue a STEM degree.

Many of the students who stated that their teachers had an influence on their decision to pursue a STEM degree explained that these teachers showed qualities such as compassion or enthusiasm, or they made classes fun and motivated them to do their best work. Some students discussed how their teachers introduced them to career possibilities that were not familiar to them. Other students stated that teachers got them interested in the subjects by implementing a laboratory-based or hands on learning environment versus a lecture-based class. Students stated the same when describing course influence. Both FGCS and nonFGCS discussed how in their science classes, the instructors made the classes engaging by providing hands-on lessons. The instructors of the mathematics classes the students mentioned all had the same qualities (engaging, caring, and helpful). The students stated that the instructors made the material easy to understand and provided extra help if they needed it. Students who stated being influenced by their high school guidance counselors discussed how they helped them navigate the process of finding a college to attend, finding programs that were offered, classes to take, and how to apply for financial aid.

Findings related to the literature

Family and friend influence. When students start thinking about their future career, or what they want to study in college, their parents and friends have a significant influence on that decision (Bergin 2016). When comparing the FGCS with nonFGCS, the degree to which family and friends influenced their decision to pursue a degree in STEM were not significantly different but were still influential based on the descriptive data. This study agrees with Trey et al., (2020), who found that parent influence was the only statistically significant factor on both students' STEM interest and career choice intention. Parents and family were an influence for all participants, but there was not significant difference between FGCS and nonFGCS.

When looking at the overall means data from the questionnaire, FGCS were slightly more influenced by their family and friends than nonFGCS. This finding does not align with Jenkins et al., (2013) who found that when FGCS are applying to college they receive less informational, financial, and emotional support from their family compared to nonFGCS. The findings from Tate et al., (2015) align more with the findings from this study. The researchers found that even though some of the FGCS listed that their parents were not able to help them through the college process, they still provided them with support in their decisions to pursue a college degree. Multiple students stated in the interviews that the encouragement their parents provided helped them have the confidence they needed to go to college for STEM. Colton, a FGCS in the study stated,

> "I was considered kind of smart by my parents. They're like "yeah you really do well, at least when it came to science, math, and English. They're like yeah,

> you're really smart, you should definitely do that (in reference to pursuing a STEM major) they supported me big time."

The influence from friends was another factor measured in this study. When comparing the two groups, friend influence was influential for some students. Sixty-seven percent of the FGCS who participated in the questionnaire stated that friends were slightly to extremely influential in their decision to pursue a degree in STEM. During the interviews, a few of the FGCS stated their friends tried to talk them out of going into STEM. None of the nonFGCS interviewed stated that they had friends try to dissuade them from pursuing a STEM degree. These results align with the findings from Jenkins et al. (2013) who found that FGCS friends who do not want to go to college may not be supportive of their friends' decisions to pursue a college degree. This trend was reported more often with the participating FGCS than nonFGCS.

Many of the FGCS were influenced by members of their family that did not live with the student. The definition of a FGCS is a college student whose parents never attended a four-year university (Fernandez et al., 2008). By not having parents that attended college, FGCS may not have the same access to social capital that may be necessary to learn about STEM majors that nonFGCS have through their parents' experiences attending college (Snodgrass et al., 2020). For this study, the researcher did not just ask about the influence from participant's parents. Instead, participants in the study were asked about family influence, which included aunts, uncles, cousins, and grandparents. Zimet et al. (1988), found that there are many different people in a student's life that may support FGCS decisions to go to college. In this study, not only did support and encouragement from family help the students make their decisions but experiences with family members also played a role. More than one FGCS talked about experiences, such as grandparents or family members who were sick in the hospital, being the reason they wanted to go into a STEM field. All the students who stated this are currently biological science majors with the intent of going on to nursing or medical school. Some of the students stated wanting to help others in the future and some of the students said just watching how the doctors and nurses were interacting with their family members got them interested in the field.

College concerns (cost, feeling welcome, course difficulty): The results from this study showed that the three main college concerns FGCS have are the cost of college, feeling welcome on campus, and course difficulty. These data coincide with previous research. Snodgrass et al. (2020) found that FGCS were more likely to be in low level mathematics and science courses, which can cause students to assume they are not prepared for college level classes. In this study, FGCS are enrolled in the Opportunity Scholars Program which requires that the student's total family income cannot be more than fifteen thousand dollars a year. FGCS who are from low-income and working-class households have access to finical aid when applying to college but still struggle to pay for college (Peters et al., 2019). Students who come from low-income families can have concerns about how to pay for college causing some students to not apply. (Henley & Roberts, 2016). According to the questionnaire data, 79% of nonFGCS and 91% FGCS rated financial concern as slightly to extremely concerning.

Gibbons and Borders (2010) found that family, finances, racial discrimination, not having role models that attended college, and not being prepared for college classes were the areas of concern for FGCS. They also found that nonFGCS major concerns were cost and higher levels of stress. An item on the questionnaire for this study asked FGCS and nonFGCS how concerned they were about feeling welcome or comfortable on campus. Sixty-four percent of FGCS and 46% of nonFGCS stated concern about feeling welcome on campus. Aries and Seider (2005) found that FGCS can feel excluded or even intimidated in college. Students who feel that they have been discriminated against do not perform as well academically as those that do not feel discriminated against (Langhout et al., 2007). Racial discrimination was not specifically asked about but would be something to add to the questionnaire for future research.

When applying to college, some students are concerned about feeling welcome on campus. Stebleton et al. (2009), found that FGCS are more likely to be concerned about being welcomed on campus and in classes than nonFGCS. Similarly, William and Ferrari (2015) described how FGCS scored lower on Harborg's 1994 sense of school belonginess scale than nonFGCS. Both studies found that FGCS tend to have a lower sense of belonging and connectedness on campus than non-FGCS. The reasons could be linked to their school, work, and family obligations, which result in limited time for social engagement and campus activities. In this study, 28% of the FGCS who participated stated they were moderately to extremely concerned and 36% were slightly to somewhat concerned compared to 18% of the nonFGCS were moderately to extremely concerned and 28% were slightly to somewhat concerned. Once FGCS are enrolled, making connections, and feeling like they belong on campus, the chances of them dropping out are reduced (Jehangir, 2010). The FGCS in this study are all enrolled in the OSP which provides the students with many resources such as cultural enrichment activities, social gatherings, mentoring, academic tutoring, and career advisement. This may help explain why only 65% of the students were concerned about feeling welcome on campus. Students also receive a scholarship that covers tuition which may explain why most of the students only work part time. When students do not have to work while going to school, they have more time to participate in school and social activities which can build social capital (Trenor et al. 2008).

Both FGCS and nonFGCS stated that they were concerned about the difficulty of the classes in college. The questionnaire data showed that 98% FGCS and 96% of nonFGCS were slightly to extremely concerned about the difficulty of college classes. Studies have shown that FGCS were more likely than nonFGCS to be less prepared in mathematics and basic English, score lower on admission tests, and enter college with lower grade point averages than nonFGCS (Jehangir, 2010; Terenzini et al., 1996). The average GPA for the FGCS in this study was 4.0. Even though all the FGCS in this study had high GPAs and over half took AP classes, they were still concerned about the difficulty of college classes. FGCS that take advanced mathematics and science classes in high school still do not feel that they are well prepared for the challenging college courses (Reid & Moore,2008). Depending on where students live can mean having access to advanced classes and highly qualified teachers. Tieken et al. (2021) found that due to funding inequities, fewer educational opportunities are available to students who attend rural schools. Students who attend these schools can have limited access to advanced coursework. Rural schools offer less advanced math classes than the average urban school. Over 90% of urban and suburban schools offer at least one advanced placement course compared to 73% of rural schools (Tieken et al., 2021). Teacher turnover is also lower in rural school mainly due to lower salaries. These lower salaries reduce the amount of highly qualified teachers, especially in STEM.

STEM confidence: Data from the study showed that FGCS had a significantly lower STEM confidence when compared to the nonFGCS in the study. Students who do not feel that they are prepared for college classes may have lower self-efficacy as well as lower STEM confidence than students who do feel prepared (Litzler et al., 2014). Litzler et al. (2014) also found that experiences with teachers (encouragement, respectful, inspiring), perceptions of STEM courses, and the students GPA were all factors that can affect a student's STEM confidence.

Ninety-eight percent of the FGCS in this study stated that they were somewhat to extremely concerned about college course difficulty. All of the FGCS in this study had grade point averages at or above 3.5 and were interested in STEM enough to pursue their STEM major. It is surprising that many of these students still have low STEM confidence. Choy et al. (2000) found that FGCS have less mathematics and science preparation in high school and that they do not take as many high-level mathematics and science classes as nonFGCS.

Growth mindset: When compared, FGCS in this study had significantly higher growth mindset than nonFGCS. Growth mindset is the belief that with hard work and perseverance you can overcome challenges (Yeager & Dweck, 2012). During the interviews, FGCS discussed how they overcame various challenges growing up to follow their dream of going into a STEM major. Many of these students thought they were not good enough at mathematics to get into a STEM program. Other challenges included, discouraging comments about going into STEM from family and friends, having lower grades in classes like science and mathematics, not thinking they had the money to go to college, and lack of knowledge about the college application process. All the students interviewed who stated these challenges overcame them by doing their own research to find scholarships, finding tutors in subjects that they were struggling with, or finding individuals like school counselors to help them through the college application process. Evans et al., (2020) found that FGCS have a high sense of independence, were self-motivated, and defined themselves as achievers. They knew they had social, economic, or cultural barriers that they had to overcome to get into college. As stated above, FGCS in this study had low STEM confidence yet overcame this and are now STEM majors. Students with a growth mindset understand that a skill can be developed with hard work and perseverance. When students with a growth mindset experience a setback, they concentrate on effort rather than performance or validation (Dweck, 2006).

Informal influence (museums, vacations, organizations, cultural events)

Research has shown that when students participate in informal STEM learning led by qualified instructors in controlled environments, students perform better academically, increase their interest in STEM subjects, and learn more about future careers in STEM (Dabney et al., 2012). When comparing the FGCS with nonFGCS, their degree of informal influences was not significantly different on the students' decision to major in a STEM field. The informal influence that had the largest impact on both FGCS and nonFGCS in this study, according to the data collected from the questionnaire, was not an experience led by a qualified instructor or in a controlled environment. The data showed that 92% of the nonFGCS and 76% of the FGCS were influenced by watching STEM related videos on YouTube or other video streaming services. When asked about what types of videos the students were watching, answers ranged from surgery, animal documentaries, how-to, and astrophysics videos. Renninger and Hidi (2011) found that if students are interested in a certain subject, they are more likely to be successful academically and pursue a career in that subject.

The second highest informal influence for the students in this study was participating in a STEM club, with 69% of nonFGCS and 65% of FGCS stating they were slightly to extremely influenced. Participation in STEM clubs has been shown to increase students' interest and academic performance in STEM (Wade-Jaimes et al., 2019). Both FGCS and nonFGCS in this study discussed how the Health Occupations Students of America (HOSA) club got them interested in pursuing a degree in the medical field. They also discussed how they got to learn about the various careers in the medical field and participate in activities that increased their interest. Participation in this club helped build the student's confidence by allowing the students to see others doing the job, which helped them picture themselves doing the same job. This agrees with two of the four sources of Bandura's research on self-efficacy. The idea of mastery experiences shows that a student will use an experience to determine their sense of efficacy. If the student feels that they have had a successful experience, it can increase their sense of efficacy. Another method in which an individual can increase or decrease their self-efficacy is through vicarious experiences. Individuals can increase their self-efficacy by observing others complete a task (Bandura, A., 1997). Both of these sources of methods in which a student can increase their self-efficacy show the importance of students participating in internships, clubs, or experiences that allow them to observe professionals in various careers.

The theoretical framework for this study was based on Lent et al. (1994) Social-Cognitive Career Theory (SCCT) and Bandura's (1986), Social Cognitive Theory. SCCT states that students who have high self-efficacy in a certain subject are more likely to pursue a career in that subject than a subject in which they feel less confident. Fadigan and Hammrich (2005), found that clubs provide the students with opportunities to learn skills that are not always taught in traditional classrooms and learn about the different career opportunities in STEM. The questionnaire had a separate question about being a member of an organization (Girl Scouts, Boy Scouts, 4H, etc.). Students' participation in these types of informal organizations had the least amount of influence on both nonFGCS (35%) and FGCS (40%).

Formal (counselor and teacher). The data from this study showed FGCS were more influenced by their middle and high school counselors than nonFGCS. High school counselors slightly to extremely influenced 68% of the FGCS in the study and 32% nonFGCS. Middle school counselors influenced 43% of the FGCS and 14% of the nonFGCS. Choy et al., (2000) found that FGCS are not as likely to work with a counselor or teacher to learn about colleges, get help on applications, or find scholarships and financial aid. This was the opposite of what was found in this study. Since FGCS do not have parents at home that are familiar with the college application process, counselors and teachers need to provide support to these FGCS to help them through the process and help them learn about possible careers in the STEM field (Hines et al., 2020). If a student does not have parents or family members that are familiar with careers in STEM, it's very important for counselors to get the information to the students and parents (Murcia et al., 2020). Schmidt et al., (2012) stated that school counselors are key in helping students see their full potential and are responsible for guiding them through the many career choices.

Career counselors and teachers play a large role when students do not have parents that can help them with college and career planning (Wang & Degol, 2013; Bergin, 2016). Starting with the 2006-07 school year, The South Carolina Education and Economic Development Act, Chapter 59, stated that school counselors had to provide students with career counseling. The students must take a career interest assessment and the counselors help the students with exploring the path to achieve the career. This law helps to explain why the students in this study considered counselors as an influence in their decision to major in STEM.

There have been multiple studies on the influence of teachers on student's STEM interest and career choice. The results of these studies have been mixed. Tey et al. (2020) found that teacher influence was not a significant factor in nonFGCS decision to go into STEM. They found that parents have a larger impact on this decision. In this study, when looking at student groups individually, more nonFGCS stated that a teacher or teachers helped influence their decision to go into STEM. High school science teachers influenced 94% of the nonFGCS. High school mathematics teachers were the second most influential teachers for nonFGCS with 81% stating they were slightly to extremely influenced. High school science teachers were also the most influential teachers for 85% of the FGCS. Middle school mathematics teachers were the second most influential for 60% of the FGCS. The results from this study align more with Bergin (2016) and Mohd et al. (2010) who found that teachers have a major influence on students STEM interest and career choice. These interests come from classes that engage students and help them connect what they are learning in class to real-life experiences and potential career connections. Both FGCS and nonFGCS stated in the interview portion of this study that the teachers that influenced them were passionate about what they were teaching, made the lessons fun, and provided hands-on learning opportunities.

Future research

With the completion of this study, further questions arose. Since counselors were a significant influence on FGCS decision to pursue a STEM degree, future studies may look at the age in which counselors start to become important in influencing students' decisions to pursue STEM degrees. Would career counselors be helpful in elementary school or is it better to start in middle school? Students who participated in the interviews stated the importance of learning about potential jobs in STEM fields and how this helped them decide on a major in college. Programs like Project Lead the Way (PLTW) incorporate a project-based curriculum that connects students to potential STEM careers. Beier et al. (2019) found that students who participate in one project-based course have higher career aspirations in STEM. Incorporating more project-based curriculum and teacher training in how to develop project-based lessons may help get more students interest in STEM careers. Once students learn about STEM careers, what methods would be used to help students learn about the degree or certification program needed to obtain jobs in these fields? These data may help educators set up programs that could help be beneficial to both FGCS and nonFGCS.

A large percentage of the students in this study stated that online streaming platforms such as YouTube were influential in their STEM degree decisions. More research is needed to determine ways to provide access to these platforms to students who may not have access at home due to low socioeconomic status or connectivity issues. Other areas of study could include how to incorporate a more structured environment for this type of exploratory learning as a strategy for FGCS engagement.

Implications

When students experience STEM, they are more likely to pursue a career in a STEM field (Hidi & Ainley, 2009). Seventy percent of FGCS and 72% nonFGCS in this study stated that they were influenced by their elementary science classes to pursue a degree in a STEM field. Fifty-seven percent of FGCS and 56% of nonFGCS stated being influence by their elementary mathematics courses. Research by Sullivan and Bers (2019) showed that elementary students who participated in STEM activities were more likely to state that they wanted to go into a STEM career than students who did not participate.

The percentages of both FGCS and nonFGCS who were influenced by science and mathematics courses increased through middle and high school. There were many different influences found in this study that led the participants to pursue a degree in a STEM field. Starting in elementary school, getting students excited about STEM and building a solid foundation in their core classes such as mathematics, science, reading, and writing, would help build the STEM confidence and enthusiasm needed to be interested in STEM in middle school and beyond.

Middle School. Once in middle school, keeping students engaged in STEM is important. Students in this study stated that the courses that influenced them had teachers that were engaging, provided hands-on lessons, explained the information in ways that were easy to understand, and were caring. Collins et al. (2020) found that when students are engaged in a STEM activity that they find meaningful, they are more likely to gain interest in STEM and develop valuable academic skills. By helping students be successful, students build STEM confidence that will in turn help the students stay interested in STEM. STEM confidence can help build a student's STEM identity. This identify is how a student sees themselves regarding their ability to be successful in STEM courses and careers (Brickhouse 2001). Students who think they cannot be successful in STEM courses or fields because they are not a "mathematics or science person" are less likely to go into a STEM field (Dou et al., 2019). A student's STEM identity starts to develop at a young age and is formed through life experiences and interactions at home and at school (Aschbacher et al., 2010). Counselors can help students by identifying FGCS at an early age and then providing support and guidance for the parent and student. The TRIO program currently provides programs for middle school students to learn about college. Helping the parents and students early may help reduce college concerns. Students can start to learn about future career choices and the paths that lead to these careers.

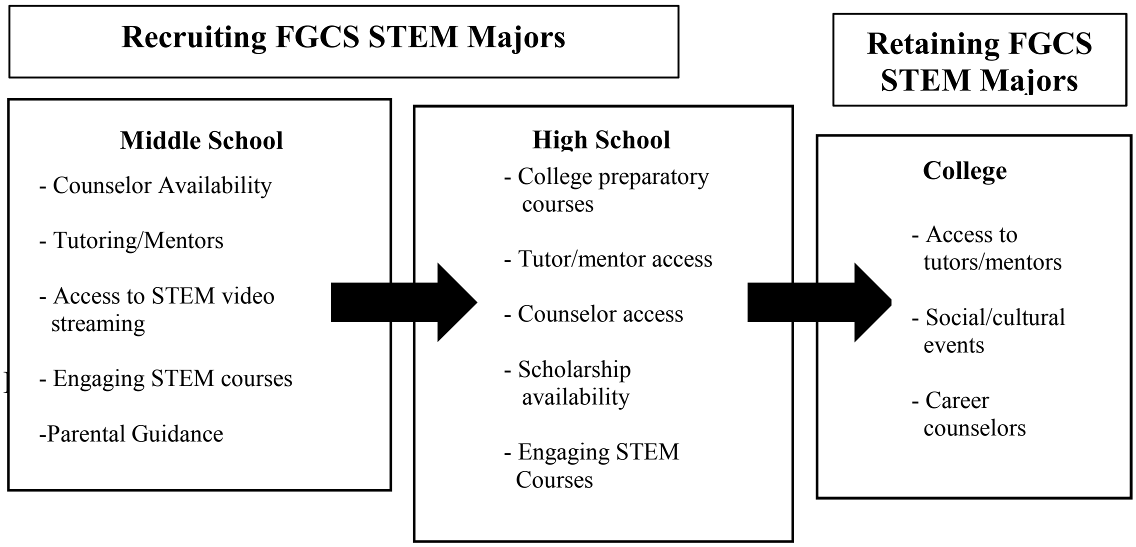
Another finding from this study is that a large percentage of both FGCS (76%) and nonFGCS (92%) were influenced by watching online STEM videos on platforms such as YouTube. Teachers can incorporate online video clips in their lessons to help build enthusiasm in their subject. One problem is that not all students have access to the internet at home and may not be able to stream videos. Low-income households and communities of color are less likely to have internet access or a computer at home (Horrigan, 2020). Incorporating time before, during, or after class to allow students to explore different videos and topics may help these students get interested in STEM.

High School. All the methods mentioned above that may help encourage more middle school students to get interested in STEM can also be applied in high school. Teachers should provide students with engaging STEM courses that connect students to future careers in STEM fields. The students should have access to tutoring to provide academic support and mentors to help guide them. FGCS should be identified during their freshman year to help the students set goals and guide them through the courses they need to reach these goals. Counselors can also help students and their parents find the right school, apply for scholarships, and complete the application process. Starting early will help ease some of the college concerns mentioned by participants in this study, such as how to pay for college. Not all students have internet access at home so continuing to provide before, during, and afterschool time to access the internet is important. Other college concerns that were mentioned by participants in this study, including time management and course difficulty, could be eased by ensuring that schools are providing information about programs like AVID, Gear Up, and TRIO. Starting as early as middle school, these programs help students see that college is an option for anyone. The programs offer academic support, summer college prep programs, and college placement assistance. The TRIO program also invites students to attend cultural events on the weekends. This may be beneficial for the students who stated that one of their college concerns was feeling welcome on campus.

Retaining FGCS STEM majors. Being enrolled in a college STEM program does not mean that the student will graduate and successfully begin a career in a STEM field. Retaining FGCS STEM majors is important to meet the need of more STEM graduates for the work force. Supporting these students academically throughout their college years can help students who feel overwhelmed by the challenge of college courses. If students do not feel well prepared for a course, they may switch majors. The students' advisors need to help identify these students and provide them with information about the various options for tutoring on campus. The OSP students in this program are provided tutors, mentors, and career counselors to help guide them through college. This group also provides events that help students feel welcome on campus. Not all FGCS are enrolled in the OSP and may not have access to or be aware of the various programs offered on campus that could help them. The students not enrolled would benefit from a similar service so promotion of programs like these is important for retaining more STEM graduates.

The results from this study show that to increase the number of FGCS pursuing a degree in STEM, a targeted approach to building interest in the STEM field among these students is key, and students must be provided the academic support they need to be successful in STEM courses. Just as importantly, the students need support to feel confident that they can be successful if they pursue this field. FGCS interested in STEM benefit from counselors and mentors that can guide them to the various colleges that offer STEM programs and careers, while also helping them navigate the application process. Once in college STEM programs, FGCS-targeted support programs can help FGCS successfully complete their STEM degree, either directly through academic services like tutoring or indirectly by helping these students feel more welcomed and encouraged while on campus. Figure 5.1 shows the pathways for recruiting FGCS starting in middle school and continuing into high school. It also shows methods for retaining FGCS once they are in a college STEM program.

Figure 5.1: Pathways to recruiting and retaining FGCS STEM majors



The limitations for this study include the sample size, which depended on the number of first year FGCS who agreed to take the questionnaire and be interviewed. All student participants are in their first year at a large Southeastern University. All the student participants are majoring in a STEM field. Due to a small sample size that is limited to one university, the data are not generalizable to a population outside of this university and do not represent the true population of all FGCS. All the FGCS in this study are enrolled in the Opportunity Scholars Program. To be considered for the OSP, students must have a family income not greater than 150% of DHS poverty guidelines. Sixty-eight percent of the FGCS in this study have a combined family income less than $30,000. FGCS that are not from low socioeconomic status families may not share the same influences for going into a STEM degree program. The questionnaire and interview data are self-reported and are limited to the participant's honesty. When answering questions on the questionnaire or during the interview, participants may give answers they think the researcher wants to hear.

Conclusion

For the United States to increase the number of STEM graduates to meet the increased need for STEM professionals, every possibility of increasing interest in the field should be examined. As observed in this study, there are many different factors that influence FGCS as well as nonFGCS decisions to pursue a degree in a STEM field. Offering a variety of STEM opportunities to all students may help those who are not sure if they want to go to college or are trying to decide on a major in college find STEM topics engaging and consider a STEM career. Making sure that all students have access to engaging STEM teachers and courses, technology, academic tutoring, mentors, and counselors may increase the number of FGCS STEM majors as well as help the U.S. meet the future demand for STEM professionals.

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Appendix A

Student Questionnaire

STEM Experience Survey

STEM Experience questionnaire

Please complete the STEM experience questionnaire so that the research may obtain some general information about you. Your responses will be confidential. For completing the survey, your name will be entered into a drawing for a $50 Amazon Gift Card

Please check the box for each response.

1. What is your first and last name?

2. Are you majoring in a STEM (science, technology, engineering, or mathematics) field of study?

- [ ] Yes
- [ ] No

3. What STEM area(s) are you currently majoring in?

4. How many semesters of college have you completed?

- One
- Two
- Three or more (exit survey)

5. Are you in the Opportunity Scholars Program?

- Yes
- No

6. How influential were the following experiences in your decision to pursue a degree in STEM?

	Not at all influential	Slightly influential	Somewhat influential	Very influential	Extremely influential
Elementary Science					
Elementary Math					
Middle School Science					
Middle School Math					
High School Science					
High School Math					

7. How influential were the following people in your decision to pursue a STEM degree?

	Not at all influential	Slightly influential	Somewhat influential	Very influential	Extremely influential
Mother					
Father					
Sibling					
Middle School Science Teacher					
High School Science Teacher					
Middle School Mathematics Teacher					
High School Mathematics Teacher					
Middle School Counselor					
High School Counselor					
Friends					
Other					

8. Who was the most influential and why?

9. How influential were the following informal educational experiences?

	Not at all influential	Slightly influential	Somewhat influential	Very influential	Extremely influential
Visiting a museum					
Vacation					
Attending camp					
Participating in a club					
Being a member of an organization (Girl Scouts, Boy Scouts, 4H, etc.)					
Attending a cultural event					

Other (please specify)

10. Did you participate in any clubs in middle or high school?

- Middle
- High School
- Both
- No (skip the next 2 questions)

11. List the clubs you participated in Middle and or High School.

Middle School:

High School:

12. Did any of these clubs influence you picking a STEM major? If yes, please list the club(s) and explain how the club(s) influenced your STEM major decision.

13. Are you the first in your family to attend college?

- Yes
- No

14. Mother's highest level of education:

- Less than high school diploma
- High school diploma
- Some college
- Undergraduate college degree
- Master's Degree
- Ph.D.
- M.D.

15. Father's highest level of education:

- Less than high school diploma
- High school diploma
- Some college
- Undergraduate college degree
- Master's Degree
- Ph.D.
- M.D.

16. Did anyone in your family try to persuade you **NOT** to major in a STEM field?

- [ ] Yes
- [ ] No (skip next question)

17. If you answered yes to the above question, please list who and why they did **NOT** want you to major in STEM.

18. What challenges did you face in deciding to major in STEM?

19. How would you rate your level of concern for the following factors as they relate to the completion of your degree?

	Not at all concerned	Slightly concerned	Somewhat concerned	Moderately concerned	Extremely concerned	N/A
Financial concern						
Time management						
Course difficulty						
Feeling welcomed/comfortable on campus						

Other (please specify)

20. What is the yearly combined income level of your parents?

- Under $15,000
- Between $15,000 and $29,999
- Between $30,000 and $49,999
- Between $50,000 and $74,999
- Between $75,000 and $99,999
- Between $100,000 and $150,000
- Over $150,000

21. Which of the following categories best describes your employment status?

- Employed, working full-time
- Employed, working part-time
- Not employed, looking for work
- Not employed, NOT looking for work

22. Select all the ways in which you are paying your college tuition:

- Grants
- Scholarships
- Work Study
- Student loans
- Parents or other family member(s) is paying your tuition
- You hold a part-time or full-time job to pay tuition
- Other (please specify)

23. What is your age?

- 18 or under
- 19-20
- 21-25
- 25 or older

24. What is your gender?

- Female
- Male
- Nonbinary
- Other

25. What is your race or ethnicity?

- Asian
- Black or African American
- Hispanic or Latino
- Middle Eastern or North African
- Multiracial or Multiethnic
- Native American or Alaska Native
- Native Hawaiian or other Pacific Islander
- White
- Another race or ethnicity, please describe below

Self-describe below:

26. What was your high school GPA?

27. Please check all of the courses you took in high school.

- [ ] Honors math course(s)
- [ ] Honors science course(s)
- [ ] AP Calculus
- [ ] AP Computer Science
- [ ] AP Statistics
- [ ] Other (please specify)
- [ ] AP Biology
- [ ] AP Chemistry
- [ ] AP Environmental Science
- [ ] AP Physics
- [ ] Did not take any honors or AP classes in high school

28. Please provide your opinion about each of the following statements.

	Strongly Agree	Agree	Disagree	Strongly Disagree
Your intelligence is something very basic about you that you can't change very much	○	○	○	○
No matter how much intelligence you have, you can always change it quite a bit	○	○	○	○
Only a few people will be truly good at sports, you have to be born with the ability	○	○	○	○
The harder you work at something, the better you will be	○	○	○	○
I often get angry when I get feedback about my performance	○	○	○	○
I appreciate when people, parents, coaches, or teachers give me feedback about my performance	○	○	○	○
Truly smart people do not need to try very hard	○	○	○	○
You can always change how intelligent you are	○	○	○	○
You are a certain kind of person and there is not much that can be done to really change that	○	○	○	○
An important reason why I do my schoolwork is that I enjoy learning new things	○	○	○	○

29. How confident do you feel about your ability to perform the following tasks? Answer based on the field closest to your major (math or science)

	Not confident	Somewhat confident	Confident	Extremely confident
Find reliable information about a particular scientific or mathematical question				
Read, understand, and critically evaluate media coverage of scientific or issues				
Interpret graphs and tables				
Recognize a sound argument and appropriate use of scientific or mathematical evidence				
Write about a science, technology, engineering, or mathematics topic				
Apply scientific concepts and/or solutions to situations I encounter in daily life				
Explain scientific or mathematical concepts or ideas to another person				
Give a presentation about a scientific or mathematical topic				

Appendix B

Student Interview Questions

Researcher says: Thank you for taking time out of your busy schedule to be here today. I really appreciate you taking the time to help with my research on STEM education.

Psychological and sociological questions:

1. What are you majoring in?

2. What got you interested in this major?

3. Did you ever feel that math or science were hard? If yes, how so?

4. Were you ever told, “You’re good at math?” Or “You’re good at science”. If so, who told you this and how did this influence your decision to be a STEM major?

5. Did you ever have anyone in your family try to persuade you not to major in a STEM field or not go to college? If so, why do you think they didn’t want you to go?

6. Did you have anyone in your family that positively influenced you to go to college and major in STEM? If so, how did they positively influence you? Why did they want you to major in STEM?

7. Who were your STEM role models growing up?

8. Were you encouraged or not encouraged to major in STEM by anyone outside of your family (teachers, counselors, friends, etc.)? Who? How did they encourage you or try to discourage you to major in STEM?

9. When picking your major, did expected salary influence your decision? If so, how? What do you expect to make a year once you graduate?

Informal experience questions:

10. Did you participate in any clubs (or other informal experiences before or after school) in middle school? If so, what were they? Did they play a role in you selecting a STEM major? Can you tell me a story about this informal STEM experience?
11. Did you participate in any clubs (or other informal experiences before or after school) in high school? If so, what were they? Did they play a major role in you selecting a STEM major? Can you tell me a story about this informal STEM experience?

12. Did any of the clubs or informal experiences you participated in have competitions? (local, state, national, world) Did your team or club go to any of the competitions? If so, what was this experience like? Did this motivate you to major in a STEM field?

13. Were there any other informal events/experiences that got you interested in any of the STEM fields? (museums, going to the beach, or any other vacation or trips) Explain how they influenced you.

Formal experience questions:

14. Did you face any challenges when deciding to go to college for STEM? If so, how did you overcome this(these) challenge(s)?

15. At what age/grade level did you know that you were going to go to college and major in a STEM field? Why was this time important to your decision?

16. Did you take advanced science/math or honors classes in middle school? If so, which ones? Did you excel in the classes or did you think they were hard? Do you remember what grades you received in these classes? Can you describe the relationship between your performance in the classes and your interest in STEM?

17. Did you take honors or AP STEM classes in high school? Did you think any of these were difficult or easy? If so, which ones and why?

18. Describe any experiences from these STEM classes that stand out to you as being influential in your decision to major in your STEM field.

19. What elective STEM classes (additional science or math courses beyond the ones needed to graduate) did you take in high school? What made you select these classes? How did any of these classes help you decided to go to college for STEM?

20. If you had to pick one (school or non-school?) experience to get others interested in pursuing a degree in a STEM field, what would it be?

Summary questions:

21. What advice would you give to future first generation college students who want to major in a STEM field. (just FGCS)

22. How do you think being a FGCS impacts your college experience? Your experience in STEM classes? (Just FGCS)

23. What do you plan to do after you graduate?

24. Was there anything that I have not asked that may have led you to pick a major in a STEM field? If so, could you tell me about it?

Appendix C

Participation Letter

Dear students,

My name is James Byrum, and I am a Ph.D. candidate in the College of Education at the University of South Carolina. As part of my degree requirement, I am conducting research. The purpose of my research is to determine what experiences during middle and high school guide students into pursuing a degree in a STEM (Science, Technology, Engineering, and Mathematics) field.

I have created a brief questionnaire to help me find out more information about STEM majors at USC. All the information that you provide will be confidential and no data will be identifiable. Only themes and patterns will be shared. No individually identifiable information will be included in any written products of this research. At the end of the questionnaire, you have the option of meeting with me for some follow-up questions. This will be done using Zoom or in person (your choice) at a time that is convenient for you. The interview will last approximately thirty minutes.

Participating in this study is voluntary. If you do decide to participate you are free to quit at any time. You also do not have to answer any questions that you do not feel comfortable answering. Your participation or non-participation in this study will not have any impact on your USC courses or grades.

If you have any questions about the study, please contact me at jbyrum@email.sc.edu or my advisor, Dr. Christine Lotter at lotter@mailbox.sc.edu. If you have any questions about your rights as a research participant, please contact the Office of Research Compliance at the University of South Carolina at 803-777-7095

Thank you,

James Byrum
University of South Carolina
School of Education

Appendix D

Interview and Questionnaire Protocol Analysis

Research Questions	Topics	Questionnaire Item	Interview Item
Q1: How do select economic, sociological, and psychological factors differentially influence FGCS and non-FGCS decisions to major in a STEM field?	I. Economic	Q20: What is the yearly combined income level of your parents?	I9: When picking your major, did expected salary influence your decision? If so, how? What do you expect to make a year once you graduate?
		Q21: Which of the following categories best describes your employment status?	
		Q22: Select all the ways in which you are paying your college tuition:	

	II. Sociological	Q6: How influential were the following experiences in your decision to pursue a degree in STEM? (See Likert Scale on questionnaire for list of experiences)	I6: Did you have anyone in your family that positively influenced you to go to college and major in STEM? If so, how did they positively influence you? Why did they want you to major in STEM?
		Q7: How influential were the following people in your decision to pursue a STEM degree? (See Likert Scale on questionnaire for list of people)	I5: Did you ever have anyone in your family try to persuade you not to major in a STEM field or not go to college? If so, why do you think they didn't want you to go?
		Q8: Who was the most influential and why?	I7: Who were your STEM role models growing up?
		Q13: Are you the first in your family to attend college?	I8: Were you encouraged or not encouraged to major in STEM by anyone outside of your family (teachers, counselors, friends, etc.)? Who? How did they encourage you or try to discourage you to major in STEM?
		Q14: Mother's highest level of education.	

		Q15: Father's highest level of education:	
		Q16: Did anyone in your family try to persuade you NOT to major in a STEM field?	
		Q17: If you answered yes to the above question, please list who and why they did NOT want you to major in STEM.	
		Q18: What challenges did you face in deciding to major in STEM?	
	III. Psychological	Q19: How would you rate your level of concern for the following factors as they relate to the completion of your degree? (See Likert Scale on questionnaire)	I1: What are you majoring in?
			I2: What got you interested in this major?

			I14: Did you face any challenges when deciding to go to college for STEM? If so, how did you overcome this(these) challenge(s)?
	Efficacy	Q29: How confident do you feel about your ability to perform the following tasks? Answer based on the field closest to your major (math or science)	I3: Did you ever feel that math or science were hard? If yes, how so?
			I4: Were you ever told, "You're good at math?" or "You're good at science?" If so, who told you this and how did this influence your decision to be a STEM major?
	Growth Mindset	Q28: Please provide your opinion about each of the following statements. (See Likert Scale on questionnaire for list of questions)	

Q2: How does participation in informal learning experiences in middle and high school influence first-generation college students (FGCS) STEM degree selection?	Clubs	Q10: Did you participate in any clubs in middle or high school?	I9: Did you participate in any clubs (or other informal experiences before or after school) in middle school? If so, what were they? Did they play a role in you selecting a STEM major? Can you tell me a story about this informal STEM experience?
		Q11: List the clubs you participated in Middle and or High School.	I10: Did you participate in any clubs (or other informal experiences before or after school) in high school? If so, what were they? Did they play a major role in you selecting a STEM major? Can you tell me a story about this informal STEM experience?
		Q12: Did any of these clubs influence you picking a STEM major? If yes, please list the club(s) and explain how the club(s) influenced your STEM major decision.	I11: Did any of the clubs or informal experiences you participated in have competitions? (local, state, national, world) Did your team or club go to any of the competitions? If so, what was this experience like? Did this motivate you to major in a STEM field?

	Before, during, and after school experiences	Q9: How influential were the following informal educational experiences? (See Likert Scale on questionnaire for a list of informal experiences)	I12: Were there any other informal events/experiences that got you interested in any of the STEM fields? (museums, going to the beach, or any other vacation or trips) Explain how they influenced you.
Q3: How does participation in formal learning experiences in middle and high school influence first-generation college students (FGCS) STEM degree selection?	Taking advanced STEM courses	Q26: What was your high school GPA?	I16: Did you take advanced science/math or honors classes in middle school? If so, which ones? Did you excel in the classes or did you think they were hard? Do you remember what grades you received in these classes? Can you describe the relationship between your performance in the classes and your interest in STEM?
		Q27: Please check all the courses you took in high school.	I17: Did you take honors or AP STEM classes in high school? Did you think any of these were difficult or easy? If so, which ones and why?
			I18: Describe any experiences from these STEM classes that stand out to you as being influential in your decision to major in your STEM field.

			I19: What elective STEM classes (additional science or math courses beyond the ones needed to graduate) did you take in high school? What made you select these classes? How did any of these classes help you decided to go to college for STEM?
	Open Ended Follow-Up Questions		I15: At what age/grade level did you know that you were going to go to college and major in a STEM field? Why was this time important to your decision?
			I20: If you had to pick one (school or non-school?) experience to get others interested in pursuing a degree in a STEM field, what would it be?

Appendix E

STEM Confidence Questions

STEM Confidence Questions	How confident do you feel about your ability to perform the following tasks?
	Find reliable information about a particular scientific or mathematical question.
	Read, understand, and critically evaluate media coverage of scientific or mathematical.
	Interpret graphs and tables
	Recognize a sound argument and appropriate use of scientific or mathematical evidence
	Write about a science, technology, engineering, or mathematics topic
	Apply scientific concepts and/or solutions to situations I encounter in daily life
	Explain scientific or mathematical concepts or ideas to another person
	Give a presentation about a scientific or mathematical topic

Appendix F

Fixed and Growth Mindset Questions

Mindset Questions	Fixed	Growth
	Your intelligence is something very basic about you that you can't change very much	No matter how much intelligence you have, you can always change it quite a bit
	Only a few people will be truly good at sports, you must be born with the ability	The harder you work at something, the better you will be
	I often get angry when I get feedback about my performance	I appreciate when people, parents, coaches, or teachers give me feedback about my performance
	Truly smart people do not need to try very hard	You can always change how intelligent you are
	You are a certain kind of person and there is not much that can be done to really change that	An important reason why I do my schoolwork is that I enjoy learning new things

Appendix G

Informal Learning Experiences

Informal learning experiences	How influential were the following informal educational experiences?
	Visiting a museum
	Vacation
	Attending camp
	Participating in a club
	Being a member of an organization (Girl Scouts, Boy Scouts, 4H, etc.)
	Attending a cultural event
	Watching STEM related videos on YouTube or other video streaming services
	Nonformal learning influence (average friends through watching STEM videos)
	Middle School STEM Club Participation
	High School STEM Club Participation
	Both Middle and High School STEM Club Participation